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CONFIDENTIAL

REGISTER No. 96

MANEUVER RULES

(Cancels Edition of May, 1939)

NAVAL WAR COLLEGE
Newport, R. I.
June, 1940

NavTraSta Newport — 3-18-40 — 100.

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E. C. KALBFUS
Rear Admiral, U. S. Navy
President.

Naval War College
Newport, R.I.
June, 1940

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CONFIDENTIAL

MANEUVER RULES

Naval War College
Newport, R.I.
May, 1940

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SECTION A - GENERAL RULES

INTRODUCTION

The Rules for both Chart (Strategic) and Board (Tactical) Maneuvers are combined in this pamphlet. Where practicable the rules are grouped as follows: First, rules that apply to both Chart and Board Maneuvers begin with number 1 following the letter designating the rule; second, rules that apply only to the Chart Maneuver begin with the number 100 following the letter designating the rule; and, third, rules that apply only to the Board Maneuver begin with the number 200 following the letter designating the rule.

"The Conduct of Maneuvers" referred to in Section B of this publication is issued as a separate pamphlet, and should be studied in preparing for Chart and Board Maneuvers.

SECTION A - GENERAL RULES

Rule A-1. (a) Actual types of ships and aircraft will ordinarily be used in the maneuver.

(b) Types will be designated in accordance with standard nomenclature.

(c) The data for individual ships and for each type of aircraft will be as given in the current War College publications.

(d) The data for types or individual ships not listed in current War College publications will be stated in the problem.

Rule A-2. (a) Surface vessels are classified as to size as follows:

Size Class	Gross Tons or Standard Displacement
Large	18,000 plus
Intermediate	8,000 - 17,999
Small	3,000 - 7,999
Destroyer	200 - 2,999

(b) All submarines and all surface craft of 199 tons or less are classed as being of submarine size.

(c) All aircraft carriers are classed as large size for gunfire and visibility purposes.

(d) Only battleships and battle cruisers are classed as capital ships.

Rule A-3. (a) The size of war vessels is usually expressed in terms of displacement, which is the actual weight of a vessel in tons of 2240 pounds. The size of merchant ships is usually expressed in terms of gross tonnage, which is the measurement of the cubic capacity of the ships in tons of 100 cubic feet.

(b) In U.S. Navy practice, bunker fuel capacity is classified as

(1) full load; for coal burners, the full bunker capacity; for oil burners the amount of fuel estimated to be required under normal conditions to give the steaming radius prescribed in the design characteristics of the vessel as laid down by the Department.

(2) emergency full load for oil burners is 95% of the total capacity of all spaces available for use as bunkers.

(3) normal fuel capacity is two-thirds of the bunker fuel carried at full load for coal burners and at emergency full load for oil burners.

(4) maximum bunker capacity is the maximum amount that all bunkers will hold; for oil-burners, the same as emergency full load, for coal-burners, the same as full load;

Note:- In the "Fleets" the value shown for fuel is the maximum bunker capacity, except for submarines two values are given, normal fuel capacity and emergency full load.

Rule A-5. (a) The unit of distance in the chart maneuver is the nautical mile, taken as 2,000 yards.

(b) The unit of range in the tactical maneuver is 1,000 yards.

Rule A-6. The unit of speed is the knot; one nautical mile per hour.

Rule A-7. (a) Wind force will be expressed as one of the figures, 0 to 12, of the Beaufort scale, but for simplicity the wind velocity in knots will be taken as five times that figure. That is, for wind force 4, velocity is 20 knots.

(b) In the open sea, unless otherwise stated, the state of the sea corresponding to the various wind conditions will be considered to be as follows:

Wind force	Sea
0 - 3	Smooth
4 - 6	Moderate
7 - 9	Rough
10 - 12	Heavy

(c) Unless otherwise stated, the direction of the sea will be assumed to be the same as that of the wind.

Rule A-8. Unless otherwise stated, sunrise will be considered to be at 0600, sunset at 1800.

Rule A-9. Position Reports.

(a) Position reports will be subject to errors depending in value upon whether the report comes from surface vessels or planes, and the conditions affecting the accuracy of the report.

(b) Positions given to players by the Director will rarely be exact positions. They will be subject to introduction of such errors as in the discretion of the Director are warranted.

(c) The following tables of errors are furnished as an approximate guide to the limits which may be introduced by the Director.

(1) Vessels

Time since weather was suitable for obtaining a fix	Error in Miles
0 hours	2
4	4
12	8
24	14
36	22
48	30

(2) (a) Aircraft during daylight for extended flight over water or strange terrain.

Time since leaving ship or landing field (no fix during the flight)	Error in Miles
0 hours	0
1	4
2	8
3	12
4	16
8	32
12	48
16 plus	60

(b) VP planes - Weather suitable for sights

For VP planes, with weather conditions suitable for obtaining fixes, the errors will be assumed to be 50% only of the values of Table 2 (a) above.

(c) Aircraft during night without fixes

Due to the difficulty of making drift observations at night, the values given in Table 2 (a) above will be doubled.

(d) Effect of Reference Positions

(1) Vessels.

Vessels which are in sight contact with each other, and which have had a reference position sent out within a 4 hour period will usually not be subject to error of position relative to themselves greater than 2 miles.

(2) Effect of search light or flare.

A report of position relative to something in view of both reporter and the receiver of the report, such as a search light or flare, will ordinarily not be subject to an error greater than 2 miles.

Rule A-10. (a) The maneuver rules are, in general, empirical rules intended to express what will, on the average, occur in actual practice.

(b) Decisions of the Director will be in accord with the spirit of the rules. For instance, if a certain penalty attaches to making a change of course of 30 degrees or more, the Director might properly apply this penalty to a change of 29 degrees.

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SECTION B - CONDUCT OF THE MANEUVER

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Attention is called to the pamphlet "THE CONDUCT OF MANEUVERS".

SECTION C - SPEED AND FUEL

SECTION C -- SPEED AND FUEL

PART I SPEED

General Speed Rules

Terms employed with reference to speed rules are defined as follows:

Rule C-1. (a) Normal underway condition obtains while making passage under conditions of:-

(1) Smooth sea

(2) Clean bottom

(3) Paravanes not streamed

(4) Not keeping station in formation.

(5) Not towing or being towed

(6) No damage

(7) Maintaining reserve steam

(b) Engine speed is the designed speed of a vessel through the water and over the ground, under normal underway conditions (see (a) above) for a given number of revolutions. If the engine is making revolutions for a speed of 12 knots, its engine speed is 12 knots, and its speed over the ground under normal underway conditions is 12 knots.

(c) Actual speed is the speed over the ground. For normal underway condition it is the same as engine speed. For other than normal underway conditions, it is determined by subtracting from engine speed the speed losses incurred in accordance with subsequent rules of this section. The effect of current is disregarded unless otherwise directed. Actual speed is the speed plotted on the maneuver board and on flimsies.

(d) Maximum engine speed is the speed given in "Fleets" as the maximum speed.

(e) Engine speed allowed (E.S.A.) is the maximum engine speed allowed under conditions of moderate to heavy seas. These speeds are given in table of Rule C-4.

(f) Reserve of speed is the difference between the engine speed being made and the maximum speed immediately available with the boilers in use.

Rule C-2. All losses of speed due to damage are in percent of original maximum speed. (Rules C-24, 25)

Rule C-3. Speed will be taken to the nearest half knot, in all cases.

Rule C-4. The engine speed allowed (E.S.A.), and the loss in speed, for a state of the sea other than smooth, is as given in the following table. This loss of speed is determined by the conditions existing at the end of the move.

Angle between sea and course, in degrees

Classification as per Rule A-2 (a)		0 - 30	31-80	81-120	121-180
Moderate Sea					
Large	E.S.A.	(M)	(M)	(M)	(M)
	Loss	(2)	(1)	(0)	(0)
Intermediate	E.S.A.	(M)	(M)	(M)	(M)
	Loss	(2)	(1)	(0)	(0)
Small	E.S.A.	(31)	(M)	(M)	(M)
	Loss	(3)	(2)	(0)	(0)
DD & DL	E.S.A.	(29)	(32)	(34)	(M)
	Loss	(4)	(3)	(1)	(0)
Old Destroyer	E.S.A.	(26)	(30)	(30)	(M)
	Loss	(6)	(5)	(2)	(1)
Submarine	E.S.A.	(M-2)	(M-1)	(M)	(M)
	Loss	(3)	(2)	(1)	(0)
Rough Sea					
Large	E.S.A.	(20)	(26)	(M)	(M)
	Loss	(4)	(3)	(1)	(0)
Intermediate	E.S.A.	(18)	(23)	(28)	(M)
	Loss	(4)	(3)	(2)	(1)
Small	E.S.A.	(18)	(20)	(25)	(30)
	Loss	(5)	(4)	(3)	(1)
Destroyer type	E.S.A.	(17)	(19)	(23)	(27)
	Loss	(7)	(5)	(3)	(2)
Submarine	E.S.A.	(M-3)	(M-2)	(M-2)	(M-2)
	Loss	(4)	(3)	(2)	(2)
Heavy Sea					
Large	E.S.A.	(10)	(12)	(15)	(18)
	Loss	(10)	(5)	(3)	(2)
Intermediate	E.S.A.	(10)	(10)	(12)	(16)
	Loss	(10)	(5)	(3)	(2)
Small	E.S.A.	(10)	(10)	(12)	(16)
	Loss	(10)	(8)	(5)	(3)
Destroyer type	E.S.A.	(10)	(10)	(12)	(15)
	Loss	(10)	(10)	(6)	(3)
Submarine	E.S.A.	(10)	(10)	(10)	(12)
	Loss	(9)	(9)	(8)	(7)

M equals maximum individual speed.

(See Rule C-7.

Rule C-5. A foul bottom makes actual speed less than engine speed by an amount varying with the time out of dock. The percentage of speed loss per month out of dock is given below. Four months is the maximum loss applied.

Battleships 1%

Cruisers, carriers, destroyers . . . 3%

Auxiliaries and other types 2%

Rule C-6. (a) In towing, in smooth sea, the actual speed is the engine speed of the towing vessel multiplied by the displacement of the towing vessel and divided by the aggregate displacement of the towing vessel and the tow, but cannot exceed the following limits, which are based upon strength of towing gear and ability of vessels to ride the sea:

Size of vessel towed	Limit
Large	10 knots
Intermediate	12 "
Small	12 "
Destroyer	14 "
Submarine	11 "

(b) To find the actual speed in other than smooth sea, the speed as determined in (a) above is reduced by the amounts given in parenthesis in the table of Rule C-4, using the larger of the figures given for the vessel towing , and for the vessel towed.

Rule C-7. (a) Vessels proceeding in formation at less than 1000 yards distance, except the guide, must have a reserve of speed (Rule C-1(f)) in knots as follows:

Formation Engine Speed	Reserve of Speed	Engine Speed Required to be available.
10 (or less	1	11 (or less)
11 to 22	2	13 to 24
23 to 30	3	26 to 33
31 (or more)	4	35 (or more)

If the reserve of speed being maintained is not greater than what required in the above table for a given formation speed and the formation speed is increased to absorb this reserve, in whole or in part, then the formation will be broken.

(b) The engine speed required to be immediately available may be limited by the Engine Speed Allowed (Rule C-4), due to state of the sea, and the formation speed thus be correspondingly limited.

Rule C-8. With paravanes out a vessel can not make more than 28 knots engine speed without losing them. To put them out or take them in a vessel must run at not over 12 knots engine speed for six minutes. (Rule H-16).

Rule C-9. The speed of a vessel capable of laying smoke screens is not penalized while laying a screen.

Change of Speed - CHART MANEUVERS

Rule C-10. To raise additional steam:

Coal burners require two hours

Oil burners require forty-five minutes
(See Rule C-11 (d))

Rule C-11. (a) A steam vessel of destroyer or submarine size (Rule A-2), under port conditions (Rule C-101 (a)) has enough steam for engine speed of one-half maximum, and can at any time take any engine speed up to this amount without charge for having raised or maintained additional steam.

(b) A steam vessel of intermediate and small size (Rule A-2), under port conditions, can take and maintain an engine speed of 10 knots.

(c) A steam vessel of large size (Rule A-2), under port conditions cannot use her main engines until the necessary additional steam has been raised. (Rule C-10).

(d) A vessel with internal combustion engine drive can immediately take any engine speed up to maximum.

Rule C-12. For underway condition, if no additional steam is being maintained, steam vessels can increase speed as follows:

(a) Coal-burners:

(1) If engine speed is three or more knots less than maximum, can increase two knots immediately.

(2) If engine speed is within three knots of maximum, can increase one knot immediately.

(b) Oil-burners:

(1) If engine speed is ten knots or more, can increase immediately to 75% of maximum speed.

(2) If engine speed is within two knots of 75% of maximum, can increase immediately to 85% of maximum.

(3) If engine speed is within two knots of 85% of maximum, can increase immediately to maximum.

(c) Further increases require additional time as prescribed by Rules C-10 and C-13. (See C-11 (d)).

Rule C-13.(a) When maintaining additional steam, engine speed may be increased immediately to that for which steam is being maintained, except that coal burners require one-half hour to work up to speed when increasing to maximum speed from a speed below 90% of maximum.

(b) While working up to speed, the mean engine speed during this half-hour is the average of the engine speed at the beginning and that at the end of the half hour. The fuel expenditure is that corresponding to the speed to which increasing. (See C-11 (d)).

CHANGE OF SPEED - BOARD MANEUVERS

Rule C-20. Unless otherwise stated, all vessels will be assumed to have steam for full speed.

Rule C-21. (a) Surface vessels may not increase speed during a three-minute move by more than the number of knots given in the following table:

Size Class	*Maximum Speed 19 minus	20-29	30 plus
Large	3	4	5
Intermediate	4	5	6
Small	5	6	8
Destroyer or Submarine	6	8	10

* (as given in FLEET or as corrected for damage.)

(b) Submarines on the surface can increase speed 8 knots in one three-minute move. Submarines submerged and awash can increase speed 5 knots in one three-minute move.

(c) By backing engines any vessel can be stopped in three minutes from any speed. Unless engines are reversed, vessels cannot lose speed at a greater rate than shown by the table in (a) of this rule, using engine speed being made instead of maximum individual speed.

Rule C-22. Any change of speed will be considered as being effected at a uniform rate during the move in which it is made. The speed used to locate the position of the ship shall be the mean of the speed at the beginning and at the end of the move.

Rule C-23. All losses of speed due to damage are effective at the end of the move in which the damage was received, and are permanent.

Rule C-24. Underwater damage inflicts a loss of speed corresponding to the percent of damage due to the mine, torpedo, or bomb. Rules H-20, J-17(j).

Rule C-25. (a) Above water damage inflicts a loss of speed as follows: (Rule F-23)

Above water damage - %	Speed loss - %
0 to 29	0
30 - 49 (BB & CC)	0
30 - 49 (Others)	10
50 - 69	20
70 - 79	50

(b) A vessel damaged 80% or more from all causes cannot make more than 5 knots.

(c) See Rule K-9 (b) and (c) for the effect of chemical attack.

SUSTAINED SPEED AND BREAKDOWN

Rule C-30. (a) The number of hours that a steam vessel can sustain engine speeds at or near maximum is as follows:

		Engine Speed Made			
Fuel	Max Speed	Maximum	1 kt. below maximum	2 kts. below maximum	3 kts. below maximum
Coal	12-17	4	24	X	X
	18-23	4	8	X	X
	24-29	4	8	16	X
	30 plus	4	6	8	24

		Engine Speed Made			
Fuel	Max Speed	Maximum	1 kt. below maximum	2 kts. below maximum	3 kts. below maximum
Oil	12-17	24	X	X	X
	18-23	6	12	X	X
	24-29	6	12	24	X
	30 plus	6	12	16	24

(X) can be sustained as long as fuel lasts.

(b) After running at maximum or near maximum engine speed for the allowed number of hours, a steam vessel must slow for six hours to a speed not greater than that which she can maintain indefinitely, after which the original conditions again obtain.

(c) In addition, a vessel running at maximum or near maximum speed will be subject to the chances of breakdown given in the next Rule.

Rule C-31. (a) A vessel maintaining high engine speed incurs the following chance of breakdown for each hour of operation at such speed:

Drive	Max. Speed	Engine Speed Made: Maximum	1 kt. below maximum	2 kts. below maximum	3 kts. below maximum
R	12-17	1/48	0	0	0
	18-23	1/24	1/96	0	0
	24-29	1/18	1/48	1/96	0
	30 plus	1/12	1/24	1/48	1/96
T.G.E.	12-17	1/48	0	0	0
	18-23	1/36	1/144	0	0
	24-29	1/24	1/72	1/144	0
	30 plus	1/18	1/36	1/72	1/144
I.C.	1-11	1/24	1/96	0	0
	12-17	1/18	1/48	1/96	0
	18 plus	1/12	1/24	1/48	1/96

R - Reciprocating drive
T or G - Turbine drive
E - Electric drive
I.C - Internal combustion engine drive.

(b) When moving a vessel at a high speed involving chance of breakdown, the player concerned will report the fact at once to the Director, giving maximum speed, speed being made, and number of hours. The Director will decide whether breakdown occurs and will assign the penalty therefor.

PART II - FUEL

Fuel Expenditure.

Rule C-101. As regards fuel expenditure the following definitions are given:

(a) Port condition - main engines not in use and only steam for port use being maintained.

(b) Stand-by condition - main engines not in use but steam above the requirements for port use being raised or maintained.

(c) Underway condition - main engines are in use.

(d) Port expenditure is computed, prorating for a fraction of a day, from the data given in tons per day in the "Fuel Expenditure Tables" of "Fleets".

(e) Stand-by expenditures and underway expenditures are computed from the data given in tons per hour for various engine speeds in the "Fuel Expenditure Tables" of "Fleets". See also the explanatory notes regarding these tables in the Preface to "Fleets". These expenditures are subject to increase for:

Additional steam (Rule C-102)
Station keeping (Rule C-103)
Foul bottom (Rule C-104)
Paravanes (Rule C-105)

(f) A steam vessel burning both coal and oil is classified as a coal burner or an oil burner for determining fuel expenditure, according to the type of fuel being used. Such a vessel may use either type of fuel as long as it is available but may not use both types simultaneously. To convert in terms of calorific value, use 100 tons of oil equal to 150 tons of coal.

Rule C-102. While raising or keeping steam for more than the engine speed being made, fuel expenditure is increased as given below. For the purpose, in case speed being made is less than that shown in fuel expenditure tables, pick out fuel expenditure for lowest speed shown. Then:

(a) For coal-burners,

(1) if raising or keeping steam for only two knots above engine speed, - no increase;

(2) if raising or keeping steam for more than two knots above engine speed, - increase 15%

(b) For oil-burners,

(1) if raising or keeping steam for only five knots above engine speed, - no increase.

(2) if raising or keeping steam for more than five knots above engine speed, - increase 10%.

Note: Obviously, Rule C-102 does not apply to vessels with internal combustion engines.

Rule C-103. For vessels keeping station in formation at distance of 1000 yards or less, except the guide, fuel expenditure is increased 3%.

Rule C-104. For foul bottom, fuel expenditure is increased by a percentage which is twice the percentage of speed loss determined by Rule C-5.

Rule C-105. With paravanes out, fuel expenditure is increased 7%.

COALING

Rule C-106. - Unless otherwise stated, it is assumed that at the beginning of an operation all vessels have bunkers filled to full loaded capacity, and that all fuel vessels have full cargoes. (See Rule A-3).

In Port

Vessel Coaling	Vessel Coaled		
Type	Type	Max. number at one time	Max. rate per hour one vessel can receive.(Fraction of bunker capacity.
AC	Any	2	1/12

At Sea

Vessel Coaling	Vessel Coaled					Time of maneuver
Type	Type	Max.number at one time	Max. rate per hour one vessel Frac. of bunker capacity.	Sea	Speed while coaling	Hrs. required to take in tow, rig & cast off
AC	Any	1	1/20	S	5	2
				(M (R (H	Coaling impossible.	

NOTE: Coal burning vessels may take on board an excess of 10% of coal over their allowed coal bunker capacity, assuming this excess to be stored in fire rooms and other below-deck spaces and on deck.

OILING IN PORT

2737
6-15-32

Section C

Rule C-107

Vessel Oiling Type	Max. Delivery (Tons per hr.	Vessel oiled Type	Max. number at one time	Max. rate one vessel can receive (Tons per hour).	Time of maneuver Hrs. required to come along side connect up, and disconnect.
AO	500-1800	DD	6	200	½ per DD N.B. Use both sides of oiler simultaneously
AD	15-180	DD	4	200	do
Other than AO & AD	80-150 BB 60-230 CL 15 Misc.	DD	2	200	1/2
AO	500-1800	SS	6	15	1/2 per S: each side
AS	6-180	SS	4	15	do
Other than AO, AL AS	80-150 BB 60-230 CL 15 Misc.	SS	2	15	1/2
AO	500-1800	(Large (Int. (Small	2	250	1
Other than AO	80-150 BB 60-230 CL 15 Misc.	do	1	do	1

Note; 292 gals. fuel oil equals one ton.

DISCHARGE CAPACITIES OF VARIOUS TYPES (GALLONS PER HOUR)

Ship		
BATTLESHIPS (Except MARYLAND and WEST VIRGINIA - - - -	25,000	
MARYLAND and WEST VIRGINIA - - -	45,000	
CRUISERS		
RICHMOND, CONCORD, OMAHA MILWAUKEE, CINCINNATI - -	19,000	(booster pumps
All others	70,000	(booster and re-circulating pumps)
DESTROYER TENDERS		
DOBBIN and WHITNEY - - - -	55,000	
BLACK HAWK - - - - - - - - -	12,000	
ALTAIR - - - - - - - - -	9,900	
MELVILLE - - - - - - - - -	4,400	
SUBMARINE TENDERS		
HOLLAND - - - - - - - - -	55,000	
CANOPUS (regular fuel oil)	32,000	
CANOPUS (Diesel oil)	6,300	
BEAVER - - - - - - - - -	19,000	
ARGONNE - - - - - - - - -	15,000	
BUSHNELL - - - - - - - - -	1,700	
CAMDEN (Diesel oil) - - -	2,700	

TANKERS

KAWEAH Class - - - - - - 220,000
PATOKA Class - - - - - - - 143,000
KANAWHA Class - - - - - - 360,000

OILING AT SEA

Vessel Oiling		Vessel oiled (B-Broadside A-Astern)					
Type	Max. Delivery (Tons per hr.)	Type	Max. Number at one time	Max. Rate one vessel can receive (Tons per hour).	Sea	Speed while oiling	Time in hrs. exclusive of pumping.
AO	500-1800	DD	2(B)	120	S	10	1/2
"	"	"	"	"	M	7½	1/2
"	"	"	1(A)	50	R	6	3/4
"	-	"	-	-	H	Oiling impossible	
AD	15-180	"	2(B)	100	S.M.	10 7½	1/2
"	"	"	1(A)	50	R	6	3/4
"	-	"	-	-	H	Oiling impossible	
AO	500-1800	SS	1(A) or 2(B)	10	S	7½	1/2
"	"	"	1(A)	10	M	6½	1/2
"	-	"	-	-	R) H)	Oiling impossible	
AS	6-180	"	AS with AO	15	SMR	AS with AO	
"	-	"	-	-	H	Oiling impossible	
Other than AO -AS	80-150BB 60-230CL 15-Misc.	DD or SS	1(B)	100 or 15	S.M.	5	1/2
"	"	"	1(A)	"	R)	Oiling impossible	
"	-	"	-	-	H)		
AO and other than AO	15 to 1800#	(Int (Small	2(B)	100	S.M.	5	3/4
"	"	"	1(B)	"	R	3	1
"	"	"	1(A)	50	S.M.	10	1
"	"	"	1(A)	50	R	5	1¼
"	-	"	-	-	H	Oiling impossible.	

See Table of Discharge Capacities various types, preceeding page.

SECTION D - VISIBILITY, AUDIBILITY AND SMOKE SCREENS

SECTION D - VISIBILITY, AUDIBILITY AND SMOKE SCREENS

I. VISIBILITY

(1) Natural Visibility.

Rule D-1. (a) Natural visibility is that obtained without the use of artificial illumination. Conditions as to natural visibility will be classed as either day, night or twilight.

(b) Day condition obtains from sunrise to sunset. (A-8).

(c) Twilight condition obtains for a period following sunset and an equal period before sunrise. Unless otherwise stated, the length of each twilight period is one-half hour.

(d) Night Condition obtains from the end of evening twilight to the beginning of morning twilight.

Rule D-2. (a) Under either day, night or twilight conditions visibility will be further classed as either high, normal, low or fog.

(b) Visibility other than normal may be stated in the problem, or may be announced at any time by the Director.

(c) Unless otherwise stated, normal visibility will obtain.

Rule D-3. (a) Range of visibility varies according to

(1) Height of observer
(2) Number and efficiency of lookouts
(3) Character of object observed
(4) Clearness of atmosphere
(5) Amount of light

Height of observer is assumed to be height of bridge at night and fore top in day time.

Natural Visibility of Vessels on the Surface and in the Air.

Rule D-4. The ranges of visibility of vessels on the surface and of aircraft in the air, under conditions other than fog and twilight, are as given in the following tables:

DAY - HIGH VISIBILITY

With high barometer: clear atmosphere: clear sky

Visibility is in miles. Where only one set of figures is given, object seen is not only visible at that range, but is recognizable as to general type. Where a second set is given, the one of less value is the range of recognition as to general type.

In Miles

Object seen	Seen from: Vessels on surface: Large Int.	Small	Dest.	Sub.	Sub. periscope #	Aircraft at Alt. indicated. Ft.	
SMOKE - 8 plus (See Rule D-5)	40	40	40	35	25	35	any
4 - 7 (See Rule D-5)	35	35	35	30	20	30	any
1 - 3 (See Rule D-5)	30	30	30	25	15	30	any
VESSELS ON SURFACE							
Large, Int.	25	22	20	16	13	25	up
	19	16	14	10	8	15	
Small	22	20	18	14	12	20	to
	18	15	13	9	7	15	
Dest.	20	17	15	11	9	20 ##	10,000*
	17	14	12	8	6	15	
Sub.	8	7	7	4	3	10 ##	5,000*
	6	5	5	3	3	8	
AIRCRAFT IN THE AIR	See Rule J-10.						

#For visibility from periscopes when unrestricted. Otherwise, use Rule D-10.

##NOTE: The figures given above for destroyers and submarines observed from aircraft apply with a condition of "smooth sea"; otherwise an aircraft can see and recognize destroyers and submarines on the surface at 15 and 7 miles respectively.

*NOTE: Distances that vessels may be seen by aircraft at greater altitudes than 10,000 feet are reduced one mile for each increase of 1000 feet in altitude, but distances shall not be reduced below two miles.

For Classification of Vessels, see Rule A-2.
For Visibility of Periscopes and Submerged Submarines, see Rules D-8 and D-9. Also Rule J-13(a).

DAY - NORMAL VISIBILITY

With high barometer: clear atmosphere: clear sky

Visibility is in miles. Where only one set of figures is given, object seen is not only visible at that range, but is recognizable as to general type. Where a second set of figures is given, the one of less value is the range of recognition as to general type.

In Miles

Object seen	Seen from: Vessels on surface: Large Int.	Small	Dest.	Sub.	Sub.# periscope	Aircraft at Alt. indicated. Ft.	
SMOKE - 8 plus) See	25	25	25	25	20	25	any
4 - 7) Rule	20	20	20	20	16	20	any
1 - 3) D-5	18	18	18	18	12	18	any
VESSELS ON SURFACE							
Large, Int.	14	13	12	10	8	15	(
	12	11	10	9	7	13	(
							(
Small	13	12	11	9	7	14	(10,000*
	11	10	9	8	6	12	(
							(
Dest.	12	11	10	8	6	13##	(
	10	9	8	7	5	11	(
Sub.	7	6	6	4	3	8##	5,000*
AIRCRAFT IN AIR	See Rule J-10.						

\# For visibility from periscopes, when unrestricted, otherwise use Rule D-10.

NOTE: The figures given above for destroyers and submarines observed from aircraft apply with a condition of "smooth sea"; otherwise an aircraft can see and recognize destroyers and submarines on the surface at 8 and 5 miles respectively.

* NOTE: Distances that vessels may be seen by aircraft at greater altitudes than those listed in last column are reduced one mile for each increase of 500 feet.

For classification of vessels, see Rule A-2.
For visibility of periscopes and submerged submarines, see Rules D-8 and D-9. Also Rule J-13(a).

DAY - LOW VISIBILITY

With low barometer: moist atmosphere: cloudy sky

Visibility is in miles. Where only one set of figures is given, object seen is not only visible at that range, but is recognizable as to general type. Where a second set of figures is given, the one of less value is the range of recognization as to general type.

In Miles

Object seen	Seen from: Vessels on surface: Large Int.	Small	Dest.	Sub.	Sub.# periscope	Aircraft at Alt. indicated. Ft
SMOKE - 8 plus (See Rule D-5)	7	7	7	7	6	7##
4 - 7 (See Rule D-5)	7	7	7	7	6	7## 6,000*
1 - 3 (See Rule D-5)	6	6	6	6	5	6##
VESSELS ON SURFACE						
Large, Int.	6	6	6	6	5	6##
	5	5	5	5	4	5##
Small	6	6	6	6	5	6## 5,000*
	5	5	5	5	4	5##
Dest.	5	5	5	5	4	5##
Sub.	4	4	4	4	3	4## 2,000*
AIRCRAFT IN AIR	See Rule J-10.					

#NOTE. For visibility from periscopes when unrestricted. Otherwise use Rule D-10.

##NOTE. Distances noted in table for visibility from aircraft and altitudes indicated in last column are variable and dependent on clouds and atmospheric conditions.

* Note. Distances that vessels may be seen by aircraft at greater altitudes than those listed in last column are reduced one mile for each increase of 500 feet.

For classification of vessels, see Rule A-2.
For visibility of periscopes, and submerged submarines, see Rules D-8 and D-9. Also Rule J-13 (a).

NIGHT - HIGH VISIBILITY

With moonlight, clear sky, clear atmosphere, and horizon

In Miles

Object seen	Seen from: Vessels on surface: Large Int.	Small	Dest.	Sub.	Sub. periscope	Aircraft # Alt. 1000 ft.
SMOKE - 8 plus) See:	5	5	5	5	0	3
4 - 7) Rule:	4	4	4	4	0	3
1 - 3) D-5:	3	3	3	3	0	3
VESSELS ON SURFACE:						
Large, Int.	3	4	5	5	0	3
Small	2½	3	4	4	0	2
Dest.	2	2½	3	3	0	2
Sub.	1	1½	2	2	0	1
Periscopes	0	0	0	0	0	0
Aircraft in air (at 3000 ft. or less)	¼	¼	¼	¼	0	See Rule J-10

With moon less than 45° high, objects bearing in the moon's reflection can be seen twice the above distance. Aircraft in path of moon ½ mile only.

For classification of vessels, see Rule A-2.

NOTE: Distances that vessels may be seen by aircraft at greater altitudes than those listed in last column are reduced one mile for each increase of 500 feet.

NIGHT - NORMAL VISIBILITY

With clear sky, clear atmosphere and horizon, but no moon

In Miles

Object seen	Seen from: Vessels on surface: Large Int.	Small	Dest.	Sub.	Sub. periscope	Aircraft Alt. 1000 ft.
SMOKE - 8 plus (See Rule D-5)	3	3	3	3	0	1/2
4 - 7 (See Rule D-5)	2	2	2	2	0	1/2
1 - 3 (See Rule D-5)	1½	1½	1½	1½	0	1/2
VESSELS ON SURFACE						
Large, Int.	1½	2	3	3	0	1/2
Small	1¼	2	2½	2½	0	1/4
Dest.	1	1½	2	2	0	1/4
Sub.	½	½	¾	¾	0	0
Periscopes	0	0	0	0	0	0
Aircraft in air (at 1000 ft. or less)	¼	¼	¼	¼ #	0	See Rule J-10

For classification of Vessels see Rule A-2.

#NOTE: Distances that vessels may be seen by aircraft at greater altitudes than those listed in last column are reduced 1/4 mile for each increase of 500 feet.

NIGHT - LOW VISIBILITY

With sky overcast, moist atmosphere, and no horizon

In Miles

Object seen	Seen from: Vessels on surface: Large Int.	Small	Dest.	Sub.	Sub. periscope	Aircraft 1000 Ft. Alt.
SMOKE - 8 plus) See	½	½	½	½	0	0
4 - 7) Rule	½	½	½	½	0	0
1 - 3) D-5	½	½	½	½	0	0
VESSELS ON SURFACE						
Large, Int.	½	½	½	½	0	0
Small	1/3	1/3	1/3	1/3	0	0
Dest.	¼	¼	¼	¼	0	0
Sub.	1/10	1/10	1/10	1/10	0	0
Periscope	0	0	0	0	0	0
Aircraft in air (at 3000 ft. or less)	0	0	0	0	0	See Rule J-10

For classification of Vessels, see Rule A-2.

Rule D-5.

(a) Coal burning vessels are considered to make funnel smoke at all speeds.

(b) Oil burners are considered to make gas but not funnel smoke at all speeds two or more knots below maximum. The gases of groups of 8 or more oil burners proceeding together at such reduced speed is considered to have the same visibility as the smoke of groups of coal burners four less in number.

At speeds within two knots of maximum speed, oil burners make the same funnel smoke as coal burners.

(c) Vessels with internal combustion engine drive are considered to make neither gas nor smoke.

Rule D-6.

(a) During the twilight periods (D-1) visibility ranges gradually increase or decrease, approximately in accordance with the following:-

(b) For this purpose, the twilight period is divided into five equal parts; in the case of the half-hour twilight usually assumed each division being of six minutes duration. The visibility obtaining during each period is based on the day and night visibility conditions obtaining, as follows:

Period	Minutes before sunrise after sunset	Visibility
1	25-30	1½ times night visibility
2	19-24	2 times night visibility
3	13-18	1/4 day visibility
4	7-12	1/2 day visibility
5	1-6	3/4 day visibility

(c) While the foregoing is a guide in determining visibility under twilight conditions, the Director will be free to decide in accordance with his judgment.

Rule D-7. Visibility under fog conditions is as follows:

From surface craft: Visibility will be within limits to be established by the Director.

From aircraft: Visibility is the same as from surface craft, if on, or very close to the water; otherwise, aircraft can see nothing of surface or sub-surface craft; but if above the fog can see other aircraft also above the fog, according to visibility conditions obtaining there.

Natural Visibility of Submerged Submarines.

Rule D-8. (a) If a submarine complies with all of the following conditions, she will not be seen except as provided in Rule J-13 and D-8 (c):

(1) Remains submerged at periscope depth or deeper.

(2) Does not expose periscope when making more than three knots through the water.

(3) Does not expose periscope within 1000 yards of surface or air craft.

(4) Does not expose periscope longer at one time than allowed by the following table at the distances from nearest surface or air craft as indicated:

Sea Smooth, no white caps Wind 0-2		Sea Choppy with white caps Wind 3 and above	
Distance (yds)	Time (sec.)	Distance (yds)	Time (sec.)
1000-2000	10 sec.	1000-2000	30 sec.
2000-4000	20 sec.	2000-4000	60 sec.
4000-6000	30 sec.	4000-6000	90 sec.

(b) If a submerged submarine does not comply with all of the above conditions, her periscope will be seen by any surface or air craft within 4000 yards of her.

(c) When a submarine fires torpedoes at periscope depth, the swirl may be seen by any surface or air craft within 2500 yards in smooth sea (no white caps) or within 1500 yards in moderate sea (with white caps).

(d) One minute must intervene between periscope exposures except the interval before the firing exposure.

(e) At the discretion of the Director, false contacts up to about 50% of all periscope contacts given the players may be introduced.

Rule D-9: Submarine periscopes are considered not visible at night.

Rule D-10.

(a) The commander of a submerged submarine will enter on his flimsy:

(1) Game time at which periscope is raised.

(2) Whether an all around look or on what bearings he elects to look.

(3) Duration of periscope exposure.

A look on each designated bearing requires ten seconds, and ten seconds is occupied in shifting from one ship or unit to another. For example: A 30 second exposure permits a ten second look on each of two bearings.

(b) A ten second all around look will give only the following information:

Bearings of vessels within 10,000 yards.
Range - whether nearer or farther than 6,000 yards.
Type - whether large, intermediate or small.

(c) For a ten second look on a designated bearing, the information will be as follows:

Within 7,000 yards:

(1) Type and whether enemy or friend.

(2) Compass bearing exact.

(3) Target angle, center ship.

If actual target angle is	(345°-15°, (165°-195°	correct target angle will be furnished player.
" " " " "	(16°-30°, (150°-164° (196°-210° (330°-344°	target angle to nearest 5° will be furnished player.
" " " " "	(31°- 45°, (135°-149° (211°-225° (315°-329°	target angle to nearest 10° will be furnished player.
" " " " "	(46°-134°, (226°-314°	target angle to nearest 15° will be furnished player.

(4) Range:

When actual range is

7000 to 5000 range will be given within 1800 yards of actual range.
5000 to 2500 range will be given within 1000 yards of actual range.
2500 to 1500 range will be given within 500 yards of actual range.
1500 and less range will be given as accurately as it can be measured on plot.

(5) Speed:

Will normally be determined by the player from his plot. If given to the player, the accuracy of the information will be governed by the range and the number of observations taken.

7000 to 10,000 yards:

(1) Approximate type, and in case of large vessels whether friend or enemy.

(2) Compass bearing exact.

(3) Target angles as above for range Within 7,000 yards

(4) Ranges. Within 2000 to 4000 yards of actual range. The inaccuracy varying with the range.

(5) Speed. No information.

Above 10,000 yards:

(1) Very general information as to composition of forces.

(2) Compass bearing exact.

(3) Range. Given as above for 7,000-10,000 yards.

(4) No target angle.

(2) VISIBILITY BY ARTIFICIAL ILLUMINATION.

Illumination by Searchlights.

Rule D-11.

(a) Under conditions of Night High and Night Normal visibility, by the use of searchlights the ranges of visibility from the ship using the searchlights are made those of Night High Visibility as seen from a large or intermediate sized vessel; for Night Low Visibility the ranges become those of Night Normal Visibility as seen from a large or intermediate size vessel; for fog conditions searchlights do not improve visibility. For other

ships, not using searchlights and offset to one side of the searchlight rays, the ranges of visibility given above are increased by 50 per cent.

(b) A searchlight throws a beam against which a vessel may be silhouetted. For game purposes, for conditions of Night High or Night Normal visibility, this beam will be considered to be 6000 yards in length; for conditions of Night Low visibility 3000 yards in length; for fog 00 yards. If the vessel is projected against the searchlight beam within the length above prescribed and is not more than 8000 yards from the projected beam, the visibility of the silhouetted vessel for gunfire and recognition purposes is as follows:-

Searchlight Silhouette	
Illumination for Gunfire Purposes.	Type can be made out.
Night High or Night Normal Visibility	
Smoke and Large or Int. Vessels	9000 yards
Small	7500 yards
Dest.	6000 yards
Sub.	3000 yards
Night Low Visibility	
Smoke and Large or Int. Vessels	4500 yards
Small	3700 yards
Dest.	3000 yards
Sub.	1500 yards

(c) For fire effect when using searchlights see Rule F-21(e)(4).

(d) Each searchlight used for searching for airplanes in the air has one chance in 50 of picking up and holding any one plane or formation of planes within 3000 yards, and of holding it until it has passed to a distance of 6000 yards, while if an airplane is held by a searchlight beam it can be seen by all observers within 6000 yards of it.

Visibility of Searchlights and Gun Flashes.

Rule D-12. (a) Under Night High and Night Normal visibility, searchlights are visible 30 miles, gun flashes 10 miles. Under Night Low visibility searchlights are visible 15 miles, gun flashes 5 miles.

(b) Under fog conditions, day or night, searchlights are visible to an observer in the direct ray of the light for a distance one mile greater than that at which the ship using the searchlight can be seen. The range of visibility of a ship in a fog will be determined by the Director.

Illumination by Star Shells and Parachute Flares.

Rule D-13. (a) Star shell, fired from guns of 3" to 6" caliber, are burst by time-fuse action. Point of burst should be at an altitude of about 1500 feet.

(b) Parachute flares, dropped from planes drop 1500 feet before attaining full illumination.

(c) During illumination, star shell and flares drop 400 feet per minute, and drift with the wind.

Rule D-14. The allowance of star shell is as given in the "FLEETS".

Rule D-15. Weight of parachute flares is 19.5 pounds.

Planes may carry parachute flares up to the number indicated by "Aircraft Characteristics"; plus one flare in place of each 100# bomb; plus, in VP planes, 20 flares loose in the hull.

Supply of flares carried on ship or tender for each plane will be as stated in the "FLEETS".

Rule D-16. (a) While burning, the light from a star shell or flare is assumed to illuminate a circular area of water beneath it.

(b) The maximum horizontal range at which effective star shell can be burst, the diameter in yards of the circle of illumination, the duration in minutes of each illumination, and the minimum number of bursts per minute required to maintain illu-

mination of a target, are as given in the following table. If the target is moving at high speed, a higher rate of fire is required.

Gun	Fleet	Range (yds)	Diameter (yds)	Time (Min)	Burst Per min
6"/53 6"/50 6"/50 & 6"1/50	B R O	17,000	1,000	1	4
5"/38 5"1/50	B O	15,500	800	1	6
5"/25 5"/51 5"5/50	B B O	14,500	800	.8	5
4"7 4"0 4"7 4"0	R B O R	8,000	600	.7	5
3"/50 3"/40 3"/45	B O R	7,500	500	.4	8
3"/23 3"/25	B O	6,000	500	.4	8
Flares		---	2,000	3.0	2

(c) The rate of fire and horizontal range to be used will be stated by the player, as well as the bearing limits of any search spread.

Rule D-17. (a) In using star shells or flares to illuminate a target for gunfire, or for searching an area, they must burst beyond the target not more than 4000 yards, and while burning must cross the line of sight.

(b) If the burst is from zero to 2500 yards beyond the target, the target is considered to be projected against the circle of illumination and conditions for gunfire, or recognition are most favorable. If the burst is between 2500 and 4000 yards, the conditions are less favorable; beyond 4000 yards, the burst is considered to provide no illumination. Bursts short of the target obscure it if in the line of sight.

(c) If properly illuminated, as defined in (a) and (b) of this rule and Rule D-16, a target is visible for gunfire and recognition purposes, under night conditions other than fog, as given in the following table:-

Star Shell or Parachute Flares

(a) Burst 00 to 2500 yards over Target	(b) Burst 2501 to 4000 yards over Target
Illumination for gunfire purposes. Type can be made out.	Illumination for gunfire purposes. Type can be made out.

Night High or Night Normal Visibility

Object Seen		
Smoke and Large or Int.	15,000 yds.	9,000 yds.
Small	12,000 "	8,000 "
Dest.	9,000 "	6,000 "
Sub.	5,000 "	3,000 "

Night Low Visibility

Smoke and Large, or Int.	6,000 yds.	4,000 yds.
Small	5,000 "	4,000 "
Dest.	4,000 "	3,000 "
Sub.	2,000 "	1,000 "

(d) Ships, other than the target, may be illuminated or obscured, accidentally or by design, when subject to the conditions of this rule.

(e) Under fog conditions, use of star shell or flares does not improve visibility.

(f) The outside range limits of gunfire under various visibility conditions, when using star shells or flares, on various targets are established in the table given just above. The effectiveness of gunfire will further depend upon range, the size of the firing ship and the caliber of gun carried. Curtailment of fire effect on account of this night visibility effect is provided in Rule F-21(e)(4).

Rule D-18. In using star shell or flares for searching, an arc will be considered thoroughly illuminated only in case centers of bursts are separated by a distance of not more than the width of illumination of individual bursts. (See Rule D-16).

Rule D-19 (a) When a vessel is under satisfactory illumination of parachute flares under night conditions other than fog, planes can bomb her with an accuracy 50% that of by day.

(b) Satisfactory illumination by flares requires that during the bombing period from two to three flares be constantly in the air within two hundred yards of the target, and between the altitudes of five hundred and fifteen hundred feet. The time of burning of the flares can be assumed as three minutes, and the rate of fall of burning flares as four hundred feet per minute. Illumination must be provided by a special group of airplanes, as flares cannot be effectively dropped from the bombing group.

Visibility of Star Shells and Flares.

Rule D-20 (a) Under night conditions other than fog, star shells and parachute flares are visible 30 miles in Night High and Night Normal Visibility and 15 miles in Night Low Visibility.

(b) Under fog conditions, star shells and parachute flares are visible at a distance one mile greater than the natural range of visibility of a ship as determined by the Director.

Interference with Vision by Star Shells, Flares or Searchlights.

Rule D-21 (a) Searchlight beams, if kept trained directly on the observer will cause serious interference with vision. This will adversely affect spotting of gunfire, torpedo control and maneuvering. The Director will decide the extent of this interference in all such cases.

(b) Star shell bursts or flares will, under certain conditions, completely obscure vision beyond the burst or flare. The use of star shell for this purpose must be in accordance with a definite plan and the player must satisfy the Director of the plan's effectiveness. See Rule D-17 (d).

AUDIBILITY

Through Air:

Rule D-25 (a) The normal ranges of audibility of gunfire and of destroyers proceeding at high speed (due to blowers), are as follows:

AUDIBILITY RANGE

	Miles	1,000's of yards
GUNFIRE: 12" plus	20	40
8"-11"	15	30
6"-7".5	10	20
4"-5".5	7	14
3" minus	5	10
DESTROYERS:	1	2

(b) When heading directly towards or away from the listener. the distance that an airplane may be heard is much less than when the plane is passing on a course at right angles. The ratio between these distances may be assumed as approximately 1 to 3.

The extreme distances that heavier-than-air craft will be considered audible to the unaided ear, when free from other noise follow:

One VF, VOS, VSO - below 6000 feet altitude and within 2 miles.

One VS, VTB - below 8000 feet altitude and within 2-1/2 miles.

One VP - below 10,000 feet altitude and within 3 miles.

In case two to seven planes are together add 2,000 feet to the altitude figures listed above and one mile to the horizontal distance figures.

In case more than seven planes are together add 2,000 feet to the altitude figures listed above and three miles to the horizontal distance figures.

(c) These ranges may vary according to wind, and according to local noise near the listener.

(d) If there is any wind, the ellipse marking the limit of audibility will be shifted down the wind a distance equal to the major axis times the wind force divided by 30.

(e) A vessel firing or under fire can hear through the air only one-quarter as far as normal.

(f) A destroyer proceeding at high speed can hear through the air only one-half as far as normal.

(g) For audibility of airplanes from sound locators see Rule J-11.

Rule D-26. The direction of a continued noise heard through the air can be told to the nearest multiple of 45 degrees.

UNDERWATER SOUND

Rule D-27. (a) Underwater sound equipment is assumed to be carried by vessels in accordance with Table E-5 (Section E).

(b) Players will inform the Plotting Officer when the vessels they command are using underwater sound equipment for the detection of other vessels, and will furnish a sketch or memorandum of the plan in use.

Rule D-28. The results obtained from the use of underwater sound equipment will be decided by the Director, using the succeeding sub-paragraphs as guides:

A. ECHO RANGING

(a) Both bearings and ranges may be obtained by echo-ranging.

(b) The basic limiting range assumed for underwater sound echo-ranging is 4000 yards. The limiting range for any particular set of conditions is determined by multiplying successively this value by the coefficients tabulated in (1), (2), (3), (4) below.

(1) Coefficient I - (Relative Bearing).

Angle of Train	Value of Coefficient I
0 - 80	1.0
80 - 180	0.7

(NOTE: - Echo-ranging is not prevented in any sector by own propeller noise, nor by own wake interference because the sound beam shoots under the wake. Noise level is somewhat higher when the projector is pointed aft, however.)

(2) Coefficient II - (Speed of Ranging Ship)

Own Speed	Value of Coefficient II
0-12	1.0
13-15	0.9
16-20	0.5
21-25	0.4
26 plus	0.3

(3) Coefficient III - (State of Sea)

State of Sea	Value of Coefficient III
Smooth	0.7
Moderate	1.0
Rough	0.8
Heavy	0.4

(NOTE: - Smooth sea conditions are less favorable for echo-ranging than moderate sea conditions, because the water "texture" usually associated with smooth surface is such that many false echoes (reverberations) occur. As echo-ranging is affected little by rolling and pitching of own ship, but considerably by false echoes returned by surface waves, there is no need to distinguish here between a submerged submarine and a surface ship.)

(4) Coefficient IV - (Depth of Water)

Depth	Value of Coefficient IV
0-100 fathoms	0.4
101 fathoms plus	1.0

(c) The speed of the target does not affect the limiting range of echo-ranging.

(d) The target's wake can be detected but there is no way of distinguishing between echoes returned by the wake and those returned by the hull. Development of an initial contact, by determining the limiting bearings, and watching the change of bearing (the "wake end" will not change appreciably in bearing although the "target end" will change regularly and definitely in accordance with its movement relative to the ranging ship), or by listening for propeller noises, is necessary to assure that observations are being made on the target's hull rather than its wake. For initial contacts, theeffective length of the target's wake is 50 yards per knot of target speed, i.e. the "echo-surface" of a target at 15 knots is the length of the hull plus 750 yards. After the initial contact, however, the wake is assumed to remain stationary regardless of the movements of the target for a period of about 10 minutes, in order to permit fairly realistic development of the contact.

(e) Turbulent masses of water, such as that caused by a depth charge explosion, in line of projection of the sound beam will interrupt echo-ranging through it for about 20 minutes.

(f) Determinations of ranges and bearings of the target, or of the absence of the target, in the 10 degree segment centered on the selected bearing of train of the projector (and limited in radius to the range determined by applying coefficients to the 4000 yard basic range) can be obtained every 5 seconds.

(g) Training the projector can be accomplished at the rate of 20 degrees per second, but no observations can be obtained while training so fast. While training at the rate of 5 degrees per second, or less, detection is possible, but 5 seconds must elapse after detection before range and bearing can be determined.

(h) Bearings are usually correct to plus or minus 2 degrees; ranges to plus or minus 25 yards. It must be understood, however, that while the projector is trained on the wake rather than the hull bearings and ranges obtained are those of the wake. Only after the hull has been located, as indicated in (d) above, and the projector trained on it, can ranges and bearings be assumed to be those of the target itself.

B. LISTENING

(a) Bearings and some information as to type (Rule D-29(b)) may be obtained by listening.

(b) The basic limiting range assumed for underwater sound listening is 15,000 yards. The limiting range for any particular set of conditions is determined by multiplying successively this value by the coefficients tabulated in (1), (2), (3), (4), and (5) below.

(1) Coefficient I - (Relative Bearing)

Angle of Train	Value of Coefficient I	
	Supersonic	Sonic
0-20	1.0	0.7
21-80	1.0	1.0
81-120	0.9	0.7
121-160	0.8	0.5
161-180	0.6	0.1

(2) Coefficient II - (Speed of Listening Ship)

Own Speed	Value of Coefficient II	
	Supersonic	Sonic
0-2	0.8	0.8
3-4	0.6	0.2
5-10	0.5	0.0
11-15	0.3	0.0
16-20	0.2	0.0
21-25	0.1	0.0

(3) Coefficient III - (State of Sea)

State of Sea	Value of Coefficient III	
	Listening ship on surface	Listening ship submerged
Smooth	1.0	1.0
Moderate	0.9	0.9
Rough	0.6	0.7
Heavy	0.5	0.7

(4) Coefficient IV - (Depth of Water)

Depth	Value of Coefficient IV	
	Supersonic	Sonic
0-50 fathoms	0.7	1.0
51-100 "	0.8	0.8
101-200 "	1.0	0.2
201 fathoms plus	1.0	0.0

(5) Coefficient V - (Speed and Type of Target)

Target Speed	Type of Target				
	Large	Int. & Small	DD	SS Surface	SS Submerge
1-3	0.1	0.05	0.05	0.1	0.2
4-6	0.3	0.1	0.1	0.3	0.7
7-10	0.5	0.3	0.3	0.5	1.0
11-15	0.7	0.6	0.5	0.7	-
16-20	0.9	0.7	0.6	0.9	-
21-25	1.0	0.9	0.7	1.0	-
26 plus		1.0	1.0	-	-

(c) Determination of bearing of target, or of the absence of target, in the 10 degree segment centered on the selected bearing of train of the listening device (and limited in radius to the range determined by applying coefficients to the 15,000 yard basic range) can be obtained every 20 seconds.

(d) Training the listening device can be accomplished at the rate of 20 degrees per second, and while training at that rate, or less, detection is possible but 20 seconds must elapse after detection before the bearing is determined.

(e) Bearings obtained will usually be correct to:

Supersonic device	plus or minus 1 degree
Sonic device	plus or minus 5 degrees

EXAMPLES OF DETERMINING LIMITING RANGES FOR ECHO-RANGING AND LISTENING

Example 1.

Destroyer in sound screen with one supersonic projector fixed on 060 degrees relative and the other on 300 degrees relative. Speed of destroyer 12 knots. Depth of water 1000 fathoms. Sea moderate.

A submerged submarine, speed 5 knots, attempts to penetrate the screen.

Question (a). What is the radius of the 10-degree segment (along the angle of train of either of the destroyer's projectors) within which the submarine will be detected by echo-ranging?

Answer:

Coeff. I = 1.0

Coeff. II = 1.0

Coeff. III = 1.0

Coeff. IV = 1.0

Basic range for echo-ranging = 4000 yards.

Limiting range = 4000 yards.

Question (b). Assuming that the submarine is detected by echo-ranging at 4000 yards range, can its propellers be heard, by listening with the supersonic device, in order to develop the contact and distinguish the submarine's hull from its wake?

Answer:

Coeff. I = 1.0

Coeff. II = 0.3

Coeff. III = 0.9

Coeff. IV = 1.0

Coeff. V = 0.7

Basic range for listening = 15,000 yards

Limiting range = .3 x .9 x .7 x 15,000 = 2835 yards.

The submarine's propellers cannot be heard by listening with this device until the range has been closed to 2835 yards.

Example 2.

Conditions same as in Example 1, except:

Sea smooth,
Depth, 90 fathoms,
Submarine's speed 7 knots.

Question (a). What is limiting range for echo-ranging?

Answer:

Coeff. I = 1.0

Coeff. II = 1.0

Coeff. III = 0.7

Coeff. IV = 0.4

Limiting range = .7 x .4 x 4000 = 1120 yards.

Question (b). What is limiting range for listening:

Answer:

Coeff. I = 1.0

Coeff. II = 0.3

Coeff. III = 1.0

Coeff. IV = 0.8

Coeff. V = 1.0

Limiting range = .3 x .8 x 15,000 = 3600 yds.

Example 3.

Submarine submerged patrolling at 2 knots speed. Depth of water 40 fathoms. Sea moderate. One supersonic projector listening on starboard side from dead ahead to dead astern, other supersonic projector listening on port side from dead ahead to dead astern, and sonic device listening alternately on port and starboard sides between 50 and 100 degrees from the bow.

Question 1. A cruiser at 25 knots approaches from 060 degrees relative. How far away can she be heard?

Answer:

Coeff. I = 1.0

Coeff. II = 0.8

Coeff. III = 0.9

Coeff. IV = 0.7 for supersonic; 1.0 for sonic.

Coeff. V = 0.9

Range = .8 x .9 x .7 x .9 x 15,000 = 6904 yds. for supersonic.

Range = .8 x .9 x .9 x 15,000 = 9720 yds. for sonic.

Question 2. The submarine turns toward the cruiser without increasing speed, and commences echo-ranging with the supersonic device. What is the limiting echo-range?

Answer:

Coeff. I = 1.0

Coeff. II = 1.0

Coeff. III = 1.0

Coeff. IV = 0.4

Limiting range = .4 x 4000 = 1600 yards.

C. MISCELLANEOUS

(a) After the limiting range has been determined as in Rule D-28-A or in Rule D-28-B, the percentage chance of picking up a target vessel which comes within this range may be obtained as follows:

	Per Cent of the Determined Limiting Range			
	1 - 50%	51 - 75%	76 - 100%	101% plus
Per Cent Chance of Detection	100%	75%	50%	0

(b) After a target has once been picked up as determined by (a) above, echo ranging and listening may be done effectively to the limiting range determined by Rules D-28-A or D-28-B as applicable.

(c) False Submarine contacts from echo ranging are frequently made and reported. At the discretion of the Director, false contacts will be introduced which may be as high as 50% of the contacts given the players. After the necessary time for development, which may vary from 30 seconds to 2 minutes, a considerable percentage of false contacts may be eliminated. About 25% of the false contacts reported can not be eliminated; and as far as can be determined, indicate the probable presence of a submarine.

(d) Vessels so equipped may use echo ranging and listening equipment to maintain contact during fog or darkness.

Rule D-29. (a) The results of depth charge attacks which are made against submarines as a result of sound contacts will be decided by the Director, basing his decision on the factors stated in Rule I-9, and in addition, the capabilities of the attacking vessels to track by sound. See Rule D-28-C(c) concerning false contacts.

(b)(1) Partial identification of the type of vessel and the approximate speed from the counting of the revolutions of the propeller may be obtained by listening. This information may be given a player at the discretion of the Director. The revolutions can be counted to three-fourths of the distance determined by the application of Rule D-28-B.

(2) No information as to type of ship or number of revolutions can be obtained by echo-ranging.

(3) The number of vessels present can be counted on bearings from the listening or echo-ranging vessel if not less than 10 degrees apart.

(c) Submarines may make torpedo attacks wholly by using underwater sound equipment (Rule G-214).

RADIO DIRECTION FINDERS

Rule D-30. (a) Radio Direction Finders are carried as shown by Table E-3 (Rule E-12).

(b) Shore radio direction finder stations are listed in Navy Department Publications and others may be specified in the problems. Reception is from 100 to 1500 kcs, except specially designated stations may receive on any wave length from 100 - 30,000 kcs.

(c) Rule E-12 concerns the use of radio direction finders in War College maneuvers.

Rule D-31. (a) Subject to the errors given in Rule D-32, a radio direction findor can obtain the bearing of any radio transmission, provided:

(1) It is listening on the frequency used;

(2) It is within the limiting distance of the transmission (E-11);

(3) The transmission is on a frequency below 1500 kcs., and lasts at least 30 seconds, or if above 1500, lasts 45 seconds.

(4) If listening station is not transmitting while bearing is taken.

(b)(1) For vessels not listening on the exact frequency, but searching in a fixed band of not more than 200 kcs. in width, the direction finder operator can detect the transmission, tune to it, and obtain a bearing, provided that the transmission lasts at least three minutes.

(2) Shore station nets listen only on a designated frequency until shifted to another frequency. It requires 3 minutes to shift the direction finders of the net to a new frequency.

Rule D-32. (a) Except in aircraft, the unilateral method of radio direction finding may be used provided the transmission is listened to for three minutes. When such method can not be used, a bearing reciprocal to the actual bearing may be furnished the player.

(b) Aside from (a) above, the error of a direction finder bearing will be determined in each case by casting a die twice and picking out the error in the table below. The error applied to the true bearing will give the direction finder bearing to be furnished the player.

TABLE OF DIRECTION FINDER ERRORS

Second die

First Die	1	2	3	4	5	6
1	0	0	0	0	0	0
2	0	0	+1	+1	+1	+1
3	+1	-1	-1	-1	-1	-1
4	+2	+2	+2	-2	-2	-2
5	+3	+3	-3	-3	+4	+4
6	-4	+5	-5	-6	-7	+10

TACTICAL

SMOKE SCREENS

Rule D-200. (a) Smoke screens may be laid by any type of oil-burning vessel, or by any vessel or aircraft carrying special smoke apparatus or by aircraft carrying smoke bombs. (For smoke screens laid by aircraft, see Rule J-14).

(b) In order for a smoke screen to be so dense as to prevent vision, it must be laid by at least one CL or larger vessel, or three smaller vessels not over 500 yards apart.

Rule D-201. (a) In order for smoke to lie on the water and not rise at once, atmospheric conditions must be favorable, and the relative wind as felt by the smoke-laying vessels must be 15 knots or more. (D-208).

(b) Atmospheric conditions at night are always favorable for smoke screens. Whether or not existing conditions by day are favorable will be stated in the problem or announced by the Director.

Rule D-202. When the conditions permit the laying of a screen, the screen will always lie, but as atmospheric conditions regulate the period during which the smoke will form an effective screen, the Director will decide, from time to time, whether or not the effective period as given in Rule D-206 should be increased or decreased. The effect of this decision will be applied by the Assistant Director and the decision will not be announced to the players.

Rule D-203. The Assistant Director must in every case be informed when the emission of smoke to form a screen is started and when it is stopped. The intention to smoke must be indicated on the Move Blanks.

Rule D-204. A smoke screen may be started at will (boats of group following motions of leader) or by signal. It may be stopped at will if the laying vessels are clear of the screen. If the laying vessels are operating in the screen, the emission of smoke may not be stopped except by signal.

Rule D-205. A smoke screen will not protect the vessels laying it during the three-minute move in which the laying is begun. It will, however, interfere with the gunfire of the smoking ships and of other ships between which it intervenes, and will subject them to the funnel smoke penalty. After emission of smoke has ceased, the destroyers and other vessels will be protected by only the screen already laid.

Rule D-206. The smoke emitted during a move will be carried directly to leeward at the speed of the wind during three subsequent moves. During these three moves it is impenetrable; at the end of the fourth move, including the move in which it was first emitted, it is entirely dissipated. See also Rule D-202.

Rule D-207. The form of a smoke area at the end of a move during which smoking is begun shall be determined as follows:

(a) From the position of the leader at the beginning of the move draw a line in the direction in which the wind is blowing and equal in length to the distance a particle of smoke would travel during the move.

(b) Join the point last determined with the position of the leader at the end of the move. This line is the forward edge of the smoke area, and is called line (b) in the subsequent explanation.

(c) Determine in the same manner a line for the rear vessel. This is the after edge of the smoke area, and is called line (c).

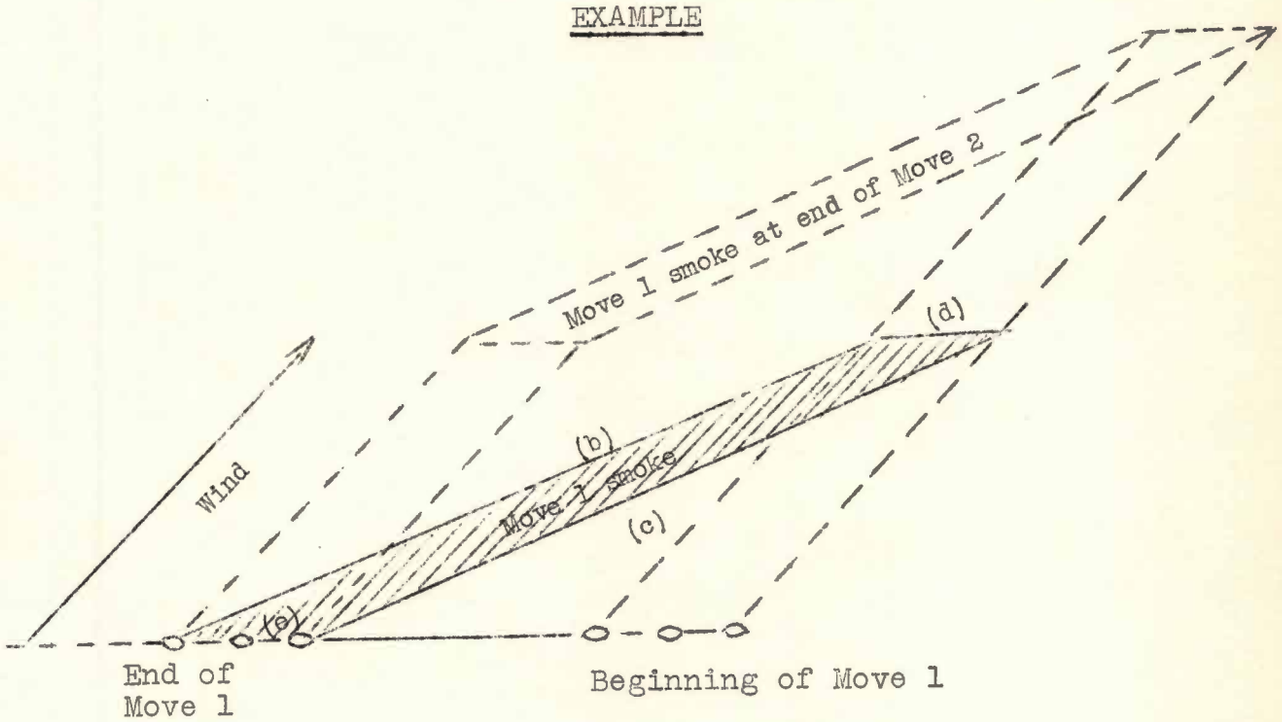
(d) Connect the outer ends of lines (b) and (c) with a line parallel to the shape of the formation at the beginning of the move. Call this line (d).

(e) Draw a line connecting the inner ends of lines (b) and (c) through the formation as it exists at the end of the move. Call this line (e).

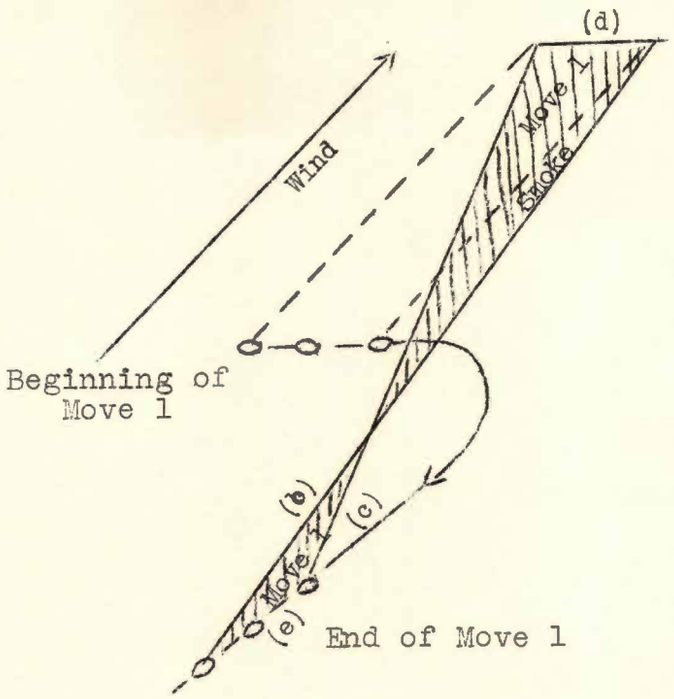
(f) Then the smoke area is bounded by lines (b), (c), (d), and (e). This smoke area is usually in the form of a parallelogram, but when the smoking unit during the move has made a large change of course it frequently appears as two triangles with apexes touching.

NOTE: In plotting smoke screens it will usually be most convenient to lay out the smoke for one move as described above, then to translate this block of smoke bodily in each succeeding move the distance it will be moved by the existing wind. It will be found that the blocks of smoke laid out on the 2nd and subsequent smoking moves will connect up with the first block and with each other forming a continuous smoke screen.

EXAMPLE



EXAMPLE



It will be found helpful to label each block of smoke with the move in which it was laid, and it should be borne in mind that each block represents the situation at the end of a move.

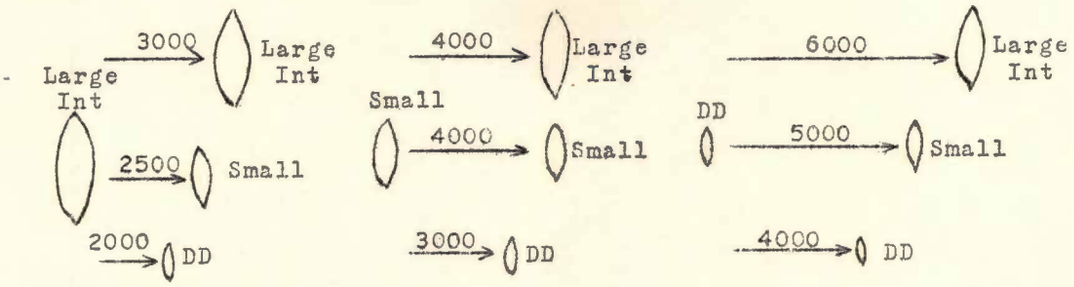
Rule D-208. Having determined the smoke area by the application of Rule D-207 the smoke screen is effective if the line (b) has a length equal to or greater than 15 knots on the scale of the board. The smoke screen is ineffective if this length is less than 15 knots.

Rule D-209. (a) For Aerial Smoke Screens and Curtains, see Rule J-14.

(b) For Chemical Smoke Screens and Chemical Smoke Blankets for anti-aircraft purposes, see Rule K-15.

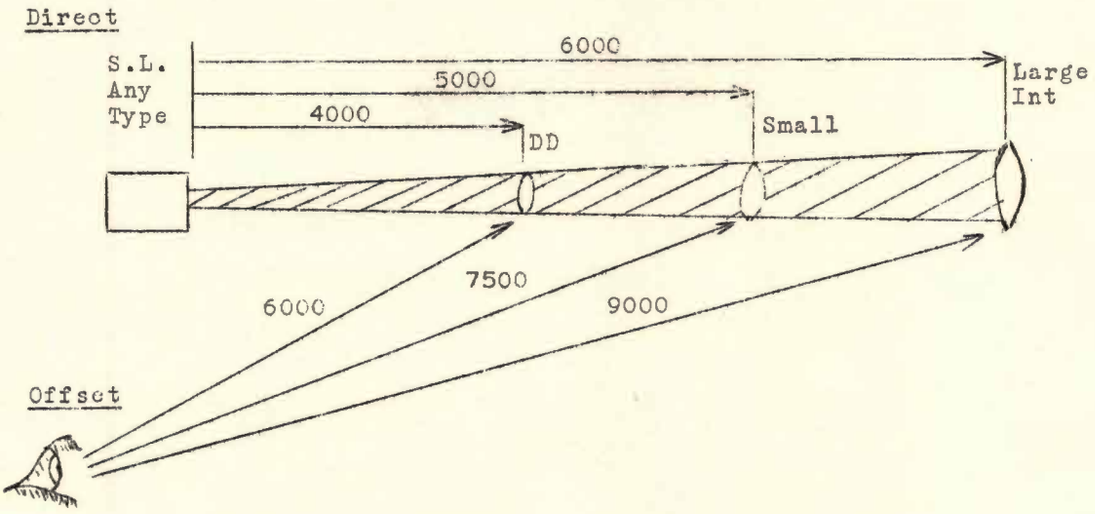
GRAPHIC REPRESENTATION OF NORMAL VISIBILITY AND ILLUMINATION THEREUNDER.
(to follow at end of "D" Rules, Maneuver Rules)

Rule D-4



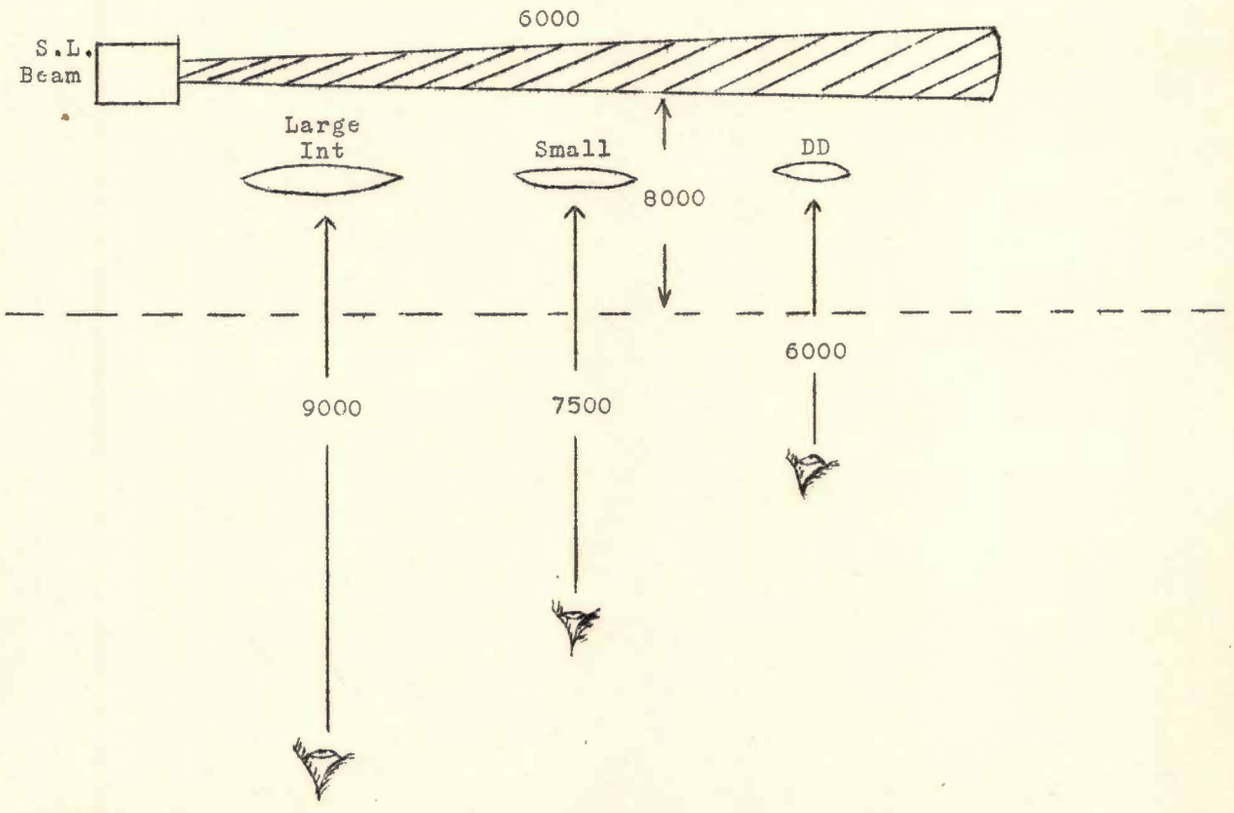
Rule D-11

Searchlight Illumination



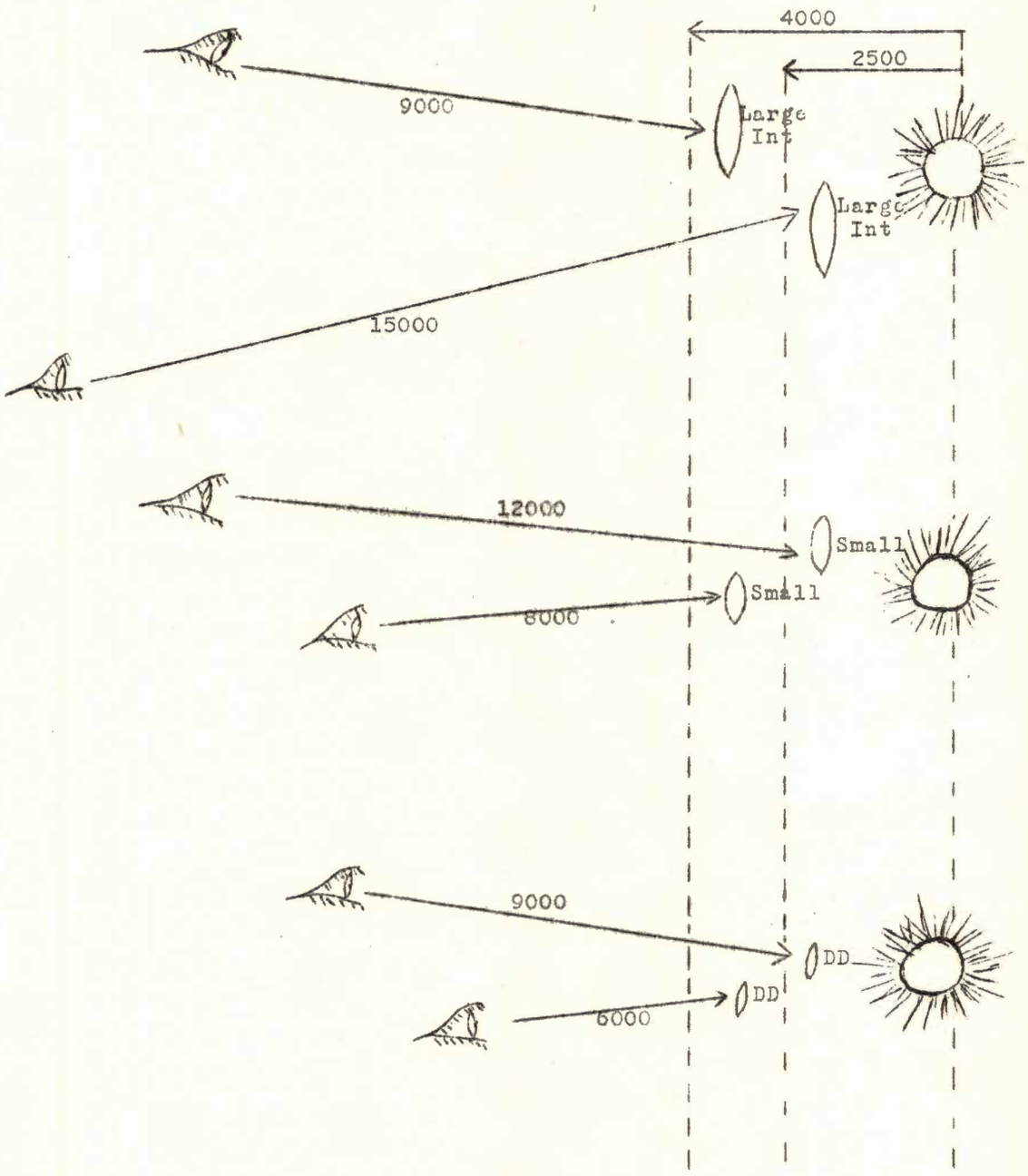
Rule D-11

Searchlight Silhouette

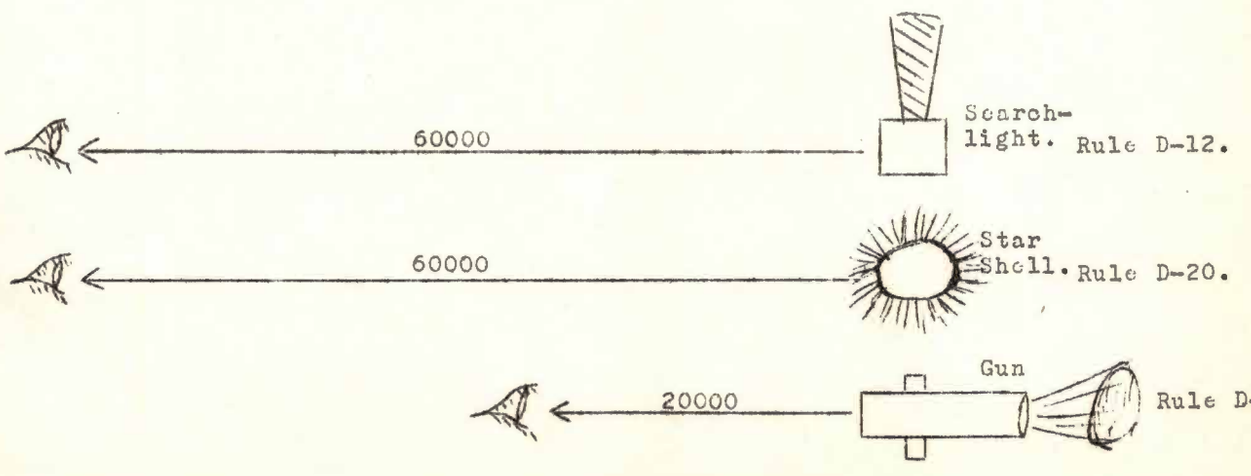


Rule D-17.

Star Shell Illumination



Visibility



SECTION E - COMMUNICATIONS

No.	Means of Transmission	(1)* Maximum Distance: Day	(1)* Maximum Distance: Night	Max. number simultaneous Hoists or Circuits by each Means (2): Combatant types sizes** : Large	Intermediate	Small	Destroyer	Submarine	Auxiliary types, size** : Large - inter.	Small, DD, SS	Aircraft in air : ZR, ZN	VP, VT, VS	VO, VF
1	FLAGS, large	10(d)	-	5	4	4			4				
	intermediate	5(d)	-				2			2			
	small	2(d)	-					1					
2	SHAPES	3	-	(a)	(a)	(a)	(a)	(a)	(a)	(a)			
3	SEMAPHORES	2(d)	-	4	3	3	2	1	2	1			
4	WIGWAG	5(d)	-	3	3	2	1	1					
5	FLASH, searchlight, large	20(d)	40	2	2				2				
	inter.	16(d)	20			2	2			1			
	small	12(d)	16	2			1	1					
6													
7	blinker light	-	10	1	1	1	1	1	1	1	1	1	1
8	blinker tube, undimmed	-	10(d)	2	2	2	2	1	2	1			
	dimmed	-	2(d)	2	2	2	2	1	2	1			
9	hand flashlight	-	2(d)	-									
10	PYROTECHNICS	16	20	1	1	1	1	1	1	1	1	1	1
11	HAND SIGNALS	1	-	-									
12	MOVEMENTS OF PLANES	(x)	-										
13	DECK & GROUND SIGNALS	(x)(d)	-	1S(b)	-	-	-	-			1R	1R	1R
14													
15	GUN	(x)	(x)	1	1	1	1		1	1			
16	WHISTLE	2	2	1	1	1	1	1	1	1			
17	VOICE	(x)	(x)	1	1	1	1	1	1	1			
(3)	Max. number simultaneous Bridge Messages by any or all means			6	3	3	2	1	2	1	1	1	1

Notes:-
(x) = as decided by umpire.
S = sending only.
(b) = Can be made only by carriers.
(d) = more or less directional.
* = Max. distances in thousands of yards and are estimated for favorable conditions (see Rule E-2).
R = receiving only.
(a) = speed indicators allowed in addition to flag hoists. Other shape hoists may be made in lieu of flag hoists.
** = for class sizes (see Rule A-2).

Change No. 1.

TABLE "E-2". BRIDGE COMMUNICATIONS

LIMITING DISTANCES & NUMBERS

FREQUENCY PLANS

The making of frequency plans is the joint function of Command and radio engineering experts. It is the duty of Command to indicate:

(1) Which flags, ships, or shore stations are to be grouped together on each circuit. (The following is a guide and not a rule. The number of radio sets which can transmit on a single circuit, without undue traffic delays, varies with the amount of traffic and has been found to be from 6 or 8 for very busy circuits, to not over 15 ships or an aircraft squadron. The number which can receive is limited only by the availability of apparatus and personnel.

(2) What daylight range it is desired to insure.

(3) Whether a key or voice circuit is desired.

It is the duty of radio engineering experts to recommend the frequency(ies) to be used on a given circuit, provide the necessary alternate frequency(ies), the necessary separation between frequencies, etc. It will be assumed that this has been provided in all student plans made at the War College.

Frequency plans prepared for use during Operations Problems will provide one or more circuits for each of the following:

(1) OTC to his Task Force Commanders;

(2) OTC to his own Task Group (or Unit) Commanders (if he commands a Task Force);

(3) OTC broadcast (F Method) circuit. (May be assumed continuously effective during Tactical Problems and only on schedule or via radio guardship (i.e., relay) during Strategical Problems);

(4) Special circuits as desired by OTC; e.g., air task groups, etc.;

(5) Each Task Force Commander to his Task Group (or Unit) Commanders.

Each circuit list will be headed as follows: (shown in "--"):

"List ___" (A,B,C, etc., without repeating).

Maximum daylight distance required in miles "---- miles".

Whether key or voice by indicating "voice" when desired.

Circuit designation - ("A combination of two letters representing the List and Band Letters.") (If more than one parallel circuit is being provided for simultaneous transmissions each should be indicated with its distance in miles, if different.)

EXAMPLES: "List A
AQ 3000 miles"

or "List F voice
FN 100 miles"

or "List B
BH 800 miles
BL 800 miles" (Two simultaneous circuits)

The circuit designation will be entered in the "Circuit space" on the message form.

All transmissions from ships or unit commanders not included above will be considered "unit" or "plane" frequencies and will require at least one relay. The word "unit" or "plane" will be inserted in the "Circuit space" on the message form.

Sets marked "To aircraft" will be reserved for that purpose.

Avoid repetition of bands as far as practicable.

TABLE E-3 RADIO EQUIPMENT

Line No.	Column	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	Line No.
		TRANSMITTERS																RECEIVERS												PORTABLE SETS						
	Use	Long Distance	Long Distance	Medium or Long Distance	Med. or Long Distance (To Aircraft)	Med. or Long Distance	Small Patrol Craft	Med. Distance (To Aircraft)	Med. Distance	Med. Distance	Battle Line	Aircraft	Aircraft	Aircraft	Aircraft			Low and Int. Frequency	Low and Int. Frequency	Int. and High Frequency	Int. and High Frequency	Small Patrol Craft	Aircraft	Aircraft	Aircraft	Direction Finder	Direction Finder			Transmitter	Receiver	Transmitter	Receiver	Transmitter	Receiver	
(f) Figures Indicate Distance in miles (Daylight)	Higher Frequency Bands	O-U 4000	O-S 3000	M-S 3000	(a) (g) M-S 3000 Key 500 Voice	(a) (g) M-S 2000 Key 200 Voice	(a) (g) M-Q 500 Key 100 Voice					(a) (g) N-O or Q 200 Key 50 Voice	(a) (g) N-Q 500 Key 100 Voice	(a) (g) N-R 3000	(a) (g) N-O or Q 200 Key 50 Voice					(a) M-V	(a) M-T	(a) M-Q	(a) N-Q	(a) M-R	(a) N-O or Q							M-O 30	(a) M-O	(a) M-Q 800 Key 100 Voice	(a) M-R			
	(l) Lower Frequency Bands				(l) G-L 800 Key	D-I 300 Key	(l) H-L 200 Key	(l) I-L 300	D-I 800	D-I 500	C-I 100		H-K 200 Key	G-I 300	K 200 Key			A-J	B-I	K-L	G-L	H-L	H-K	E-L		C-K	F-K				G-I	(l) H-L 800 Key	E-L			
1	Fleet (BB) Flags	2		3	1	1		1	1	2	1							6	2	9	2					1	1			1	1					-
2	Force Flagships	2		3	1			1	1	2(b)	1							6	2	9	2					1	1			1	1					2
3	BB and CC	1		3				1	1	2	1							5	2	6	2					1	1			1	1					3
4	CV and XCV	2		3	4(c)				2	1								6(c)	2	9(c)	2					2	1			1	1					4
5	CA, CL and XCL	1		3(c)	1				1	2								5(c)	2	6(c)	2					1	1			1	1					5
6	DL, DD and DM (m)			1		1				1								1	2	1	2					1										6
7	SS, SM (m)					1													1		1					1										7
8	OSS (m)					1													1		1															8
9	BM, PG, PY, and XPG (m)	1				1				1								1	2	1	2					1				1	1					9
10	PC, PD, PE, PG, PY, PZ (m) YP (under 1000 tons)						1												2		2	1														10
11	AD, AR, AS, AV, CM and all auxiliaries assigned flag		1	2	1(d)				1	1								4	2	5	2					1				1	1	1(j)	1(j)			11
12	AC, AE, AF, AG, AH, (m) AK, AO, AP and similar converted types.			1					1										2		2					1										12
13	AM, ASR, AT, AVP (m) AZ, XAM, XAT.					1(h)													1		1															13
14	ZR											1		1										2(e)												14
15	VP and VB (A) Shore or tender based.											1		1										2(e)								1(k)	1(k)			15
16	VB, VJ, VTB, VSO, and VSB											1(i)	1										1(e)		1(i)											16
17	VF											1													1(e)											17
18	VOS														1								1(e)													18
19	Advanced Bases	Sets other than Portable will be indicated in Statement of Problem.																												1	1					19
20																																				20

(a) Only one frequency at a time.
(b) On BBs, CAs, CLs and CVs. Others but one.
(c) Converted Types have two less.
(d) Two on AV.
(e) May be used as direction finder or homing device.
(f) Distance is maximum transmission in miles under favorable conditions by day. At night for Frequency Bands A-L maximum distance is double that given above. At night use of Frequency Bands M-V and at all times use of Frequency Bands O-V is attended by danger of abnormally long distance transmission.
(g) No equipment is provided for radio telephone transmission in Frequency Bands A-L. Aircraft sets may use either voice or telegraph in Frequency Bands N-V.
(h) Two on AVP.
(i) Two planes in each squadron and liaison planes.
(j) AV only.
(k) One for each squadron.
(l) Subject to shipboard D/F, except Frequency Band L.
(m) Only Squadron Flags can man more than one circuit during Chart Maneuvers, except by use of split phone reception.

USE OF FREQUENCY BAND LETTERS

The frequency bands are indicated in Table E-3 by letters which show the complete range of the set. For example: The set in Column 1 has a range of "O-U". This is inclusive, i.e., includes Bands O, P, Q, R, S, T, and U. Suppose it is desired to establish a 2000 mile (maximum) circuit on frequency Band P; any of the transmitters in Columns 1, 2, 3, 4, 5, and 13 could be used on this circuit. Transmitters in Columns 6 and 12 can operate on frequency "P", but do not have the required power (distance).

BAND LETTER	FREQUENCY	
V	26000 - 30000	High
U	23000 - 26000	
T	18100 - 23000	
S	13575 - 18100	
R	9050 - 13575	
Q	6000 - 9050	
P	4525 - 6000	
O	4000 - 4525	
N	3000 - 4000	Intermediate
M	2000 - 3000	
L	1500 - 2000	
K	1000 - 1500	
J	600 - 1000	
I	500 - 600	
H	350 - 500	
G	300 - 350	
F	250 - 300	
E	224 - 250	
D	175 - 224	
C	100 - 175	
B	15 - 100	Low
A	10 - 15	

For a brief general description of the Naval Employment of Frequencies, see Article 138, Communication Instructions, 1939.

TABLE E-4

	Words per minute
I. DRAFTING (Rule E-3)	
(1) All messages including recorded telephone message	10
(2) Number of messages which may be drafted simultaneously:	
Fleet and Force Flagships	3
Large and intermediate combatant type	2
All others	1
II. CODING AND DECODING (Rule E-4)	
(Rate given is for each process)	
(1) Contact Code or Signal Book. (Includes Aircraft Codes. See Rule E-4(e))	12
Code (spd) Held only By BB,CC,CV,CA, CL,CM,DL,DD,DM,AD,AR,AS,AV, and similar K-Types. District Commandants.	8*
Code Held by all commands.	2
(2) See Rule E-26 for effect of damage and gassing.	
(3) Number of messages which can be handled simultaneously same as for drafting.	
(**For Code (spd))	
(4) See Rule E-4(c) concerning actual use of Contact Code and Signal Books.	

III. CALLING, ANSWERING, HEADING, RECEIPTING.

Method	Minutes
Radio - I, F or G method	0
Radio - R method (more than 10 addressees)	2
Radio - R method.	1
Radio telephone	0
Visual	1
Sound	2*

* Only one message can be handled at a time except by O.T.C.
** Add 5 minutes for supersonic equipment (exception Rule E-21(a)).

IV. TRANSMISSION OF TEXT.

	Words per minute
Radio - plain language	15
Radio - code	10
Radio telephone - recorded	15
*Visual - Flag hoist	15
Visual - other means - plain language or code	8
Sound	5

*For Flag Signals only.

V. INTERNAL DELIVERY.

	Minutes
(1) *Radio - bridge circuit	0
Visual	0
Other methods	1

*For plain language, contact code, aircraft code and general signals only.

(2) Bridge radio circuits allowed as follows:

Flagships, large and intermediate types-3

Large, intermediate, and small combatant type -2

DL, DD, DM, ODD, ODM, AD, AR, AS, AV -1

NOTE: For each relay, in addition to repeating the times for call, heading and transmission of text, add one minute (Rule E-23(c)).

TABLE E-5

UNDERWATER SOUND

	EQUIPMENT					
	Supersonic echo-ranging & listening (b)	Supersonic listening	Sonic Listening	Supersonic transmitter-receiver	Sonic transmitter	
Distance (miles) for Communication	3			3	1	
DL and DD	2					
ODD	1					
SS (1100 tons and over)	1	1	1	1 (c)		
SS (under 1100 tons)	1					
OSS		1			1 (a)	
PC, ASR	1					

(a) Any vessel can hear this transmitter through the hull.

(b) Set can not be used simultaneously for echo-ranging and listening.

(c) Multi-directional.

FORM S-5
1940

MESSAGE

FROM: Commanding Officer (Title) CV-6 (Ship) J. Smith (Player) 132 (Room No.)

TO

*	Title	Player	Room No.	TOD
Z	C in C	B. Jones	154	0734
Q	Comscofor	L. Brown	156	0734
Q	Comairbatfor	W. Green	158	0731
Q	Comcardiv Two	F. Johnson	160	0728
Q	CO. CV-6	J. Smith	132	

"Q" - for Information.
"Z" - for Action.
*

TO BE FILLED IN BY UMPIRE

		Min.	Time
Words 19			
Coding		10	0715
Call & Head		0	
Text		2	0717
Decoding		10	
Delivery		1	
Each Relay		3	
Totals	No relay	23	0728
	1 relay	26	0731
	2 relays	29	0734

SENDER INDICATE BY CHECK

Plain Lang.	Urgent or Abb. Proced.	Radio V (Key)	R	F V	Radio (Voice)	Exec. at
Sig. Book, Con. Code, or Air Code	Priority V		G	I		
Code (Spd.) (See Table E-4-II)	Routine	Bridge Circuit: Visual			Flag / Other	Dist. 700
Code V	Deferred	Sound				
	Acknowledge	Wire				Circuit
		Carrier				Unit

Additional delay of ... min. in delivery to:

Reason:

Actual Time of release by Umpire: 1030 Sept 4

UMPIRES FILE No. 69

HEADING — — — — 020705 (Date and Time of Origin Group) — — — —

TEXT.

Damaged by air attack require extensive flight deck repairs and full complement planes comma proceeding PEARL HARBOR speed twelve

DO NOT USE BACK OF THIS BLANK FOR ADDITIONAL TEXT

Directions for preparing messages for duplication:— Place a sheet of the "special duplicating carbon," face up, under message blank, using celluloid sheet beneath both to provide a good hard writing surface. Write with a firm even pressure using ordinary No. 3 lead pencil (or any harder grade). The deposit of hextograph carbon (called the negative) on reverse side of message blank is the medium by which duplication is accomplished. Do not use common carbon.

Change No. 1.

INTRODUCTORY

Rule E-1. The actual means of effecting communications are:

(1) Visual,
(2) Radio,
(3) Sound,
(4) Wire,
(5) Carriers (postal, messengers, planes, etc.)

Rule E-2. (a) In War College maneuvers, except as provided in Rule E-16, players will transmit all messages to each other by means of Form S-5, indicating on this form which of the means listed in Rule E-1 is to be simulated. On this form, also, a player will fill out the other transmission instructions in accordance with the rules of this Section and will write his message in the space provided. The example on page e-6 should be used as a guide. A hard pencil, or typewriter, and the special carbon provided will be used in order to make an impression on the back of the form. It will then be sent to the Assistant Communication Umpire who will, based on the values in Table E-4, compute the game time or times of delivery, and will fill out the part of the message form designed for this purpose. The Marine orderlies on communication detail will then make sufficient copies and deliver one to each addressee at the computed game time of delivery.

(b) In order to obtain file copies of their own messages players will include themselves as information addressees on all messages sent.

(c) Players will be considered to be present in all parts of their command for which other players have not been assigned as subordinate commanders. It will therefore not be necessary to use the message form for communication within such a command, but proper regard should be had for existing capabilities and conditions in considering such communication to have been accomplished.

Rule E-3. The times for drafting and the number of messages which can be drafted simultaneously will be as specified in Table E-4(I). In initiating a message as a result of receiving a message or an information slip, a player will take the drafting time into account in assigning the "date and reference group" on his message.

Rule E-4. (a) In respect to codes, messages may be designated to be sent in the following forms which are listed in order of relative over-all speed of use:

(1) Plain language;

(2) Contact Code, Aircraft Code, Signals;

(3) Code (spd) Held only by BB,CC,CV,CA,CL,CM, DL,DD,DM,AD,AR,AS,AV and similar addressees. District Commandants.

(4) Code Held by all commands.

(b) The rates for the computation of coding and decoding times by the Assistant Communication Umpires will be as prescribed in Table E-4 (II). The number of messages which can be coded or decoded simultaneously on the various types of ships is the same as the number which can be prepared simultaneously. (Rule E-3).

(c) Players are assumed to possess necessary code and signal books. The Director may direct that appropriate messages be actually encoded from the Contact Code or Signal Books. When this is done the computed time for coding and decoding will be zero.

(d) When a Contact Code, Signal Book or Aircraft Code is designated in the transmission instructions, the form and subject matter must be such that the code designated could actually be used.

(e) Aircraft are assumed to have only the Contact Code and the Aircraft Codes. The time taken to code and decode messages in airplanes will be double that in ships (Table E-4 (II)).

(f) If special signals for radio direction finding are to be made, the text on the message form should be "Test for ____ minutes for direction finding". (Rules D-30, 31, 32).

(g) Players will invariably indicate on the message form what code is to be used.

Rule E-5. (a) Messages will be handled over any channel in their order of precedence, which is as follows:

Urgent, or abbreviated procedure,

Priority,

Routine,

Deferred,

Acknowledge.

(b) The urgent designation should be used with specially important signals or dispatches concerning battle or impending battle. It should always be used to report a first contact with any important enemy force and on all subsequent reports which represent vital new information rather than mere amplification.

(c) "Abbreviated procedure" is used with Contact Code, Signals and Aircraft Codes, and may be used also for other messages of great immediate importance.

(d) The "Priority" designation gives precedence over routine traffic, and should not be used without good reason.

(e) The designation "Deferred" is used for messages which do not require delivery before the beginning of office hours on the following day. They are transmitted, however, as soon as the circuit is cleared of traffic having a higher precedence, and at any rate in time for delivery as indicated above.

(f) Players will invariably indicate on the message form the procedure desired, and will indicate acknowledge if an acknowledgment is desired.

Rule E-6. Communications by various means (visual, radio, sound, etc.) can be conducted simultaneously except in airplanes where the same personnel handles both visual and radio.

RADIO

Rule E-7. (a) The methods employed for the transmission of messages by radio are, for key transmissions:

(1) Intercept ("I"),

(2) Broadcast ("F"),

(3) Receipt ("R"),

(4) Repeat back ("G"). (Normally used between shore stations sending messages for ships to copy in using the "I" method),

and for voice:

(5) Radio telephone.

(b) The times charged for calling, answering, heading, and receipting when using the above methods will be as given in Table E-4 (III).

(c) The rate of transmission by radio of messages in plain language or code will be as given in Table E-4 (IV).

(d) The times for internal delivery will be as given in Table E-4 (V).

(e) The number of radio circuits which may be used simultaneously will be determined as indicated in Rule E-8 below.

(f) The number of bridge radio circuits permitted will be as specified in Table E-4 (V).

(g) Players will invariably indicate on the message form what radio method and if bridge radio is to be used.

Rule E-8. (a) The number of radio transmitters and receivers carried by the various types of craft and the frequency range of each are given in Table E-3.

(b) Subject to the special rulings by the Communication Umpire as in (c) below, the number of radio circuits which can be fully guarded is equal to the number of transmitters on board. Other frequencies may be guarded for listening only until all the receivers on board are in use. (See Rule E-25(b) concerning bridge radio circuits).

(c) In chart maneuvers, if the number of circuits guarded continuously is considered to be greater than personnel considerations would permit, the Communication Umpire will require an appropriate reduction. This is in addition to the limitation imposed by Note (m) of Table E-3.

(d) Players will, for radio messages, invariably indicate on the message form the circuit designation to be used by the originating ship or shore station.

Rule E-9. (a) In order for jamming to be effective the plan must provide that each searching ship will search a frequency band not broader than 200 kcs. for frequencies of 2000 kcs. and below, and 1000 kcs. for frequencies above 2000 kcs. After two transmissions by an enemy within a frequency band which is being searched, any further transmissions two or more minutes in length on the same frequency may be jammed in accordance with the plan. The effectiveness of this jamming interference will depend, as indicated in (b) below, on the relative strength of the jamming signals, and will be decided by the Communication Umpire.

(b) The effect of interference will vary in accordance with the relative strengths of the interfering signals as heard by the receiving ship. If a transmission and the interfering signals are heard with equal strength, reception is impossible. A lesser degree of interference will have the effect of doubling the time of transmission of text as given in Table E-4 (IV).

(c) If included in the Statement of the Problem, for the purpose of illustrating a possible situation, one side may be considered to have a specially designed transmitter, which can be used to interrupt 20% of the enemy spotting frequencies for a period of 12 minutes from the time the interference is started. This interference cannot be started earlier than 6 minutes after commencement of gunfire. The Director will determine which spotting frequencies are interfered with during this period.

This interference will completely cut out all own radio communications and if not being made by the OTC, or on a time schedule, will require a visual signal to stop it.

Rule E-10. Shifting the frequency of a transmitter will involve the following delay:

(a) For ships, if the new frequency is one regularly assigned in the Commander's basic plan, none; if not so assigned, five minutes.

(b) For airplanes, any shift of frequency, five minutes.

Rule E-11. (a) The maximum reliable daylight transmission distance of each transmitter is given in Table E-3. See Table E-3 note (f) for transmission distances during darkness.

(b) For frequencies in Bands A-L (10-2000 kcs) these distances may be decreased by proportionate reduction in transmitter power. A player may indicate such reduction by the distance he prescribes on his message form. It will be assumed that the message can be read at a distance 10 percent greater and heard at a distance 20 percent greater than the distance thus prescribed by the player.

Rule E-12. (a) Rules D-30, D-31, and D-32 will govern radio direction finding.

(b) In order to penalize the excessive use of radio, in some manner approximating the harmful effects which would result in war, the approximate radio direction finder bearings of all ships sending or acknowledging messages, receipting for messages, or testing, may, at the discretion of the Director, be given the enemy commander, if any enemy vessel or shore radio station is qualified to take the bearings under Rules D-31(a), (2) (3).

(c) Only one bearing will be given on any one transmission.

Rule E-13. In order to emphasize the danger of indiscreet transmission of radio messages which may furnish information of value to the enemy, plain language messages and translations of approximately five percent of messages in contact code, signals and aircraft signals, and two percent of those in code (spd) or code, which might be intercepted, may, at the discretion of the Director, be furnished the enemy Commander.

Rule E-14. (a) Submarines submerged to a depth greater than periscope depth can neither transmit nor receive radio.

(b) At periscope depth, when its vertical antenna is exposed, a submarine can transmit and receive on frequencies in Band M and higher. When using the vertical antenna while submerged at periscope depth the effective distance of transmission will be one-fourth of the distance specified in Table E-3.

(c) If a player desires to arrange for submarines to hear their radio calls while submerged, listening periods must be planned and indicated on the flimsies. The Communication Umpire will decide from the existing conditions and the length of the periods arranged how many submarines hear their call in any one period.

Rule E-15. Special conditions for aircraft are contained in Rules E-4(e), E-6 and E-10(b).

VISUAL

Rule E-16. For chart maneuvers, when their respective forces are in company, players may hold oral communication instead of simulating visual communication by means of the message form.

Rule E-17. (a) The means and maximum distances for visual communication and the number of simultaneous transmissions permitted are as specified in Table E-2.

(b) Flaghoist can be used for signals only.

(c) Players will, for visual, invariably indicate on the message form whether flag-hoist or other method is to be used.

Rule E-18. (a) The time charged for visual calling, answering, heading and receipting will be as specified in Table E-4 (III).

(b) The rates of transmission of text by visual will be as given in Table E-4 (IV).

(c) The time of internal delivery for visual messages will be zero.

Rule E-19. (a) As the semaphore, blinker and searchlight methods are more or less directional, the Asst. Communication Umpire will judge from the positions of the addressees on the game board whether the number of transmissions required exceeds the number that can be made simultaneously by the sending unit, and will delay transmissions accordingly.

(b) For Flag signals, if there is not enough relative wind to make flags fly clear; or for flash signals, if there is considerable roll and pitch on the sending vessel, the Asst. Communication Umpire will charge appropriate delays in delivery.

SOUND

Rule E-20. (a) The underwater sound equipment on various types of craft and the distances at which it can be used for communication are shown in Table E-5. (The use of this equipment for detection is covered in Rule D-28).

(b) The effective distance of sound in air will be as given in Table E-2.

Rule 21. (a) The times and rates for underwater sound communication will be as given in Table E-4.

(b) Unless fitted with multidirectional installations vessels using supersonic equipment for communication will be charged 5 minutes for calling, etc, in addition to the values in Table E-4 (IV).

(c) Transmission by audio frequency oscillators can not be received through interference by other oscillators.

WIRE

Rule E-22. (a) Cable and land wire messages may be sent over existing lines, provided they do not traverse enemy country.

(b) A ship may send such a message one hour after arrival at the port where the message is to be sent, or it may be sent ashore at any time by any method available for transmission through a Naval Communication shore station.

(c) It must be addressed to a ship or station at a port or place named in the address, or to "Senafloat".

(d) It will be received at the place of address after an interval of two hours after sending.

(e) If any vessel or station of the same navy is in the port of address, the message will be delivered to the senior officer present one hour after its receipt.

(f) If the ship addressed is present, the senior officer present will forward the message to her immediately.

(g) If the ship addressed is not present, the senior officer present may relay the message under the same conditions as if it were an original message.

GENERAL

Rule E-23. (a) The total delivery period of a message as determined by the Asst. Communication Umpire by adding the various charges for coding, etc., represents the number of minutes from the time that the message reaches the communication office of the transmitting ship (time of origin) until it reaches the action officer of the receiving ship (time of delivery).

(b) The communication times and rates specified in Table E-4 are designed to represent those which actually obtain under average conditions. When unfavorable conditions are considered by an Asst. Communication Umpire to exist, he will, with the approval of the Communication Umpire, charge appropriate delays in the delivery of messages. (Rules E-9, E-19, E-26).

(c) Each relay entails a delay equal to the time of transmission of the text plus time for the call, heading, etc., plus one minute for changing the heading and recording.

(d) Messages designated to be sent on a circuit which is busy will receive additional delay until the circuit is clear. (See also Rule E-9).

(e) The nearest whole minute will be used for each computation.

(f) Players will invariably indicate a "date and time of origin" on the message form, which represents the time it is handed to the communication office.

(g) If tactical or other signals are not to be executed on receipt, the player will place the desired time of execution in the space provided on the message form.

Rule E-25. (a) The player detailed as the Commander of each side will be responsible for the preparation of a communication plan for his force.

(b) The plan will include the frequency plan (see Table E-3) and should designate which frequencies will be guarded on bridge radio circuits. The number of such circuits available on the various types of ships is specified in Table E-4 (V). Only messages in plain language, contact code, aircraft code and signals may be delivered from these circuits.

(c) The plan should include the arrangements for communication with shore. If intercept schedules are provided, the stations participating and the times and the circuit designation will be specified. (See Table E-3).

(d) For purposes of the maneuver, probable addressees may be grouped into distribution lists labelled "A", "B", etc.; which will be issued as a separate and unconfidential annex to the communication plan. Such lists will include the game titles, the actual names and the room numbers of the listed addressees. When appropriate, these lists may be designated in the address of

a message instead of filling in the individual titles, names and room numbers.

Rule E-26. (a) Above-water damage to a vessel will affect its communications as follows (Rule F-23):

(1) 30%: the time of coding outgoing messages or of decoding incoming messages will be doubled.

(2) 50%: cannot transmit radio on frequencies 2000 kcs. and below. (Bands A to L inclusive).

(3) 70%: cannot transmit radio.

(4) 80% total damage: cannot transmit or receive radio or flag hoist.

(b) The gassing of a vessel (Rule K-9(d)) will result in doubling the time of coding outgoing messages or of decoding incoming messages during the first hour, and in quadrupling these times thereafter until the contamination is removed in accordance with Rule K-10.

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SECTION F - GUNFIRE

SECTION F - GUNFIRE

Rule F-1. Naval War College gunfire rules are designed to express what may be expected to occur in actual practice under average conditions. In many instances the rules are arbitrary assumptions, based either on average or expected conditions for purposes of simplicity in scoring gunfire, or on a reasonable estimato of conditions for which there is no factual or single mathematical basis. In view of the above, while an approach is made towards average actual conditions in an endeavor to afford a comparative basis, there is no assurance implied that the rules which follow can be interpreted as factual.

Rule F-2. FIRE CONTROL CONDITIONS. Conditions for control of gunfire will apply as follows:

Gunlaying:	Director; Stable zenith director (or element) and generated bearing; Pointer.
Spot:	Top spot; Plane spot; Local control.
Method:	Direct; Indirect; Barrage; Bombardment.

(a) GUNLAYING.

(1) Director fire may be used, subject to loss through damage, by main, secondary and anti-aircraft batteries of large and intermediate size fighting ships, and by main batteries of small size and of destroyer size fighting ships.

(2) Stable zenith director (or the equivalent stabilized line of sight on the horizon) and generated bearing for indirect fire may be used, subject to loss through damage, by main batteries of capital ships, heavy cruisers, new light cruisers, destroyer leaders and new destroyers and for anti-aircraft batteries of the above plus aircraft carriers and less destroyer leaders.

(3) Pointer fire must be used by ships not equipped with director systems, or which, because of damage, lose their director systems.

(b) SPOT.

(1) Top spot may be used by all types except submarines, until lost by damage.

(2) Plane spot may be used, subject to loss through damage, for the main battery of a director ship, provided:

Definite assignments of spotting plane(s) for the ship and definite communication provisions have been made;

At least one spotting plane allotted to that ship alone is in spotting position and can distinguish the ship's target and the ship's splashes. To be in spotting position a plane must not be farther from the target than two miles less than recognition range as given in visibility tables (D-4) and at an altitude of at least 1000 feet unless more than 20,000 yards from the target, in which case the altitude of the plane must be at least 2500 feet.

For limitations of air spot if target is protected by a Chemical Blanket Screen see Rule K-15.

(3) Local control must be used by submarines, by other types that lose plane, top and low position spot through damage (F-23(e), (f)), or by other types that fire guns in excess of those that can be controlled from prescribed control stations. (F-13(a)).

(c) METHOD.

(1) Direct method is that by which a ship fires on a selected target visible to her. Fire by direct method may be used either with director, (stable zenith or equivalent in elevation) or pointer gunlaying.

(2) Indirect method is that by which a ship fires at a selected target not visible to her with detached observation.

Ships equipped with stable zenith director (or element) and means of generating bearing with auxiliary means of receiving bearings, and with plane spot, can use indirect fire. If in order to establish indirect fire a plane is employed to obtain bearings, the latter may be obtained by visual or radio methods. One plane may be used to establish the line of bearing for a group consisting of not more than four ships in formation whose targets consist of a division of ships or less in formation. In using either method, bearing planes must be in position to indicate the bearing of the target; and estimate of range must be obtained from bearing or spotting plane; and plane spot must be available. For visual method, bearing plane also must be able to see and distinguish both firing ship and target, and firing ship must be able to see and distinguish bearing plane. For radio method, bearing plane must be able to transmit radio signals on pre-arranged frequencies, and firing ship must be able to take approximately accurate radio direction finder bearings of plane's transmissions.

Other director ships can use indirect method, provided,

plane spot is available;
the target is fixed (not moving); and
a fixed point of aim is available, bearing within five degrees of the target;
or
a clear sea horizon exists on the opposite bearing from the target.

Shore batteries can use indirect method of fire provided plane spot is available, or target is visible from on established observation station.

(3) Barrage method is that by which a ship fires with a fixed gun range in the direction of a selected point of aim visible from the firing ship, with the purpose of having the target pass through the barrage thus laid, or of confusing enemy fire control. Barrage fire may be used with either pointer or director gunlaying.

(4) Bombardment method is that by which a ship fires, without the necessity of observing the fall of shot, into a specified area, with the purpose of inflicting damage on targets in that area. It may be used only against shore targets or ships at anchor.

Ships using stable zenith director (or element) and generated bearing can use bombardment method with predetermined compass bearings and gun ranges.

All director ships can use bombardment method, provided auxiliary point of aim is available.

Rule F-3. MEASUREMENT OF GUNFIRE.

(a) Range, target angle and bearing for ship or shore gunfire normally are measured from ship positions at the end of a move, except as provided below in sub-paragraph (e), or in special cases to be determined by the Director. For purposes of scoring gunfire, all moves, of whatever length, are divided into three-minute increments unless smaller increments are necessary for scoring extremely short-range actions.

(b) Range is the distance in thousands of yards from firing ship or shore battery to target. Actual ranges of 0 to 1500 yards are considered as a range of 1; 1500 to 2500, as a range of 2; etc. The maximum range imposed on each type of gun by its mounting is as given in the "Fleets" for ship guns. For shore batteries maximum ranges are established as follows:

Caliber	Range	Caliber	Range
		7" tractor	22000
16"	44000	155 mm gun	17000
14"	35000	155 mm howitzer	12000
12"	27000	105 mm howitzer	12000
6"	19000	75 mm gun	11000
		75 mm pack how.	8000
		3" AA(against land or water target)	13000

(c) Target angle at the Naval War College, for purposes of scoring gunfire, is measured as the angle between the line of fire and the keel line of the target ship. With the target broadside, target angle is 90°, for end on 0°. In order to determine whether hits are penetrative or non-penetrative against

vertical armor, target angle between 0° and 90° is recorded as the nearest multiple of 45 degrees. Penetration of deck armor is independent of target angle.

(d) Bearing is measured in relative degrees in order to determine the portion of the battery that will bear on the target.

(e) Special cases of measurement of gunfire.

(1) Fire of, or on, ships of the destroyer class is measured from the center of divisions (or half flotillas).

(2) When fire is masked by a smoke screen, or by interposition of ships, it is measured proportional to the time it is masked.

(3) In measuring fire by bombardment method, target areas will be as designated by the firing ship commander in one or more "100-yard squares", each square measuring 100 yards on a side. If the target is within one (or more) of the designated squares, it will be subject to damage.

Rule F-4. BASIC CONDITIONS FOR DETERMINING FIRE EFFECT.

(a) Basic conditions for determining fire effect are as follows:

THE SHIP IS UNDAMAGED, HAS NO LIST, AND IS IN NORMAL TRIM.

(1) Fire is not masked.
(2) The ship is firing by direct method.
(3) The range has been established.
(4) The target remains the same as during the preceding move.
(5) The fire of the ship is not divided.
(6) No other ship is firing at the same target.
(7) The main battery only is in use.
(8) The ship is under normal fire.
(9) There is no enfilade fire.
(10) The ship is on a steady course at a constant speed.
(11) The target does not change course or speed.
(12) The rate of change of range is small.
(13) Yaw, roll and pitch are not excessive.
(14) The visibility conditions are good; no spray, no smoke or gas interference, no sunglare or silhouette.

(b) Fire effect for the basic conditions, above, is contained in "Fire Effect Tables" and "Fire Effect Diagrams", and is expressed in terms of equivalent 14" penetrative hits per three-minute move. In both publications, fire effect values are given for conditions of director gunlaying, top (and plane) spot, and direct method of fire.

(1) The "Fire Effect Tables" are designed to set forth the expected average fire effect FOR ONE GUN of each type used afloat, at ranges within the practical limits of that gun against each class of target. Percentage bonuses are provided for deck penetration, and for deck and side penetration. Rates of fire for guns are tabulated in terms of rounds per gun per three-minute move. To use the "Tables" it is necessary to consult "Fleets" for types and numbers of firing ship guns, firing ship ammunition allowance, size-class of target, thickness of target armor, and target life.

The "Fire Effect Diagrams" have been compiled from data contained in the "Fire Effect Tables" and "Fleets" in order to facilitate obtaining fire effect of specific ships against specific targets. The "Diagrams" show, normally for main battery only, the expected, average fire effect FOR FULL BROADSIDE. Other data contained in the "Tables" and "Fleets" have been incorporated graphically into the "Diagrams".

(2) Fire effect of auxiliaries and armed merchantmen is 50% of that shown in the "Fire Effect Tables", because of relative inefficiency of fire control installation when compared with that of combatant ships.

(3) No distinction is made in the "Fire Effect Tables" or "Fire Effect Diagrams" between director and pointer fire (gunlaying), but director fire is less penalized, as shown later, by certain firing conditions.

Rule F-5. FIRE EFFECT FOR CONDITIONS OTHER THAN BASIC will be that shown in the "Fire Effect Tables" or "Fire Effect Diagrams", subject to an increase or decrease of a number of tenths in three successive corrections as follows:

Correction I. For remaining fire effect after damage is received.

Correction II. For conditions affecting own rapidity of fire.

Correction III. For conditions affecting own accuracy of fire.

DESCRIPTION OF, AND CORRECTIONS FOR, NON-BASIC CONDITIONS.

CORRECTION I. For Remaining Fire Effect.

Rule F-6. The potential value of fire effect, as shown in the "Fire Effect Tables" or "Fire Effect Diagrams", is reduced one-tenth for each ten per cent of above-water damage received from gunfire or bombs.

Rule F-7. Independently of, and in addition to, other reductions,

(a) The shock effect of a torpedo or mine hit, or of heavy bomb hits resulting in underwater damage equivalent to at least 1.8 14" hits, will render a ship incapable of using her weapons for three minutes thereafter;

(b) Ships subjected to effective strafing attacks by the equivalent of twelve VF airplanes, each carrying one .30 caliber and one .50 caliber machine gun, and two 100-pound bombs, will for the remainder of that day, have their remaining fire effect reduced as follows:

(1) turret guns, 10%;
(2) secondary battery guns by 20%;
(3) anti-aircraft battery guns by 30%.

CORRECTION II. For Conditions Affecting Rapidity of Fire.
CORRECTION III. For Conditions Affecting Accuracy of Fire.

Rule F-8. FIRE MASKED.

(a) In the following situations, fire is considered as masked, and the Director will reduce the fire effect of ships during a move by a number of tenths in proportion to the time masked: (Corr. II).

(1) When ships attempt to fire over ships of their own or larger size which are 1000 yards or less from them, or over ships of smaller size which are 700 yards or less from them, or over any physical obstruction where the angle of elevation will not carry projectiles well over such intervening obstruction;

(2) When, if firing by direct method, a ship's fire will be halted by interposition of an effective smoke screen.

(b) When more than four ships are proceeding in a line of bearing of more than 15°, their fire will be masked progressively:

if they open fire or continue fire on the third move after they have first maneuvered into that line of bearing, unless it is evident that the situation is such that errors in station keeping cannot mask the fire.

The penalty will be one tenth for ships whose fire is masked during the third move after the formation is first maneuvered into line of bearing; in the fourth move, two tenths; in the fifth, three tenths; and in the sixth and succeeding moves four tenths.

Rule F-9. ESTABLISHMENT OF FIRE.

(a) The range may be established, if

it is within the maximum range of the battery; the "Fire Effect Tables" (or "Fire Effect Diagrams") give more than zero effect;

and, in addition, if

(1) for direct method, requirements of Rule F-2(c)(1) are met;
(2) for indirect method, requirements of Rule F-2(c)(2) are met;

(3) for barrage method, requirements of Rule F-2(c)(3) are met, and a feasible plan is submitted by the player to the Director;
(4) for bombardment method, requirements of Rule F-2(c)(4) are met, and a feasible plan is submitted by the player to the Director.

(b) During the move in which gunfire is opened in establishing the range, fire effect is reduced, in tenths, for ranging before the target is straddled, as follows:

(1) For direct method: (Corr. III).

	Range	0-5	6-10	11-15	16-20	21-25	26-30	31 plus
	Top	0	1	2	4	6	9	10
Spot	Plane	0	1	2	3	4	5	6

In addition to, and independently of the foregoing reduction, when fire is opened by direct method on a target which has just appeared in view of the firing ship, the time required to get the battery on in train and to set up the fire control problem will reduce the fire effect for that move, for surprise fire, three-tenths. (Corr. II)

(2) For indirect method: 10. (Corr. III)

(3) For barrage method: same as for direct.

(4) For bombardment method: 0, except for surprise fire penalty as described above under direct method.

Rule F-10. CONTINUATION OF FIRE.

(a) For direct, barrage or bombardment methods, reduction is made for continuation of fire on the same target, as follows:

If a stable zenith director ship (Rule F-2(a)) not using plane spot which is firing by direct method and has established the range loses sight of her target, she may continue to fire, by continuation fire, using stable zenith director and generated bearing, and basing her fire control on the assumption that the target holds the same course and speed as determined while in sight. Such continuation fire will be reduced four tenths during the first move after the target is lost to view, and ten-tenths during succeeding moves unless the target reappears.

(b) For indirect method, the following obtains:

(1) The range having been established by direct method, the fire may at any time be continued by indirect method, subject to Rule F-2(c)(2).

(2) Fire by indirect method, in moves after the range has been established by either direct or indirect methods, will be reduced by three-tenths for imperfect control in azimuth. (Corr. III)

Rule F-11. RE-ESTABLISHMENT OF FIRE.

(a) When using indirect method, ships which have ceased fire for one or more moves must, on re-opening fire, re-establish the range. Fire effect for the move in which fire is re-established by indirect method will be reduced the same as for open-fire, namely, by ten-tenths. (Corr. III)

(b) When using other than indirect method, ships which have ceased fire for one or more moves must, on re-opening fire on the same or a new target, re-establish the range and be subject to open-fire penalty (F-9(b)), unless the following conditions obtain, in which case no open-fire penalty is invoked:

(1) New line of fire is within 15 degrees of that previously used;

(2) New range is within 4,000 yards of that previously used;

(3) Not more than 15 minutes have elapsed since previous effective fire;

(4) Range is not greater than:
25 for BB or CC,
15 for other large or intermediate size fighting types,
10 for small fighting types;

(5) Ship has not been subject to penalty for reduced visibility (F-21(c)) during last firing move or is not so subject on re-opening fire.

Rule F-12. SHIFTING OF FIRE.

(a) With indirect method, the fire of a battery cannot be shifted more often than once in four moves.

(b) When fire by any method is shifted to a new target, a penalty will be applied to the fire effect for that move, as follows:

Three-tenths at ranges above 11,000
Two-tenths from 6,000 to 10,000 yards,
One-tenth from 0 to 5,000 yards,

unless the new target is adjacent to the old, in which case there is no penalty. (Corr. II).

For game-board purposes, to be considered as adjacent targets, ships must be in the same formation and not more than 1,500 yards apart. Not more than three vessels can be considered as adjacent vessels. Shore targets are considered adjacent if not more than 1,000 yards apart.

(c) In addition to the foregoing penalty for shifting fire, vessels will be subject to open-fire penalty (Rule F-9(b)), if:

The difference in range from old to new target is over 4,000 yards; or
The change in target bearing is more than 15 degrees; or
New target is on a materially different course or speed from the old. (Corr. III).

Rule F-13. FIRE DISTRIBUTION.

(a) Divided Fire.

(1) To divide the fire of a ship's battery on two targets, the guns firing on each target must be controlled as separate groups.

(2) Divided fire by bombardment method is not subject to penalty. For other than bombardment method, divided fire will be subject to limitation or reduction as set forth in the following four sub-paragraphs.

(3) Fire of main batteries of capital ships and cruisers may be divided, forward and after turret groups firing either on the same side or opposite sides, turret groups to be under the direction of two separate primary control stations. Such divided fire is subject to the following:

The fire effect of guns in excess of the number that can be controlled from primary stations concerned will be reduced for conditions of local control. (F-13(e)); (Corr. III).

For divided fire on adjacent targets (F-12(b)), there will be no loss in effectiveness, the conditions of spot for each group governing the resultant normal fire effect;

For divided fire on non-adjacent targets, indirect method cannot be used for both. In all cases there will be no loss in effectiveness of the forward group, the condition of spot for this group governing the resultant normal fire effect; but for the after group, fire effect will be reduced two-tenths, the condition for spot of this group governing the resultant normal fire effect. (Corr.III).

(4) Fire of the after group of main battery guns of other than capital ships or cruisers will, if the fire is divided, be reduced for conditions of local control. (F-13(e)) (Corr. III).

(5) The secondary battery of capital ships and the anti-aircraft battery of CVs may divide fire into four groups, each separately controlled, without loss of effectiveness. (Corr. III).

(6) The anti-aircraft battery of capital ships and the secondary (or anti-aircraft) battery of other types (except CVs) are considered to have but two effective control stations. If the fire of such batteries be divided on non-adjacent targets (F-12(b)), the fire of guns not controlled by the single

primary control station on each side will be reduced for conditions of local control. (F-13(c)). (Corr. III).

(b) Over-concentration.

(1) Concentration of fire on the same target by the batteries of more than two ships may result in spotting difficulties, and may be subject, except in the case of fire by bombardment method, to penalty for over-concentration. In this connection, for game-board scoring purposes, a division (or half flotilla) of destroyers normally is considered as a firing unit (or ship) for that type of ship; a flotilla (or squadron) destroyer leader is considered as a separate firing ship.

(2) No penalty will be assigned a ship for over-concentration during daylight, if the fire is by direct method, under the following conditions:

Caliber firing	Range
11" and above	11 and below.
8" and to 11"	9 and below.
5" and to 8" (except DD and AA batteries). . . .	6 and below.
4"-7-5" (except secondary battery of capital ships)	4 and below.
4" and minus	3 and below.

During night, the foregoing ranges will be divided to the nearest (lower) half.

(3) Penalties for over-concentration of main batteries during daylight, except for fire at and under range limits shown in subparagraph (2), above, and for fire against destroyers, are as follows: (Corr. III).

> The fire effect of each ship of a number consisting of more than two capital ships (or 8" gun cruisers) firing at the same target, will be reduced n minus one tenths, where n equals the total number of ships firing.

If a capital ship (or an 8"-gun cruiser) and one ship of any other type are concentrating on the same target, neither of the respective ships will be penalized.

The fire effect of each ship of a number consisting of more than two of any type (other than capital ships or 8"-gun cruisers) firing on the same target, will be reduced n tenths, where n equals the number of ships firing.

During night, penalties noted above will be doubled.

(4) Concentration of fire against destroyers by the main batteries of destroyers and the main, secondary or anti-aircraft batteries of larger ships, or by a combination of the batteries of any ships, may be subject to penalty for overconcentration. For game-board scoring purposes in this case, each destroyer in a division (or half flotilla) under fire is counted as a separate target for determining the degree of concentration.

If the number of separately-controlled batteries firing is not greater than twice the number of targets, there is no penalty for over-concentration.

If the number of separately-controlled batteries firing exceeds twice the number of targets, a penalty for over-concentration exists. This penalty is equal to n tenths, where n equals the number of batteries divided by the number of targets, any fraction in the result being considered as the next higher whole number. The penalty n will be applied, in the case of a division of destroyers firing, against the fire effect of the entire division; and, in the case of batteries of larger ships, against the fire effect of each separately-controlled battery. (Corr. III).

During night, penalties noted above will be doubled.

(c) Battery Interference. When main and secondary (or anti-aircraft) batteries of turret ships are firing on the same side, the fire of the secondary (or anti-aircraft) battery on that side will be reduced for any method of fire, day or night, four-tenths; and the fire effect, direct method, of main battery at night will be reduced three tenths. (Corr. II).

(d) Anti-aircraft Battery Fire. For fire of anti-aircraft battery guns against aircraft, see Rule J-16.

(e) Local Control. When using direct method, fire effect will be reduced, in tenths, for conditions of local control as follows in accordance with restrictions to fire control equipment or control stations (F-2(b)(3) and F-13(a)), and with damage received (F-23(e), (f)):

Range	Penalty
0-5	0
6-10	2
11-15	4
16-20	6
21-25	8
26-30	10
31 plus	10

(Corr. III).

Rule F-14. EFFECT OF ENEMY FIRE.

(a) The volume and accuracy of a ship's fire vary according to the intensity of enemy fire directed against her, the essentials of which intensity, when well-directed, vary with the type of ship under fire, the number of enemy guns per salvo, the caliber of enemy guns, and the frequency of enemy salvos.

(b) For purposes of scoring gunfire on the game-board, a ship is considered to be under one of the four degrees of intensity of fire described below. In this connection, a division (or half flotilla) of destroyers normally is considered as a target unit (or ship); a flotilla (or squadron) destroyer leader normally is considered as a separate target.

(1) Under normal fire, when under fire of the main battery, as shown in "Fleets" of a ship (or ships) of her own general type; provided the main battery (or batteries) firing on her is at least two-thirds and less than four thirds the number of main battery guns with which she is capable of returning the fire. (Exception: one 10 or 12-gun BB under fire of one 6-gun CC is considered to be under normal fire).

(2) Under a concentration, when under fire of the main batteries of two or more enemy ships of her own general type (or of a different type), provided the guns firing on her are at least four-thirds the number of main battery guns with which she is capable of returning the fire. (Exception: one 10 or 12-gun BB under fire of two 6-gun CCs is considered to be under a concentration). When under the concentration of n ships, the fire effect of the ship under a concentration will be decreased by n minus one tenths for turret batteries, by n tenths for exposed batteries. (Corr. II).

(3) Under less than normal fire, when under effective fire of the main batteries of ships of her own general type, and the number of guns firing on her from these ships is less than two-thirds the number ofmain battery guns with which she is capable of returning the fire. (Exception: a 6-gun CC is considered as delivering less than normal fire when firing but 4 guns). The fire effect of a ship under less than normal fire will be increased one-tenth. (Corr. II).

(4) Not under effective fire, when the number of enemy main battery guns firing on her is two or less. The fire effect of a ship not under effective fire will be increased two-tenths. (Corr. II).

(For those cases which do not seem to be adequately covered by the foregoing, decisions will be made by the Director, either on request in advance of situations, or at the time situations arise. In these decisions, due consideration will be given the practical limitations on fire control and fire distribution).

(c) Independently of and in addition to the provisions of sub-paragraph (b), above, a firing ship under fire of a number of guns appreciably smaller in caliber than those of her own main battery will have her fire effect decreased one-tenth for being under minor fire, provided the volume of such minor fire is at least that of the following number of guns:

Caliber	Number
7".5 to 10"	8
5" to 6"	14
Under 5"	20

(Corr. II).

(d) When a ship, other than the target ship, is under fire by any method except bombardment, she is liable to damage by enfilade. To be subject to damage by enfilade, a vessel must be within 100 yards of the line of fire, and within 1000 yards of the target. (For method of scoring enfilade fire, see Rule F-22 (a)(3)). (Corr.III).

Rule F-15. EFFECT OF CHEMICAL GASES.

For the effect on chemical agents on reducing gunfire, see Rules K-9, K-11, K-13.

Rule F-16. EFFECT OF CHANGE OF COURSE.

(a) By firing ship. Change of course during a move by a firing ship reduces her fire effect for that move, in tenths, as follows:

(1) When using director lay:

	Degrees Change						
	0-30	31-50	51-70	71-90	91-110	111-130	etc.
Penalty:	0	1	2	3	4	5	etc.

(Corr. II).

(2) When using pointer lay:

	Degrees Change						
	0-10	11-20	21-30	31-40	41-50	51-60	etc.
Penalty:	0	1	2	3	4	5	etc.

(Corr. II).

(3) When using indirect method:

Same penalties as for pointer lay. (Corr.III).

(b) By target ship. If a target ship changes course during a move, the fire effect of ship(s) firing on her is reduced, in tenths, as follows: (Corr. III).

(1) Fire of main battery of BBs, CCs, CAs or CLs by direct or barrage methods, with plane spot:

Target speed	Degrees Change 15-30	31-44	45-59	60-74	75-89	90
6-10	0	0	0	1	1	-
11-21	0	0	1	2	3	3
22-29	1	1	2	3	4	4
30	1	2	3	3	5	5

(2) Increase the foregoing penalties one-tenth, if

Fire of main battery of BBs, CCs, CAs or CLs by direct or barrage methods is with top spot at ranges over 16,000;

Fire by direct or barrage methods is with batteries other than the main batteries of BBs, CCs, CAs or CLs.

(3) For fire by indirect method, double the penalties shown in sub-paragraph (1), above.

(4) For fire by bombardment method, no penalty.

(c) For changes of course by firing or target ships, during night or low visibility, see Rule F-19.

Rule F-17. EFFECT OF CHANGE OF SPEED.

(a) By firing ship. If a firing ship changes speed during a move her fire effect is reduced, in tenths, for each 4 knots as follows: (Corr. III).

(1) When using direct or barrage method, one tenth;

(2) When using indirect method, two-tenths;

(3) When using bombardment method, no penalty.

(b) By target ship. If a target ship changes speed during a move, the fire effect of ships firing on her will be reduced, in tenths, for each 2 knots, as shown in sub-paragraph (a), above, provided the range is greater than 5,000 yards. (Corr. III).

(c) For changes of speed by firing or target ships during night or low visibility, see Rule F-19.

Rule F-18. EFFECT OF CHANGE OF RANGE.

(a) Rate of change of range may reduce the fire effect, dependent upon the amount of change. For game-board purposes, the following will obtain:

(1) Change of less than 2,000 yards in range per move will not reduce fire effect;

(2) If a ship has penalties imposed on her fire effect for shifting of fire and open-fire (Rule F-12(c)), no change of range penalty will be invoked.

(3) For rate of change of range of 2,000 yards or greater per move, the following reduction, in tenths, will be made to fire effect of ships using direct, barrage or indirect methods: (Corr.III).

3 minute rate	Direct, or Barrage: Range			Indirect: Any Range
	0-5	6-20	21	
2	0	1	2	3
3	1	2	4	6
4	2	3	6	9
5	3	4	8	10

(4) No change of range penalty is invoked against ships firing by bombardment method.

(b) For changes of range during night or low visibility, see Rule F-19, following.

Rule F-19. EFFECT OF CHANGES IN COURSE, SPEED OR RANGE DURING NIGHT OR LOW VISIBILITY.

(a) Following a night or low visibility contact, a ship firing at close range may experience very rapid change of relative bearing and range of the target, due to the relative course and speeds of firing and target ships. This may seriously interfere with the rapidity and accuracy of the fire, may interfere with illumination, and may make it impossible for the firing ship to pick up and follow the target with her battery.

(b) Taking into consideration the above factors, penalties to reduce fire effect may be assigned by the Director. (Corrs.II and III).

Rule F-20. EFFECT OF SEA ON STEADINESS OF FIRING CONDITIONS.

(a) When the character and direction of the sea are such as to cause a firing ship to pitch, roll or yaw more than usual, the effect on gunlaying and ammunition handling may slow the fire. For game-board purposes, penalties to a ship's fire effect are assigned for moderate, rough and heavy sea conditions (A-7):

(1) For pitch when the sea is from a direction 20 degrees or less from ahead;

(2) For roll when the sea is from a direction between 15 degrees forward of the beam and 60 degrees abaft the beam;

(3) For yaw when the sea is from a direction 30 degrees or less from astern.

(b) Fire effect for conditions of pitch, roll or yaw is reduced, in tenths, as follows, when using any method:

Pitch:

State of Sea	Ship size: Large	Inter.	Other
Moderate	1	2	3
Rough	2	3	4
Heavy	3	4	5

Roll: Same as for Pitch, except add 2 if using other than director or stable zenith director lay.

Yaw: Add 2 to penalties shown for Pitch. (Corr. II).

Rule F-21. VISIBILITY CONDITIONS.

(a) Sun-glare.

(1) When a ship is firing into the glare of the sun, the accuracy of her fire is reduced when using direct method, or when using indirect method with visual bearing plane. The sun-glare penalty is operative if the sky is clear during the two hours after sunrise and the two hours preceding sunset, when the target bears within 15 degrees of the sun.

(2) The sun-glare penalty reduces fire effect:

When using director lay, one-tenth;
When using pointer lay, or indirect method with visual bearing plane, three-tenths. (Corr. III).

(b) Silhouette.

(1) A target ship is judged to be silhouetted against the horizon when bearing within 30 degrees of the sun:

During the twilight period (one-half hour before sunrise, or one-half hour after sunset) if sky is clear;
During the sun-glare period (two hours after sunrise or two hours preceding sunset) if there is a haze or a cloudy sky, in degree decided by the Director.

(2) When the target ship is silhouetted, a firing ship using direct method against her will not be penalized for reduced visibility (see sub-paragraph (c), following), but will have her fire effect increased two-tenths. (Corr. III).

(c) Gases and Funnel Smoke.

(1) When using direct method, the fire effect of a ship is penalized if, owing to the relation between her course and speed and the direction and force of the wind, gun gases, funnel gases, or funnel smoke from the firing ship or other nearby ships drift across the line of her fire.

(2) The gas penalty, effective when gases but no funnel smoke so intervenes, is the reduction of fire effect one-tenth. (Corr. III).

(3) The smoke penalty, effective when funnel smoke intervenes -- at speeds within two knots of maximum speed for oil-burning ships (at all speeds for coal-burning ships) -- is the reduction of fire effect by day of three-tenths; by night of five tenths. (Corr. II).

(d) Spray.

(1) When, owing to the character and direction of the sea and wind with relation to the course and speed of a

ship firing by direct method, spray is thrown over gun positions, the fire effect of such ship may be reduced. For gameboard purposes, the spray penalty is operative when the wind has a force of 4 or more, and its true direction is from 15 degrees forward of the beam to dead ahead on the engaged side.

(2) For ships using director or stable zenith director lay, direct method, the spray penalty is not effective with regard to the fire of turret guns.

(3) With the exception of the case noted in the foregoing sub-paragraph, the spray penalty reduces fire effect two-tenths. (Corr. II).

(e) Effect of Visibility on Range Limits.

(1) Visibility conditions better than normal will not increase fire effect.

(2) A ship cannot fire by direct method at a range exceeding the range of visibility, as posted and kept current for game maneuvers.

(3) With direct method, top spot, during daylight at ranges greater than 5,000 yards, when the gun range is within 4,000 yards of the range of visibility, the maximum value, in tenths, of Multiplier III (see Rule F-22) for computation of fire effect is as follows:

Visibility minus gun range	Max. Value Multiplier III.
0	5
1	6
2	7
3	8
4	9
5	10

With plane spot, no penalty is assigned for limited visibility.

(4) With direct method, during night, fire effect is curtailed on account of difficulties in spotting and control. The outside range limits of visibility for gunfire purposes at night are given in Rules D-4, D-6, D-11, D-17 and D-21. Within these limits, night fire effect will be computed the same as for daylight, except the maximum value, in tenths, of Multiplier III (Rule F-22) will be as follows:

Range	With Star Shell or Flare Illumination (A)						With Searchlight Illumination Only Or in Combination With Star Shell (or flares) Add to (A)	With no Artificial Illumination. Subtract from(A)
	BB,CC: Main	CA,CV :8" 7"5	CL :CV	DL :DD	BB :Sec	:Other		
13-15	1	0	0	0	0	0	-1	1
11-12	2	1	0	0	0	0	-2	2
10	3	2	2	0	2	0	-3	2
9	3	2	2	0	2	0	0	2
7-8	4	3	3	1	3	0	0	2
5-6	5	4	4	2	4	1	plus 1	2
3-4	5	4	4	3	4	2	" 2	1
0-2	4	3	3	2	3	1	" 3	0

Rule F-22. METHOD OF SCORING GUNFIRE.

(a) Between Ships. (Except by bombardment method).

(1) Corrections to fire effect are converted in the following manner as a first step in obtaining fire effect inflicted:

Correction I is the above-water damage in tenths on the firing ship at the end of the preceding move, plus any damage inflicted by strafing attack (F-7): or is the shock effect (F-7) applicable to the succeeding move after the shock occurs;
Corrections II and III are each the sums, in tenths, of the penalties or bonuses incurred affecting, respectively, rapidity and accuracy of fire; (tabulated for reference at end of Section F);
Multipliers for Corrections I, II and III are equal to ten-tenths minus each Correction total;
Final Multiplier is the product of multipliers for Corrections I, II and III.

(2) Fire effect inflicted is, with the exception of Enfilade Fire (F-14(d)), the product of Final Multiplier, and Fire Effect as taken from "Fire Effect Tables" (for the number of guns that bear) or "Fire Effect Diagrams" (for the percentage of the broadside that bears).

(3) Fire effect inflicted by Enfilade is additive to that which may be inflicted by other means, and is scored as follows:

From the "Fire Effect Tables" or "Fire Effect Diagrams" is taken the fire effect of firing ship against the ship enfiladed at the range existing between firing ship and target ship;
This fire effect is reduced to enfilade fire effect by application of a multiplier, as shown below:

Distance between Target and Enfiladed Ships	Multiplier (in tenths)
0-200	8
201-300	7
301-400	6
401-500	5
501-600	4
601-700	3
701-800	2
801-1000	1

Fire effect inflicted on the enfiladed ship will be the product of enfilade fire effect, and Final Multiplier as determined for target ship.

(b) By bombardment method against (anchored) ship target

If the target is within one or more of the "100-yard square" areas designated (F-3(d)(3)), fire effect inflicted will be assigned in general accordance with the following provisions:

(1) Corrections I and II are determined in the same manner as for other methods of fire between ships, except that Correction II penalties or bonuses are based on figures for direct method, plane spot;
There is no Correction III;

Multipliers for Corrections I and II are determined in the same manner as for other methods of fire between ships;
Final Multiplier is the product of Multipliers for Corrections I and II.

(2) From the "Fire Effect Tables" is taken the fire effect for the number of guns that bear.
This fire effect is reduced, first, in proportion to the total target areas occupied and the total areas designated, and, second, by five tenths;
Fire effect inflicted will be the product of the foregoing resultant fire effect and Final Multiplier as determined in sub-paragraph (1), preceding.

(c) By Ship Guns Against Shore Targets.

(1) Because of the different requirements that may be made on ship gunfire against shore targets, as well as the varied nature of the terrain, arbitrary decisions in scoring such gunfire will be made by the Director in general accord with standard instructions concerning landing operations and the provisions that follow.

(2) The "100-yard square" normally will be taken as the unit for target areas to be designated by the firing ship commander, and fire effect will be computed in proportion to the area(s) occupied by the target and the total areas designated.

(3) Basic fire effect of naval guns against shore targets will be that given in Conversion Tables of "Landing Operations Doctrine, U. S. Navy, 1938". For convenience, and as a general guide only, the table on the following page is set forth as basic fire effect for direct method, to accomplish various fire missions in the area occupied. For variations of basic fire effect, reference should be made to the publication noted.

Gun (Shell)		Guns and Ammunition per Gun Required per 3 Minutes For Each 100-Yard Square Occupied by Target.				
		MISSION				
		SUPPORTING FIRE		COUNTER-BATTERY **		Other
		Close *	Deep **	(For silencing guns a limited time)		
				Range 10000 minus	Range 10000 plus	
3"	AA	3-25	2-20	3-25	-	Interdiction - (1) For general area, same as for Deep Supporting Fire, except maintain fire for about 6 minutes, then repeat at frequent intervals. (2) For specific, vulnerable target, at least that for Close Supporting Fire while target is in vulnerable formation; thereafter, repeat requirements for Deep Supporting Fire for about 6 minutes at intervals of about 6 to 18 minutes to keep enemy immobilized. Harassing Fire - Perhaps half that for Deep Supporting Fire. Targets of Opportunity. Dependent on target, but may be, approximately, that required for Deep Supporting Fire. Destruction - Heaviest expenditure of ammunition, and should be limited to small area and direct fire. Dependent on target, but, generally, ammunition double that for Close Supporting Fire.
	FN & Shrap.	2-26	1-26	2-26	-	
	Com.	4-26	2-26	4-26	-	
4"	FN	2-18	1-18	2-18	6-23	
	Shrap.	2-19	1-19	2-19	7-22	
	Com.	3-18	2-13	3-18	9-23	
5"/25 5"/38	AA	1-26	1-13	1-26	4-26	
5"/51	AA	2-13	1-13	2-13	6-18	
	FN	2-13	1-13	2-13	6-18	
	Com & AP	3-17	2-13	3-17	12-17	
6"	FN	1-15	1-8	1-5	5-13	
	Com.	2-15	1-15	2-15	6-15	
	AP	3-15	2-11	3-15	12-15	
8"	FN	1-4	1-2	1-4	3-5	
	Com.	4-5	2-5	4-5	14-6	
	AP	5-6	3-5	5-6	20-6	
12"	Bombdt.	1-4	1-2	1-4	3-5	
	AP	2-6	1-6	2-6	9-5	
14" (Light Bursting Charge)	Bombdt.	1-3	1-2	1-3	3-5	
	AP	2-5	1-5	2-5	7-6	
14" (Heavy Bursting Charge)	Bombdt.	1-2	1-1	1-2	2-4	
	AP	2-4	1-4	2-4	9-5	
16"	AP	1-5	1-3	1-5	4-5	

* Advantageous to open and close with heavy burst of fire and slow down in between.

** After enemy fire decreases, reduce rate of fire one-half.

(4) For non-basic fire effect conditions, the rounds of ammunition required in the area occupied will be arbitrarily increased as follows:

For indirect method, multiply tabulated figures by 1.4;
For bombardment method, multiply tabulated figures by 1.6.

In addition, the rounds of ammunition tabulated may be increased by the Director in accordance with conditions affecting Corrections I, II and III (except the 40% penalty relating to continuation of fire by indirect method (F-10(b)(2)), and the penalty relating to enfilade (F-14(d)) for fire between ships, the multiplier for ammunition being the reciprocal of the Final Multiplier as determined for fire between ships.

(d) By Shore Batteries against Ship Targets. Fire of shore batteries against ship targets will be scored in the same manner as for fire between ships, except that when using direct method, or indirect method with direct terrestrial observation, the normal fire effect for plane spot given in the "Fire Effect Tables" will be multiplied by the following in order to allow for the increased accuracy of shore batteries:

Range	Multiplier	Range	Multiplier	Range	Multiplier
0-5	1.0	12	1.7	19	3.4
6	1.1	13	1.8	20	4.0
7	1.2	14	1.9	21	4.5
8	1.3	15	2.0	22	5.0
9	1.4	16	2.2	23	5.5
10	1.5	17	2.5	24 plus	6.0

Rule F-23. CLASSIFICATION, AND EFFECT, OF DAMAGE TO SHIPS.

(a) Classification and Assignment of Damage to Ships.

(1) Damage to ships is classed as

above-water damage, due to hits by gunfire or bombing;
under-water damage, due to hits by torpedoes, mines, or bombs, or to ramming or grounding.

(2) Only above-water damage inflicts a permanent reduction in gunfire effectiveness so far as determining remaining fire effect of a firing ship is concerned.

(3) Damage is assigned in terms of equivalent 14" penetrative hits against the life of a ship, and is converted into percentage of life for determining not only the ship's remaining fire effect but also specific handicaps to her battle ef-

ficiency, to be described in following sub-paragraphs. In this connection, a destroyer division (or half flotilla) is considered as a target group (or ship) for purposes of scoring damage, with the following special provisions:

> The fire effect of the target group will be penalized for remaining fire effect;
> Individual destroyers will have speed undiminished until sufficient damage has accrued to the group to destroy one ship, at which time the ships remaining will have their speed reduced in proportion to the original maximum speed and number of the group;
> Under-water damage in excess of the value of the life of one ship will not be scored against the group.

(b) Effect of Under-water Damage. Under-water damage to any ship reduces her original maximum speed in proportion to the percentage of such damage received, expressed in one per cent increments. Such reduction is assigned in addition to other speed losses incurred as the result of above-water damage.

(c) Effect of 30% Above-water Damage. Any ship, other than a capital ship, which has received 30% above-water damage, shall lose 10 per cent of her original maximum speed; and on all ships the time of coding and decoding of coded despatches (Rule E-4) will be doubled.

(d) Effect of 50% Above-water Damage. A ship which has received 50% above water damage:

(1) Can no longer use director gunlaying, except capital ships;
(2) Can no longer use plane spot;
(3) Loses all effective secondary battery and anti-aircraft fire;
(4) Loses all planes then on deck; can no longer use catapults;
(5) Can no longer fly planes off or on;
(6) If a capital ship, loses 20 percent of her original maximum speed; any other ship loses an additional 10 percent (total 20 percent) of her original maximum speed;
(7) Loses one-half her deck tubes and torpedoes on each side;
(8) If carrying mines, can no longer lay them;
(9) If a submarine, can no longer submerge;
(10) Can no longer transmit despatches by radio on frequencies below 2,000 kilocycles.

(e) Effect of 70% Above-water Damage. A ship which has received 70% above-water damage:

(1) If a capital ship, can no longer use director and stable zenith director gunlaying;
(2) If other than a capital ship, must use local control;
(3) Loses all deck tubes and torpedoes;
(4) Loses an additional 30 per cent (total 50 per cent) of her original maximum speed;
(5) Can no longer transmit despatches by radio.
(6) If a surface mine-layer with at least 50% of mine allowance on board, blows up.

(f) Effect of 80% Total Damage. A ship which has received 80% total damage from all causes:

(1) Can not make more than 5 knots through the water;
(2) If a capital ship, must use local control;
(3) Can not use director gunlaying or plane spot;
(4) Can not fire torpedoes;
(5) Can no longer transmit or receive despatches by flag hoist, or radio.

(g) Effect of 90% Total Damage. A ship which has received 90% total damage from all causes is in sinking condition, dead in the water.

For convenient reference, penalties of many of the foregoing rules have been incorporated into Gunfire Penalty Tables, and Ship Damage Tables which are reproduced on the succeeding pages.

Section F

GUNFIRE PENALTY TABLES

(Penalties are given in number of tenths)
(Ranges are shown in thousands of yards)

· CORRECTION I: (To Remaining Fire Effect)
(A.W. Damage to Firing Ship in tenths at end of preceding move)
(See F-7 for shock or strafing Effect)

CORRECTION II: (Affecting own rapidity of fire.)

PENALTIES NOTED BY GUNFIRE RECORDER ON GAME BOARD; SCORED BY GUNFIRE SCORER IN MASTER PLOT.

Symbol		Rule (F)	Penalty
A	Ship, Fire Masked, or Line of Bearing	8	
B	Ship, Continuation Fire	10 (a)	
C	Ship, Surprise Fire	9 (b)	3
D	Ship (Dependent on Pitch Weather)	20	
E	Ship Roll "	20	
F	Ship Yaw "	20	
G	Ship Spray "	21 (d)	Q and NTu: 2
H	Ship, Funnel Smoke (Oil Burners: within 2 kts. of Max. Speed.)	21 (c)(3)	

Fire Masked Penalty
(1) Loss proportional to time masked.
(2) Line of Bearing penalty 1 beginning 4th move; 2 in 5th, 3 in 6th, and succeeding moves 4.

Continuation Fire Penalty
Loss 1st move, 4; thereafter 10.

	State of Sea	Ship Size		
		Large	Inter.	Other
Pitch	Moderate	1	2	3
	Rough	2	3	4
	Heavy	3	4	5

Roll: Same as for Pitch except add 2 if other than Director or Stable Zenith Director Lay.

Yaw: Add 2 to penalties shown for Pitch.

Funnel Smoke Penalty. Pointer or Director Lay. (Direct Method only)

Day	Night
3	5

PENALTIES APPLIED AND SCORED BY GUNFIRE SCORER IN MASTER PLOT

I	Ship, Change Course (Except Indirect Method)	16 (a)	
J	Ship, Under Concentration N ships	14 (b)	Tu: N-1 NTu: N
K	Ship, Under less than Normal Fire (+)	14 (b)	+1
L	Ship, Not under Effective Fire (+)	14 (b)	+2
N	Ship, Under Minor Fire	14 (c)	1
O	Ship, Battery Interference	13 (c)	
W	Ship, Chemical Penalty	(K) 9	
X	Ship, Shift Fire	12	

Firing Ship Change Course Penalty

Director Lay — Degrees Change

0-30	31-50	51-70	71-90	91-110	111-130	131-150	151-170	171-190
0	1	2	3	4	5	6	7	8

Pointer Lay — Degrees Change

0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-110	111-on
0	1	2	3	4	5	6	7	8	9	10	10

Battery Interference Penalty

Battery	Day	Night
Main	0	3
Second	4	5

Shift Fire Penalty

Range	
0-5	1
6-10	2
11+	3

Fire Control Symbols

Method	Spot	Lay	Fire
Dir. – Direct Ind. – Indirect Bar. – Barrage Bom. – Bombardment	T. – – Top P. – – Plane Loc. – Local Control	R. – Director S. – Stable Zenith Director Q – Pointer	Tu. – – Turret NTu. – Exposed Batteries

Section F

GUNFIRE PENALTY TABLES

(Penalties are given in number of tenths)
(Ranges are shown in thousands of yards)

CORRECTION III: (Affecting own accuracy of fire.)

PENALTIES NOTED BY GUNFIRE RECORDER ON GAME BOARD; SCORED BY GUNFIRE SCORER IN MASTER PLOT

Symbol		Rule F.	Penalty
a	Ship, Gases (Except when Stable Zenith Lay)	21 (c)(2)	1
b	Ship, Sunglare	21 (a)	Q: 3 R: 1
c	Target, Silhouetted (+)	21 (b)	Dir: +2
	(Enfilade, See Table at upper right)	14 (d)	

Enfilade Fire Effect

Distance of Target from Point of Aim

0 to 200	201-300	301-400	401-500	501-600	601-700	701-800	801-1000	
8	7	6	5	4	3	2	1	

Maximum Effect of original fire

Target Change Course Penalty

Target Speed in Knots	(1) Degrees Change 15-30	31-44	45-59	60-74	75-89	90+	(2) Increase Penalty of (1) by (1)	(3) Double (1)
6-10	0	0	0	1	1	-		
11-21	0	0	1	2	3	3		
22-29	1	1	2	3	4	4		
30+	1	2	3	4	5	5		

(1) BB, CC, CA, CL, Main Battery Fire.
(2) Range over 16, Top Spot; and for Batteries other than Main Battery of (1).
(3) Indirect Method.

PENALTIES APPLIED AND SCORED BY GUNFIRE SCORER IN MASTER PLOT

k	Target Change Course	16 (b)	
m	Target Change Speed, each (x) kts. (if range is over 5000 yards)	17 (b)	Dir: x/2 Ind: x
s	Ship, Open Fire	9	Ind: 10
t	Ship, Change Speed, each (x) knots	17 (a)	Dir: x/4 Ind: x/2
u	Ship, Change Course (Indirect Fire Only)	16 (a)(3)	
v	Over Concentration (N ships on target except at certain low ranges)	13 (b)	BBs, CAs N-1 Others, N
w	Ship, Local Control (For ranges more than 5)	13 (e)	
x	Ship, Divided Fire (Non-Adjacent Targets) (After Group) (Dir.)	13 (a)(3)	2
y	Change of Range	18	
z	Ship, Stable Zenith Director Lay (Indirect Method)	10 (b)(2)	Ind/S: 3
	(See Max. Value for visibility conditions, below)	21 (e)	

Open Fire Penalty (Direct Method)

Spot	Range	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-on
Top		0	1	2	4	8	9	10	10
Plane		0	1	2	3	4	5	6	6

Ship Change Course (Indirect Method Only)

Degrees Change 0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	etc.
0	1	2	3	4	5	6	7	8	etc.

Local Control Penalty

Range 0-5	6-10	11-15	16-20	21-25	26-30	31-on
0	2	4	6	8	10	10

Change of Range Penalty

3 minute rate	Direct Method Range 0-5	6-20	21+	Indirect Method Any Range
2	0	1	2	3
3	1	2	4	6
4	2	3	6	9
5	3	4	8	10

Maximum Values of Multiplier III when affected by visibility

Day Vis. Effect (Top Spot Only)

Vis. minus range	Max. Value 3rd. Mul.
0	5
1	6
2	7
3	8
4	9
5	10

Night Visibility Effect

Range	(1) Star Shell Illum. BB, CC, Main	CA, CV 8"; 7"5	CL, CV	DL, DD	BB Second.	Other Types	(2) S.L. Illum. Add to (1)	(3) Nat. Illum. Subtract from (1)
13-15	1	0	0	0	0	0	-1	1
11-12	2	1	0	0	0	0	-2	2
10	3	2	2	0	2	0	-3	2
9	3	2	2	0	2	0	0	2
7-8	4	3	3	1	3	0	0	2
5-6	5	4	4	2	4	1	+1	2
3-4	5	4	4	3	4	2	+2	1
0-2	4	3	3	2	3	1	+3	0

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Fire Control Symbols

Method	Spot
Dir. Direct Ind. Indirect Bar. Barrage Bom. Bombardment	T. Top P. Plane Loc. Local Control
Lay	**Fire**
R. Director S. Stable Zenith Director Q. Pointer	Tu. Turret NTu. Exposed Batteries

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SERIAL NO. .....

SHIP DAMAGE TABLE

-CAPITAL SHIPS-

	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
ABOVE WATER DAMAGE			Communications: Time of coding and decoding doubled.		Speed: loss 20%. Guns: loss plane spot; loss secondary and anti-aircraft batteries. Torps: loss ½ deck tubes & torpedoes on each side. Air: loss planes on deck; loss catapults. Comm: cannot transmit below 2000 kcs.		Speed: loss 50% (total) Guns: loss director & stable zenith. Torps: loss all deck tubes & torpedoes. Comm: cannot transmit by radio.			
	← GUNFIRE – loss is proportional to Above Water Damage, in tenths. →									
UNDER WATER DAMAGE					Torps: loss all submerged tubes.					
	← SPEED – loss is proportional to Under Water Damage and additional to other speed losses. →									
TOTAL DAMAGE								Speed: slowed to 5 kts. Guns: loss plane spot and director; must use local control. Torps: cannot fire. Comm: cannot transmit or receive radio, or flag hoist.	Speed: stopped; sinking.	

-OTHER THAN CAPITAL SHIPS-

	10%	20%	30%	40%	50% *	60%	70%	80%	90%	100%
ABOVE WATER DAMAGE			Speed: loss 10% Communications: Time of coding and decoding doubled.		Speed: loss 20% (total) Guns: loss plane spot, director and stable zenith; loss secondary and anti-aircraft batteries. Torps: loss ½ deck tubes and torps on each side. Air: loss planes on deck; loss catapults. Comm: cannot transmit below 2000 kcs.		Speed: loss 50% (total) Guns: must use local control. Torps: loss all deck tubes & torpedoes. Comm: cannot transmit by radio. Mines: if 50% allowance on board ship blows up.			
	← GUNFIRE – loss is proportional to Above Water Damage, in tenths. →									
	* Note: At 50% A.W. damage: SS cannot submerge; CV planes cannot fly on or off; CM, etc., cannot lay mines.									
UNDER WATER DAMAGE					Torps: loss all submerged tubes.					
	← SPEED – loss is proportional to Under Water Damage and additional to other speed losses. →									
TOTAL DAMAGE								Speed: slowed to 5 kts. Guns: loss plane spot and director. Torps: cannot fire. Comm: cannot transmit or receive radio, or flag hoist.	Speed: stopped; sinking.	

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(Mod. Apr. 1939). (Mod. Feb. 1938) May. 10, 1937

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3/28/39.

SECTION G - TORPEDO FIRE

SECTION G - TORPEDO FIRE

This Section contains general rules for torpedo fire and special rules for that of surface craft and submarines. Special rules for aircraft torpedo fire are contained in Rule J-19.

Rule G-1 (a) For ODD's, complete data in regard to adjustments for torpedo fire will be submitted to the Torpedo Umpire at the beginning of a borad maneuver. This data will include the following:

(1) Type of fire to be used: curved fire ahead, virtual straight fire, straight fire, etc.

(2) Spread setting between torpedoes.

(3) Depth setting.

As this type has no outside setting devices on its tubes, these settings may not be changed during an action. (Rule G-209).

(b) For other types of surface craft, it will be assumed that settings could be changed during the period of preparation required in Rule G-215.

Rule G-200. (a) The types of torpedoes listed in the "Fleets" have the following characteristics:

Type	Size	Speed	Hit Value	Range
A	21"	26	2.4	17,000
B	21"	29	3.0	15,000
C	21"	27	2.4	13,500
E	18"	30	1.8	6,000
E-1	18"	33	1.8	3,000
E-2	23"	30	2.4	4,500
E-3	23"	33.5	2.4	6,000
F	21"	36	3.0	3,500
F-1	21"	34	2.4	5,500
F-2	18"	35	1.8	3,500
G (X	21"	27	3.0	15,000
G (Y	21"	34	3.0	10,000
G (Z	21"	46	3.0	6,000
H (Y	21"	32.5	3.0	9,000
H (Z	21"	46	3.0	4,500

(b) Players turning in torpedo fire blanks will include the type of torpedo to be fired, and in the case of the variable-speed torpedo (type G or H) the speed setting to be used.

Rule G-201. Unless otherwise stated in the problem, the torpedo armament of vessels is as given in the "Fleets".

Rule G-202. Submerged tubes in submarines are installed in the fore-and-aft line. In other vessels they are assumed to be installed at right angles to the fore-and-aft line.

Rule G-203. Submerged tubes cannot be trained in azimuth.

Rule G-204. Broadside above-water tubes may be brought to bear within 30° and center line tubes within 45° of the fore-and-aft line, unless otherwise noted in the Fleets. The Director may reduce these arcs as may be considered necessary, in the case of ships with quadruple tubes.

Rule G-205. Every torpedo is fitted with an angle-fire device by which it may be fired at an angle at 90° or less with the direction of the tube.

Rule G-206. Torpedoes cannot be fired from submerged tubes at a speed of ship in excess of 16 knots.

Rule G-207. Each tube is regarded as being loaded at the beginning of the maneuver.

Rule G-208. Reloads will be regarded as being equally distributed among tubes at the beginning of torpedo fire.

Rule G-209. Torpedoes which have been loaded into deck tubes may not be withdrawn during an action.

Rule G-210. Torpedoes may not be shifted between submerged and deck tubes, nor between forward and after tubes while underway.

Subject to the restriction of Rule G-211 they may be shifted between starboard and port submerged tubes.

Rule G-211. A vessel with broadside submerged tubes may fire torpedoes from each submerged tube at the rate of one torpedo per tube per move until the torpedoes at that tube have been

exhausted. The torpedo on the other side may then be shifted, it requiring 2 moves to make the shift. The first of these torpedoes can then be fired in the third move and the others in every alternate move thereafter.

Rule G-212. A vessel with deck tubes and spare torpedoes may reload only under conditions when there is little motion on the ship due to either sea or rudder. The minimum time for such reload is fifteen minutes. (G-208, G-210).

Rule G-213. A submarine may in one 3 minute move fire all torpedoes that are loaded. A tube in any torpedo room may be reloaded whenever a tube is empty as follows: 2 tubes in two 3-minute moves, 4 tubes in three 3-minute moves.

Rule G-214. Before a torpedo may be fired from submarines submerged the periscope must be exposed at least ten seconds; except that a submarine may fire entirely by sound subject to the limitation of accuracy given in Rule D-28. (Rule D-29c).

Rule G-215. Torpedo fire will be indicated by filling out and handing to the Torpedo Umpire the Torpedo Fire Blank, Form T-7. Detailed rules concerning such fire are as follows:

(a) Single vessels firing on their own initiative may fire during or at the end of a three-minute move, and may hand in the torpedo fire blank covering the fire after the move has been made but before the next move has been called for.

(b) For all other torpedo fire, the blank must be handed in before the firing move is made on the board and, for a three-minute move, may not specify torpedo fire earlier than the end of that move. Such fire will be considered to have been completed at the game time designated on the blank (provided it conforms to the above restrictions) unless the Torpedo Umpire is informed to the contrary immediately after this time is reached. If fire is thus held up, and firing settings are not to be changed, it may be completed at any subsequent game time

by so informing the Torpedo Umpire. If firing settings are to be changed, in order to complete firing which has been held up a modified blank must be handed in, and the fire may not be completed earlier than the end of the next three-minute move.

(c) At the time of firing, the firing units must be suitably deployed, and, if firing curved fire ahead, must be sufficiently slowed down.

(d) Data for torpedo fire will be obtained by players from their tactical plotting, but the Maneuver Staff will furnish bearings and ranges when requested, provided they would be available under actual conditions.

Rule G-216. The condition (as to damage) of a vessel firing torpedoes is her condition at the time the torpedoes are fired. (See Rule G-217).

Rule G-217. (a) A vessel receiving 50% or more of above-water damage loses one-half of her deck torpedo tubes on each side.

(b) A vessel receiving 70% or more of above-water damage loses all deck tubes.

(c) A vessel damaged 80% or more can not fire torpedoes.

Rule G-218. A vessel receiving 50% or more of under-water damage loses all submerged tubes.

Rule G-219. All torpedoes of a salvo fired from a division of vessels in formation are considered as having been fired from one point, the center of the division; except that at ranges inside 5,000 yards the commander of the firing ships may elect to have the torpedoes plotted as coming from the individual firing ship.

Rule G-220. (a) Of the total number of torpedoes intended to be fired from a surface vessel not under effective fire, due to war conditions, 75% are considered to run as directed and to function throughout the run, fractions of one-half or larger

being counted as a whole, smaller fractions being disregarded.

(b) When surface vessels are under effective gun fire or when they fire from behind smoke screens on signal from an exposed leader, 50% are considered to run as directed and to function throughout the run, a half torpedo being considered a whole.

NOTE:- Under exceptional conditions, such as vessels being under unusual concentration of fire, melees, frequent and large changes of course under fire, etc., the Director may, at his discretion, decrease the number of torpedoes that run as directed and function throughout runs to less than 50%.

(c) In the case of submarines, 80% out of the total number of torpedoes fired will be considered to run as directed and to function throughout the run. Frantions one-half or greater will be considered as a whole, fractions less than one-half will be disregarded.

(d) In moderate to rough seas, torpedo depth settings of less than 15 feet may result in torpedoes functioning improperly.

Rule G-221. Torpedo fire is plotted on the Master Plot on which are drawn the firing points and the paths of the torpedoes which are considered to run, with arcs to show the length of run of the torpedoes during each three minute move.

Rule G-222. In a salvo of two effective torpedoes from a surface vessel, their paths are along the right and left dispersion limits. When the number of effective torpedoes is three or more, one torpedo is considered to run on the right limit of dispersion line, one on the left limit of dispersion line, and the paths of the remainder are equally spaced between them.

Rule G-223. (a) Under conditions where the discharge or the tracks of torpedoes may be seen, the Director will give appropriate information to the player or players concerned. (See Rule J-13d).

(b) A player receiving such information will be permitted

to take appropriate action as of the time when he received it, if necessary modifying a move previously turned in or made. Unless otherwise prevented by existing conditions, he may start messages to maneuver his own ships or to warn other ships, and may, in an emergency, cause his ships to maneuver independently as might be done on the initiative of their commanding officers.

Rule G-224. (a) The tracks and positions of vessels that may be endangered by torpedoes will be plotted on the Master Plot.

(b) From the plot of the tracks and positions of the torpedoes and of such ships as may be in torpedo water, and whose draft exposes them to danger, the Director will determine the number and allocation of torpedo hits basin, his decision on either of the following methods:

(1) Consider each torpedo and each ship individually, and from a study of simultaneous positions determine when a hit is made.

(2) In the case of a formation of ships endangered by a salvo of torpedoes, determine "L", the total length of that part of the formation through which torpedoes pass as projected on to a line at right angles to the mean torpedo track. Determine "N", the number of torpedoes that pass through this line, and "T", the total length of ship targets as presented. Then the number of torpedo hits equals NT/L, taken to the nearest whole figure.

NOTE:- In case ships are in approximate column formation (line of bearing 180°) the Problem is simplified by using actual instead of projected length of formation through which torpedoes pass, and actual instead of presented total length of ship targets.

(c) The number of hits thus determined may be reduced, according to the Director's judgment, when the following condi-

tions obtain:

(1) The paths of the torpedoes are at least twice as far apart as the width of the target ships;

(2) The ships have had sufficient warning of the approach of the torpedoes, have straightened out on a course paralleling the tracks of the torpedoes, can see these tracks, are maneuvering independently to avoid, and have enough speed and maneuverability to give them some measure of ability to keep clear of torpedo tracks.

(d) Under conditions favorable for dodging torpedoes, as set forth in the preceding paragraph, the chances of avoiding torpedoes are better when running away from them than when meeting them.

Rule G-225. (a) A torpedo hit inflicts under-water damage equal in amount to the following number of 14" penetrative hits:

Type B, F, G, H - - - - - - - - - - 3.0
Type A, C, E-2, E-3, F-1 - - - - 2.4
Type E(18"), E-1(18"), F-2(18") - 1.8

(b) The effect of additional torpedoes which hit within fifteen minutes of a preceding torpedo hit will be increased by 1/3 for the first additional and by 2/3 for any succeeding additional hits.

(c) In its permanent effect upon the life and capabilities of vessels, torpedo damage is additive to damage from other causes and will be communicated to the damage recorder. (C-24, F-23, G-218).

(d) Independently of the permanently damaging effect of torpedo hits, the shock effect of a torpedo hit will render a vessel incapable, for a period of three minutes thereafter, of using her weapons, of flying planes on or off, or of maneuvering.

Rule G-226. (a) In each case where a torpedo hits a ves-

sel, there is some chance that the hit will be in the region of the propeller shafts and / or the rudder.

(b) The chance that a torpedo hit is in the propeller-shaft and / or the rudder area will be adjudged by the Director in accordance with the following table of chances, based upon the angle which the track of the torpedo makes with the keel line of the ship, measured from ahead to the right through 360 degrees.

Angle		Propeller shaft	Rudder
0	360	0	0
45	315	1/10	0
90	270	1/5	1/20
135	225	1/2	1/10
180	180	4/5	1/5

(c) Independently of the speed loss inflicted under Rules C-24 and F-23, a torpedo hit in the propeller shaft area on one side of a vessel with two or more screws will thereafter reduce the vessel's maximum individual speed to three-fourths of that which she would otherwise have remaining to her under Rules C-24 and F-23(b).

(d) A torpedo hit in the propeller shaft area of a single screw ship, or hits in the propeller shaft areas on both sides of a vessel with two or more screws, will render the vessel incapable of further self-propulsion.

(3) A torpedo hit in the rudder area of a ship will render her incapable of steering.

Rule G-227. A torpedo hit may cause a vessel to assume a temporary list, which will affect ability to use weapons, to fly planes on or off, and to maneuver. The amount, duration and effect of such temporary list will be adjudged by the Director. (F-23).

SECTION H - MINES

SECTION H - MINES

Rule H-1. (a) Mines used in War College maneuvers will be classified as to type, according to their method of use, as being either

A - anchored or

D - drifting;

and will be further classified as to kind, according to their method of firing, as being either

N - antenna

C - contact, or

O - observation.

(b) They will be designated as to type and kind by a two letter symbol, in which the first letter will indicate whether anchored or drifting, and the second letter whether antenna, contact, or observation, except that there are no observation-drifting.

(c) Mines carried by submarines may be suited for discharge either (1) from special mine trunks, or (2) from torpedo tubes. In designating these special types by symbol, the letters "M" for mine trunk, or "T" for torpedo tube, will be added as a third letter.

(d) Mines are not interconvertible as to type or kind.

Rule H-2. (a) Anchored mines may be either contact, antenna or observation.

(b) They may be laid in any depth of water up to 250 fathoms and may be set to ride at any desired depth below the surface, at low water slack.

(c) In a current, the slack-water submergence depth of anchored mines will be considered to be increased by an amount of dip which is, in feet, four per cent of the length of the mine anchor cable times the strength of the current in knots.

(d) With current of strength greater than 4 knots or in

rough seas, anchored mines may drag, and upon dragging may become inoperative. Whether under these conditions all or any part have in fact dragged, and if so, whether all or any part of these have become inoperative, will be adjudged by the Director.

Rule H-3. (a) Drifting contact mines are considered to float on the surface.

(b) Drifting antenna mines are assumed to be of the type that remains suspended at a fixed depth below the surface, each mine being supported there by a small surface float to which it is connected by its antenna wire. Unless otherwise stated, the length of the suspending antenna wire will be taken as 30 feet.

Rule H-4. Contact mines are exploded by actual contact of the mine case with a passing vessel.

Rule H-5. (a) Antenna mines are exploded by contact of metal with either the mine case, the antenna wire, or the antenna float, or by any contact with the case.

(b) Anchored antenna mines have an antenna wire leading upward suspended from a small float and a section of the mine anchor line leading downward also acts as an antenna. Unless otherwise stated by the player, the length of the upper antenna wire will be taken as ten feet less than the intended low water slack submergence depth of the mine, but not to exceed seventy feet; and the length of the downward antenna section of the anchor line will be taken as being one hundred feet.

Rule H-6. (a) Mines are designed to become inoperative as follows:

(1) anchored mines, if they come adrift from their anchor gear;

(2) drifting mines, upon the expiration of a certain period after they have been laid.

(b) Unless otherwise announced, in accordance with the HAGUE Convention on this subject, the life of drifting mines will be taken as one hour. For the purposes of study, if permitted by the Director, they may be given longer life.

Rule H-7. Some proportion of initially defective mines is to be expected and some proportion that become defective in time after being laid. With antenna mines, there may be some premature explosions during laying. These actual proportions may vary greatly in service, but, in the absence of abnormal factors, will be taken to average as follows, in percent of the number originally laid:

	Contact	Antenna
Initially defective	5	10
Premature explosions	0	10
Subsequent defectives, per month	2	5

Rule H-8. The ratio of effectiveness of a group of mines is the ratio between (1) the total number originally laid, minus the number that have become inoperative (H-6), or ineffective (H-7, H-14) or have been exploded in service (H-16, H-17, H-18) and (2) the number originally laid.

Rule H-9. (a) Unless otherwise stated, the mine equipment of vessels is as given in the "Fleets".

(b) If not otherwise announced, a player having mine vessels may select the type of mine for each ship to carry, and in this case will inform the Director of his decision before the beginning of the maneuver.

Rule H-10. (a) Dummy mines are pieces of wood shaped and painted to resemble drifting surface mines or antenna floats when floating in the water.

(b) Surface vessels carrying mines may also carry, in addition to their true mine equipment, an equal number of dummy mines. Other vessels may also carry a limited number of dummy mines, as

may be allowed by the Director.

(c) Players who elect to have their vessels carry dummy mines will so inform the Director before the beginning of the maneuver.

Rule H-11. (a) Contact Mines floating on the surface can be seen from vessels on the surface up to 500 yards under ideal conditions of glassy sea, good height of eye and good light. Under any other conditions they cannot be seen at sufficient distance for vessels proceeding at moderate speed to avoid them.

(b) Aircraft can see contact floating mines under ideal conditions within a horizontal radius of 500 yards, provided they are at an altitude of not over 1000 feet and are at the time concentrating their attention on searching the surface under them for such purpose as the discovery of mines, torpedoes or submarines.

(c) Dummy mines have the same visibility as real mines floating on the surface, and cannot be distinguished from them at range greater than 50 yards.

(d) Antenna floats on the surface are visible under ideal conditions only 50 yards, and are only visible to aircraft from an altitude of 200 feet or less. Surface vessels proceeding at any speed cannot see them in time to avoid.

(e) Mines or floats below the surface are considered not visible from a surface vessel, but may be seen from an airplane under favorable conditions. (See Rule J-13(a)).

Rule H-12 (a) Mine laying by surface vessels is visible under best conditions, at ranges up to 7,000 yards for small or high speed layers and up to 20,000 yards for large slow layers. Under less favorable conditions, this range will be reduced correspondingly.

(b) If premature explosions occur during laying, these may be visible at greater distances, but the cause of such explo-

sions will not necessarily be evident.

(c) Mine explosions will be considered to be audible from surface vessels and submarines for a distance of ten miles.

Rule H-13. (a) Mines may be laid by surface mine vessels at intervals of three seconds or more, and at any speed up to 30 knots.

(b) Submarines either on the surface or submerged can discharge mines at intervals of 15 seconds or more, but in the case of tube mines they can load only one per tube, and to reload requires three minutes per tube.

(c) The time interval between mines to give certain spacings at various speeds is given in the following table

Speed of layers	Time intervals between mines for different distances apart			
(a) knots	(b) 600 ft.	(c) 500 ft.	(d) 400 ft.	(e) 300 ft.
10	36	30	24	18
11	33	28	22	17
12	30	25	20	15
13	28	23	18	14
14	25	21	17	13
15	24	20	16	12
16	23	19	15	11
17	20	17	14	10
20	18	15	12	9
22	16	14	11	8
25	14	12	10	7
28	13	11	9	7
30	12	10	8	6

Rule H-14. The explosion of a mine will destroy the effectiveness of other mines that are closer to it than about 200 feet.

Rule H-15. (a) Prior to beginning a chart or board maneuver each player having mines on board his vessels will furnish a memorandum to the Mine Umpire which will show:

(1) Type of mines (See H-1).

(2) Number on each vessel.

(3) If antenna mines, the length of antenna settings. If changes are made in these settings, the Mine Umpire must be notified a sufficient time before the mines are planted to permit such changes being made.

(b) In the Chart Maneuver, when mines are laid, the player handling the mine-laying ships will furnish to the Director a Minelaying Blank (Form T-8) which shows for each mine-laying operation:

(1) date, hour and location of starting and stopping laying;

(2) the vessels laying;

(3) the formation and maneuvers used during laying;

(4) the number of mines laid by each one, and the total laid during the operation;

(5) the type and kind of mine laid; (H-1)

(6) the number of lines of mines;

(7) the interval between lines;

(8) the spacing in each line;

(9) the depth setting in each line;

(10) any detail in which mines differ from the standard characteristics set forth in Rules H-2, H-3.

(c) During the time that mines are intended to be effective, he will also show on his chart and on tracings submitted to the Director the area and location of the field.

(d) In the Board Maneuver, a player laying mines will so

state on the move blank for the vessel(s) concerned, and will also fill out the appropriate data on a minelaying blank (Form T-8) and submit it to the Director.

(e) In either case the Director will have the mine area plotted on the Master Plot, and will decide as to the ratio of effectiveness. (H-8).

PARAVANES.

Rule H-16. (a) Paravanes are assumed to be carried by all fighting ships of more than 3,000 tons displacement, by regular Navy auxiliary types of more than 5,000 tons, and by such merchant types as may be permitted by the Director. (A-2).

(b) To put over or take in paravanes, a vessel must run for six minutes at a speed of not more than 12 knots.

(c) With paravanes out, a vessel cannot make more than 28 knots without losing them.

(d) For a vessel proceeding on a straight course, paravanes afford practically complete protection against anchored contact mines, and in the case of mines of this type as come within the spread of the paravanes, will cut their anchor lines and cause them to float to the surface. (See H-6(a)).

(e) If a vessel changes course in a minefield, paravanes are not complete protection against the possibility of swinging the ship's afterbody into a mine.

(f) Paravanes are no protection against drifting surface contact mines, nor against antenna mines, whether drifting or anchored. Contact of a paravane with a mine antenna will cause the mine to explode, and, independently of any other damage it may do, will destroy that paravane.

Rule H-17. (a) If a vessel enters a mined area, the Director will have its track plotted on the Master Plot, and will determine the number of mine hits, if any, upon the vessel.

(b) Whether a vessel is endangered by a particular line of

mines which it crosses depends upon:

(1) the water levels spanned by the vessel's underwater structure;

(2) the water level at which, or levels through which, the mines are operative, according to their depth of submergence at the time (Rule H-2(c)), and the vertical length of antenna wire, if any;

(3) whether the vessel has paravanes out;

(4) whether paravanes protect against the type of mine in use.

(c) When a single vessel proceeding on a straight course, crosses a single line of mines which subject it to danger, the chance of its hitting a mine will be determined as follows:

Let d = distance between mines in feet

e = ratio of effectiveness (H-8)

a = angle between course of ship and line of mines

w = effective width of the ship in feet.

d' = effective distance between mines.

$$d' = d \sin a$$

The chance of missing is

$$m = 1 - \frac{ew}{d'}$$

The chance of hitting is:

$$h = 1 - (1 - \frac{ew}{d'}) = \frac{ew}{d'} \quad \ldots\ldots\ldots\ldots \text{I.}$$

Natural sines

Angle	Nat. Sin.	Angle	Nat. Sin.	Angle	Nat. Sin
10°	.17	40°	.64	70°	.94
20°	.34	50°	.76	80°	.98
30°	.50	60°	.86	90°	1.00

(d) If a vessel passed through successive lines of mines where the chance of hitting a mine in each line is the same, h', the probability that it will hit in one line is found as

follows:

$$h' = \frac{n!h}{n}(1 - h)^n \qquad \text{II}$$

where n = number of lines.

h = chance of hitting in any one line (I)

n! = n (n-1) (n-2) ..... 1.

If due to varying characteristics of the lines the chances of hitting lines 1, 2, 3 ... n are h_1, h_2, h_3 ---- h_n, the probability of hitting each line will be considered separately.

If a vessel is changing course while passing through a line of mines, her chance of missing in that line is reduced by reason of the fact that, while turning, her hull presents an increased effective width.

(f) The Director may decide that special sea or local conditions alter the chances of a vessel missing a line of mines.

Rule H-18. (a) If a number of vessels cross a mine area, or if a vessel crosses a mine area a repeated number of times, then for the total number of vessel-traverses involved the total number of mine hits to be expected is determined by the sum of the chances of hitting on each vessel-traverse, except as provided in (b) of this rule.

(b) A vessel which crosses a mine area directly in the wake of another vessel of a size not smaller than itself has only a negligible chance of being hit.

Rule H-19. (a) When one vessel strikes a mine, other vessels in easy sight can see that she is mined or torpedoed.

(b) The Director will inform players accordingly and may permit them to modify the moves of such vessels.

Rule H-20. (a) A mine hit inflicts under-water damage equal in amount to three 14" penetrative hits, and the second and succeeding hits in the same field each equal four 14" penetrative hits.

(b) In its permanent effect upon the life and capabilities of vessels, mine damage is additive to damage from other causes, and will be communicated to the damage recorder. (C-24, F-23, G-218, G-225).

Rule H-21. (a) Independently of the permanently damaging effect of mine hits, the shock effect of a mine hit will render a vessel incapable, for a period of three minutes thereafter, of using her weapons, of flying planes on or off, or of maneuvering.

(b) Independently of the foregoing, a mine hit may cause a vessel to assume a temporary list, which will affect ability to use weapons, to fly planes on or off, and to maneuver. The amount, duration and effect of such temporary list will be adjudged by the Director. (F-23).

Rule H-22. (a) A surface mine-laying vessel loses mines in the ratio of above water damage received.

(b) A vessel receiving 50% above-water damage can no longer lay mines. (F-23).

(c) A surface minelayer with at least 50% of mine allowance on board, and damaged 70% above-water, will blow up.

SECTION I - SUBMARINES

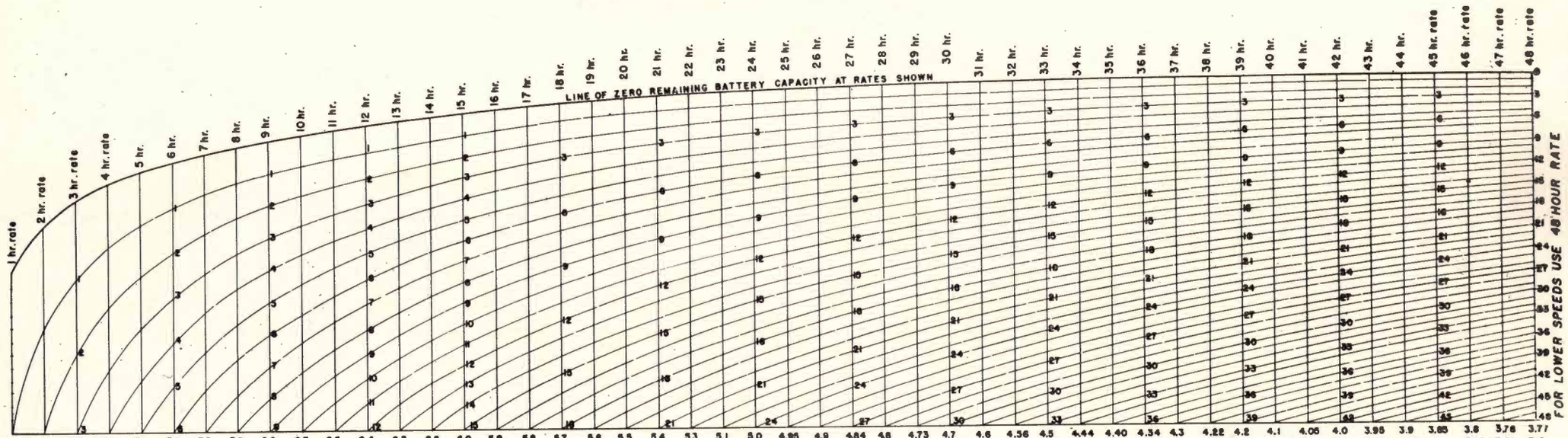
CURVE FOR COMPUTING

SUBMARINE SPEED AND ENDURANCE SUBMERGED

AND SHOWING

REMAINING STORAGE BATTERY CAPACITY

AFTER RUNNING ANY GIVEN TIME AT ANY SPEED



SPEEDS	1 hr. rate	2 hr. rate	3 hr. rate	4 hr. rate	5 hr.	6 hr.	7 hr.	8 hr.	9 hr.	10 hr.	11 hr.	12 hr.	13 hr.	14 hr.	15 hr.	16 hr.	17 hr.	18 hr.	19 hr.	20 hr.	21 hr.	22 hr.	23 hr.	24 hr.	25 hr.	26 hr.	27 hr.	28 hr.	29 hr.	30 hr.	31 hr.	32 hr.	33 hr.	34 hr.	35 hr.	36 hr.	37 hr.	38 hr.	39 hr.	40 hr.	41 hr.	42 hr.	43 hr.	44 hr.	45 hr. rate	46 hr. rate	47 hr. rate	48 hr. rate
11.0	9.8	8.8	8.1	7.6	7.4	7.2	7.0	6.9	6.7	6.5	6.4	6.3	6.2	6.0	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.1	5.0	4.95	4.9	4.84	4.8	4.73	4.7	4.6	4.56	4.5	4.44	4.40	4.34	4.3	4.22	4.2	4.1	4.05	4.0	3.95	3.9	3.85	3.8	3.76	3.77
10.5	9.0	8.4	7.4	7.3	7.1	6.9	6.7	6.6	6.4	6.3	6.1	6.0	5.9	5.8	5.7	5.6	5.5	5.3	5.2	5.1	5.0	4.9	4.8	4.73	4.7	4.62	4.6	4.52	4.5	4.42	4.4	4.3	4.24	4.2	4.14	4.1	4.03	4.0	3.92	3.9	3.8	3.77	3.72	3.7	3.66	3.61	3.6
10.0	8.6	8.0	7.37	7.0	6.8	6.5	6.4	6.3	6.1	6.0	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.45	4.4	4.35	4.3	4.25	4.2	4.15	4.1	4.04	4.0	3.94	3.9	3.83	3.8	3.73	3.7	3.63	3.6	3.54	3.5	3.45	3.4	3.36	3.32	3.3	3.27	3.25
9.5	8.2	7.6	7.0	6.6	6.4	6.2	6.04	6.0	5.6	5.7	5.5	5.4	5.3	5.2	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.4	4.32	4.3	4.23	4.2	4.13	4.1	4.04	4.0	3.94	3.9	3.84	3.8	3.74	3.7	3.64	3.6	3.54	3.5	3.45	3.4	3.36	3.32	3.27	3.23	3.2	3.16	3.12	3.10	3.08
9.0	7.8	7.2	6.6	6.3	6.1	5.9	5.7	5.6	5.5	5.4	5.2	5.1	5.0	4.93	4.9	4.74	4.7	4.6	4.5	4.4	4.3	4.2	4.1	4.05	4.0	3.96	3.92	3.9	3.82	3.8	3.73	3.7	3.64	3.6	3.55	3.5	3.45	3.4	3.36	3.32	3.27	3.23	3.2	3.16	3.12	3.10	3.06
8.5	7.3	6.8	6.25	6.0	5.7	5.5	5.4	5.3	5.2	5.1	5.93	4.9	4.6	4.7	4.6	4.5	4.4	4.3	4.2	4.1	4.06	4.0	3.9	3.82	3.8	3.74	3.7	3.65	3.6	3.57	3.53	3.5	3.43	3.4	3.35	3.3	3.26	3.2	3.17	3.14	3.1	3.05	3.01	2.98	2.95	2.92	2.9
8.0	6.9	6.4	5.8	5.6	5.4	5.2	5.1	5.0	4.9	4.8	4.6	4.56	4.5	4.4	4.3	4.2	4.16	4.1	4.0	3.9	3.8	3.7	3.64	3.6	3.56	3.52	3.5	3.44	3.4	3.36	3.32	3.3	3.23	3.2	3.15	3.1	3.07	3.03	3.00	2.95	2.9	2.87	2.83	2.80	2.78	2.75	2.74
7.5	6.5	6.0	5.5	5.2	5.1	5.0	4.8	4.7	4.6	4.5	4.4	4.3	4.2	4.1	4.05	4.0	3.9	3.8	3.7	3.64	3.6	3.5	3.4	3.34	3.3	3.2	3.15	3.12	3.1	3.04	3.0	2.97	2.94	2.90	2.86	2.83	2.8	2.76	2.72	2.69	2.65	2.61	2.58	2.54	2.51	2.48	2.46	2.43	2.41	2.40
7.0	6.0	5.6	5.2	4.9	4.7	4.6	4.5	4.4	4.3	4.2	4.1	4.0	3.9	3.84	3.8	3.7	3.64	3.6	3.5	3.4																															

CONFIDENTIAL

EXPLANATORY NOTES
TO ACCOMPANY CURVES FOR COMPUTING
SUBMARINE SPEED AND ENDURANCE SUBMERGED

GENERAL

The capacity of a submarine's storage battery in ampere hours varies with the rate of discharge. The capacity at the 18-hour rate is approximately double that at the 1 hour rate. Additional capacity can be obtained by lowering the rate of discharge. The accompanying curve forms a ready means of calculating the remaining capacity of a submarine's storage battery in terms of hours at various speeds.

Directions for using Curve.

First, select the horizontal line of figures, below the curve, which start at the left with the submerged speed at the 1-hour rate for the particular submarine under consideration (obtained from "Fleets"). Thereafter use only this horizontal line of figures for various speeds of the particular submarine.

(a) Changing from a higher to a lower speed: Pick the higher speed in the line of figures already selected at the bottom of the curve. On the vertical ordinate of the curve above this speed lay off with dividers the time run in hours at this speed. This can be most conveniently measured from the top curve down to the figure showing the number of hours. With the dividers still set as above, move over to the vertical ordinate above the lower speed. Here measure from the bottom up and the upper leg of the dividers will indicate the time for which the submarine can run at the lower speed.

(b) Changing from a lower to a higher speed: Pick the lower speed in the horizontal line of figures already selected. On the ordinate above this speed, lay off the number of hours this speed has been used, and pick off the number of hours remaining for this speed. With the remaining hours and the maximum hours for this speed (from the curve) compute the percentage of the battery remaining. From this percentage and the maximum hours for the higher speed, compute the hours the higher speed can be used.

(c) Changing from higher to a lower speed after other lower speeds have been used: To find the number of hours remaining at the final speed: add all the segments of ordinates representing runs at speeds higher than the final speed; add to these the lengths of ordinate obtained as in (b) above for speeds lower than the final speed; and apply the resulting total to the ordinate above the final speed.

Note that if a battery charge has been completely exhausted at any speed, neither that speed nor a higher speed can be used again even if the above method indicates a remaining capacity in going up from a lower speed.

EXAMPLE

A submarine which has a maximum submerged speed of 10.0 knots for one hour starts a submerged run with a full battery and runs for 1 hour and 30 minutes at 8.0 knots and then slows to 5.0 knots. (All speed figures will be found in the horizontal line which starts at 10.0 below the curve). On the ordinate above 8.0 knots (in line with 10.0) lay off 1½ hours down from the top curve. Transferring this distance over the ordinate above 5.0 knots (still in the line starting with 10.0) and laying it off from the bottom up we find that the submarine can run 13 hours at 5.0 knots.

The submarine runs for 5 hours at 5.0 knots and then desires to make 10.0 knots. At that time she could continue to run 8 hours (13 minus 5) at 5.0 knots. It is noted on the curve that at 5 knots the battery is discharged at the 20 hour rate. Hence she has remaining battery capacity of 8 divided by 20, or .4 of full capacity. At 10.0 knots, which is the 1 hour discharge rate, the submarine can run for .4 of 1 hour, or 24 minutes.

After running for 24 minutes at 10.0 knots the submarine's battery will be completely discharged at that speed. However, as she can continue to run at a lower rate, it is decided to determine how long she can continue to run at the 48 hour rate, or at a speed of 3.42 knots or less. Therefore the following ordinates are added and laid off on the ordinate above 3.42 knots: 24 minutes at the 1-hour rate, 1½ hours at the three hour rate, and 5 hours at the 20 hour rate. This measures 37 hours along the 48 hour (or 3.42 knot) ordinate and thus gives 11 hours as the remaining life of the battery at this rate.

SECTION I - SUBMARINES

In other sections of these rules there are included the following rules which have particular bearing on submarine performance:

Rule D-4 (tables) --- Visibility from submarines, and visibility of submarines on the surface.

Rules D-8 and 9 --- Visibility of periscopes.

Rule D-10 --- Information obtained with periscope.

Rule J-10 (b) --- Visibility of aircraft from periscope.

Rule J-13 (a) --- Visibility of submerged submarine from aircraft.

Rules D-28, 29 --- Underwater sound.

Rule E-14 --- Radio communication.

Rules E-20, 21 --- Sound communication.

Rules G-213, 214 --- Torpedo fire.

Rules J-13 (b), (c) --- Effect of aircraft bombing.

- - - - - - - -

Rule I-1. A submarine underway is considered as being either in the surface condition or submerged. While in the surface condition, a submarine is always ready for quick dives.

Rule I-2. A submarine requires the following times to change condition:

(1) From surface condition, underway with both engines to "Periscope under", i.e., to disappear - one minute.

(2) From submerged to surface condition at normal speed, - one minute.

(3) Speed during the interval of changing from one condition to the other, - not over maximum submerged speed.

Rule I-3. The time a submarine is submerged shall be reckoned from the instant she begins to submerge until she begins to come to the surface.

Rule I-4. The necessary securing of the radio set can be done while flooding; preparatory to diving. While submerged to a depth greater than periscope depth, submarines can neither transmit nor receive by radio. (See Rule E-14).

Rule I-5. (a) Submerged speeds and radii for one hour are as given in "FLEETS".

(b) Endurance at lower speeds may be obtained from the curve at the beginning of this section as explained on page i-1.

Rule I-6. The time and fuel required for charging batteries will be computed as follows:

A. SUBMARINE (SS) AND SUBMARINE MINELAYERS (SM)

(As designated in "FLEETS"). Assumed to have four Main Engines and one Auxiliary Charging Engine.

(a) When taking current from a tender or shore base or when not underway and charging batteries with the submarine's engines:

Engines in use	Time in hours under given engine combinations. The following % of charge				Fuel expended same as for SS Making
	100%	90%	75%	37½%	
2M	2.0	1.7	1.0	0.6	15 knots
then 1M	2.6	2.6	2.5	1.0	11 knots.
then A	2.0	2.0	2.0	1.6	10 knots.
Total time of charge	6.6	6.3	5.5	3.2	

(b) While underway on the surface and charging batteries with the submarine's engines:

Engines in use	Time in hours for charging under given engine combinations the following % of charge				Fuel expended same as for SS Making
	100%	90%	75%	37½%	
(1) 2M	2.0	1.7	1.0	0.6	15 knots
then 1M	2.6	2.6	2.5	1.0	11 knots
then A	2.0	2.0	2.0	1.6	10 knots
Total time of charge	6.6	6.3	5.5	3.2	
(2) 1M	6.0	4.8	4.0	1.2	11 knots
then A	2.0	2.0	2.0	2.0	10 knots
Total time of charge	8.0	6.8	6.0	3.2	
(3) A	12.0	11.5	9.0	4.0	10 knots

A table of fuel expenditures in tons per hour at designated speeds will be found in "FLEETS".

(c) While underway on the surface and charging batteries, the limiting maximum speeds that the submarine can make are:

1. Charging with two main engines -- 80% of the maximum speed as given in "FLEETS".
2. Charging with one main engine -- 90% of the maximum speed as given in "FLEETS".
3. Charging with auxiliary engine -- Maximum speed as given in "FLEETS".

B. OLD SUBMARINES (OSS) and OLD SUBMARINE MINELAYERS (OSM)

(As designated in "FLEETS"). Assumed to have two main engines

(a) When taking current from a tender or shore base or when stopped on the surface using both engines for charging:

% of charge	Time in hours	Fuel expended same as for SS making
100%	8.0	15 knots for 2 hours, then 8 knots for 6 hours
90%	6.0	15 knots for 2 hours, then 8 knots for 4 hours
75%	4.0	15 knots for 2 hours, then 8 knots for 2 hours
37½%	2.0	15 knots for 1 hour, then 8 knots for 1 hour

If maximum speed is less than 15 knots then, where the above table calls for fuel expenditure as if making 15 knots, the fuel expenditure at maximum speed will be used.

(b) Using one engine for charging batteries while running on the surface with the other engine the above times will be increased 25%. The total fuel expenditure for both engines will be computed for a speed of 3/2 that actually being made. In this case the maximum speed that can actually be made will be 2/3 of that which could have been made if not charging.

C. In case the charge is taken from a tender, the fuel expenditure as computed above will be charged to the tender. If the tender uses coal as fuel the figures obtained above in fuel

oil will be converted to coal on the basis of 100 tons of oil equalling 150 tons of coal.

Rule I-7. Submarines are assumed to be fitted with Recognition Signal Ejectors for the purpose of releasing colored smoke bombs when submerged. A submarine may be identified one minute after firing the recognition signal, when submerged. These signals can be seen and identified at a distance of four (4) miles.

Rule I-8. Vessels may lay depth charges at the following rate:

If making 11 to 15 knots ..... 5 per min.
If making 16 to 20 knots ..... 10 per min.
If making 21 knots or more ..... 15 per min.

Rule I-9. When, on sighting a periscope, vessels proceed to the spot where it disappeared and then lay depth charges, damage will be assessed by the Director, who will base his decision upon (1) track and depth of submarine, (2) tracks of attacking vessels, (3) number, time(s) and position(s) of dropping depth charges, (4) depth setting used. Damage inflicted may include (1) disablement for a given number of hours, (2) rupture of outer hull, (3) rudder and/or propeller damage, (4) total destruction.

Rule I-10. In consideration of the limitations imposed by fuel, fresh provisions, supplies, materiel and habitability, and reduction in efficiency of personnel, submarines may operate away from a base or tender for periods not longer than the following:

A. SUBMARINE (SS) and SUBMARINE MINELAYERS (SM).

(a) For raiding operations, in which the submarine will be required to conduct only intermittent submerged operations for not more than fifteen (15)days of the total period - 75 days.

(b) For patrol operations, in which the submarine will remain submerged during most of the daylight hours - 30 days on station plus the time required for proceeding to station and returning to base - total time not to exceed 60 days.

B. OLD SUBMARINES (OSS) and OLD SUBMARINE MINELAYERS (OSM).

(a) For raiding operations, in which the submarine will be required to conduct only intermittent submerged operations for not more than 10 days of the total period - 20 days or the limit of fuel capacity, if less than 20 days.

(b) For patrol operations, in which the submarine will remain submerged during most of the daylight hours - 10 days on station plus the time required for proceeding to station and returning to base - total time not to exceed 20 days or the limit of fuel capacity, if less than 20 days.

C. The Director may reduce the length of the above operating periods when weather, operations in tropics, or other unfavorable circumstances warrant.

D. An upkeep and rest period must be allowed after each maximum operating period as follows:

(a) SS and SM ------ 30 days,

(b) OSS and OSM ---- 10 days.

An operating period less than the maximum will be followed by a rest period reduced from the above in the same proportion as the operating period was reduced from the maximum.

SECTION J - AIRCRAFT

SECTION J - AIRCRAFT

Conventional Rules for Aircraft.

Rule J-1.

(a) The Maneuver Rules concerning aircraft are conventions adopted for the purpose of giving a comparative basis for the employment of aircraft in the strategical and tactical games. They are based upon average conditions, and the Director will modify their application whenever necessary for realism in the existing situation.

(b) During bad weather or other hazardous flying conditions, the Director may rule that aircraft are unable to take the air, or that such hazards exist as will entail the application of unusually heavy percentages of casualties to flights.

(c) Airdromes used for the regular operation of modern heavily loaded landplanes should have the following characteristics:

1. Three runways; or a lesser number if the prevailing wind is dependable; or a large area which could include such runways.

2. Minimum size of each runway should be 3,000 feet by 300 feet, clear of obstacles 1,000 feet from each end of the long dimension; level across the short dimension and approximately level along the long dimension; no soft spots, sand, soft earth, mud or marsh; tree clumps are valuable as cover along the long sides.

3. Length of time to prepare each runway, by the equivalent of an Engineer or Labor Battalion with appropriate machinery:

(1) Flat open terrain, no cuts or fills - 1 week.

(2) Ditto, but requiring heavy clearing - 5 weeks.

(3) Moderate rolling and open terrain, some cuts and fills - 3 weeks.

(4) Ditto, but requiring heavy clearing - 6 - 10 weeks.

TACTICAL QUALITIES OF AIRPLANES.

Rule J-2.

All flights of individual airplanes must be made under one or another of the conditions indicated in the pamphlet "AIRPLANE CHARACTERISTICS", which lists the tactical qualities of airplanes currently employed in the United States Navy. Where airplanes of different types are proceeding in company, the Director if requested will rule as to speed and fuel consumption.

GENERAL RULES FOR AIRPLANES.

Rule J-3.

(a) Airplanes are assigned to squadrons or to other specific organizations on board ship or at shore stations. Players may change these assignments by appropriate orders.

(b) Airplanes available will be listed in the statement of the problem.

(c) All aircraft squadrons, whether based on board ship or at regularly established shore stations, will be considered as having available spare airplanes in a disassembled condition equal in number to 25% of the operating allowance, unless otherwise specified in the statement of the problem. During the progress of the maneuver these spares may be set up to replace crashed airplanes after the time required for assembly, (see Rule J-6), and may be flown thereafter, provided flying personnel are available.

(d) Airplane tenders (AV) may transport on board all VO, VS or VF airplanes assigned to them, or 20% of the VB, VTB or VP airplanes of their allowance.

(e) Airplanes may rendezvous without penalty over a visible object at the time specified, (subject to navigational penalties in accordance with Rule A-9), but in the absence of visible objects airplanes starting from points more than 20 miles apart may rendezvous only through the use of intermediate

frequency radio. At night, with no fog, airplanes may assemble if all display running lights; after assembly they may fly together if each airplane displays one white light visible one mile above and to the rear. If flying alone, or in moonlight, airplanes may dispense with all lights except during assembly.

(f) Amphibian airplanes may operate either as landplanes or as seaplanes.

(g) During landings or take-offs at night, either from a vessel or a flying field, lights must be exhibited that are visible to a distance of five miles, provided natural obstructions do not interfere with sight. If planes are taking off from a carrier on a moonless night, a searchlight must be trained horizontally by an accompanying vessel about three miles ahead of the carrier.

(h) Landplanes landing in the water, seaplanes landing on land, and airplanes shot down by AA fire or in combat, will be considered wholly crashed, and will not be considered available for further employment in the maneuver.

(i) In cases of crashes under Rules J-1, and J-8, one-half the pilots involved, but none of the airplanes, will be considered available for further employment.

(j) Airplanes may be employed for gunnery observation in accordance with Rule F-2.

(k) Airplanes may carry parachute flares in accordance with Rule D-15.

(l) Rules for aircraft communication are set forth in Section E.

(m) The discharge of chemical agents from aircraft is governed by the rules of Section K.

(n) Small planes searching singly are subject to navigational errors and to liability to communication failures to a somewhat greater degree than are several planes in company, and

their ability to keep a good lookout and to sight objects within the assumed range of visibility is reduced. For these reasons the effectiveness of search by single, small planes may be ruled to have no more than 75% of the effectiveness of search by two or more similar planes in company.

SPECIAL RULES FOR CARRIER-BASED AIRPLANES

Rule J-4.

(a) As the space on carriers is limited, players will at all times be prepared to inform the Director as to the location on board of all airplanes, the order in which they are "spotted" on the flight deck or in the hangar, whether any have their wings folded, and which are disassembled. They will also keep record of the fuel in the airplanes and on board, and make the proper time allowances for the movement of airplanes between flight deck and hangar, for warming up, take-off, landing, reservicing, checking, etc.

(b) In computing available space, 1 VTB is considered as occupying as much space as 2 VF, and 3 VF as occupying as much space as 2 VS, 2 VB, or 2 VTB with wings folded.

(c) No airplane while carrying a torpedo may land on a carrier. Airplanes can be landed in their usual manner while carrying their bomb loads.

(d) All carriers are considered to have two elevators between the flight and hangar decks. Either elevator may carry one airplane of any class except VF, of which it may take two. A round trip between the flight and hangar decks requires one minute.

(e) All airplanes are considered to be either fully assembled or disassembled, except that VT airplanes may have their wings folded. To fold or unfold wings requires 30 seconds per airplane.

(f) With the complete allowance on the flight deck, airplanes may be launched, but may not be landed.

(g) With three-fourths of the allowance on deck, airplanes may either be taken off or landed, but both operations may not be performed simultaneously. Airplanes may be launched by catapult with full allowance of airplanes on the deck. When airplanes are landed with three-fourths of the planes on deck, a time allowance of 45 minutes for re-spotting must elapse before any airplanes can be launched over the bow.

(h) With one-half the allowance on deck, airplanes may be taken off and landed simultaneously.

(i) No more than one-half the allowance of airplanes may be placed in the hangar at one time, unless the excess are disassembled.

(j) When the carrier's course is more than 20° off the true wind, it requires five minutes to head into the wind and to begin landing airplanes, or launching them off the deck. They may be launched by deck catapult with no change of course provided the apparent wind is forward of the beam and not over 45 knots.

(k) To launch airplanes off the deck, or to land airplanes, the apparent wind must be within 10° of the fore-and-aft line, and the wind over the deck must be between 15 and 45 knots. With more than 45 knots apparent wind, all airplanes on deck must be lashed down. Carriers equipped with hangar deck catapults may launch aircraft on the windward side with the wind from any direction whose apparent force is not over 45 knots.

(l) During daylight under normal conditions, airplanes on deck may be launched at intervals of 15 seconds, and landed at intervals of 30 seconds. During rough seas, these intervals are doubled. At night these intervals are tripled. Airplanes may be launched from catapults of a carrier at the rate of one every 40 seconds. Simultaneous launching of airplanes on deck and from hangar catapults may be made. Airplanes may be re-spotted on deck in the time required for refueling and rearming. (See Rule J-7).

(m) Unscheduled launching may start five minutes after the decision is made to begin them, provided planes are on deck ready for take-off and provided they are not to go beyond 100 miles from the carrier; for longer flights, preparations will require 15 minutes before the start of launching; or, if planes take off at once, planning will require 30 minutes before planes in the air can leave on a long flight.

(n) A carrier can no longer land or launch airplanes after it has received 50% total damage, or after its flight deck has been destroyed. (Rule F-23).

(o) Each carrier is considered to have arresting gear both forward and aft. That is to say, it may land planes while either going ahead or backing into the wind. (See Rule J-18 (e)).

SPECIAL RULES FOR SEAPLANES

Rule J-5.

(a) To launch an airplane by catapult, a vessel may be on any heading with respect to the wind.

(b) Each catapult may launch one airplane every five minutes.

(c) A submarine may launch its airplane by floating off, 10 minutes after surfacing, and recover it in the same time.

(d) After stopping, a vessel may hoist out one airplane on each side every five minutes if the wind force is not above two; above two, a vessel may hoist out one airplane on the lee side every five minutes.

(e) After stopping, or heading to within 30° of the wind and slowing to ten knots, a vessel may hoist in one airplane on each side every ten minutes if the wind force is not above two; above two, a vessel under the same conditions may hoist in one airplane on the lee side every ten minutes.

TIME ALLOWANCES FOR ASSEMBLY AND DISASSEMBLY.

Rule J-6.

(a) Squadrons have one assembly crew for every six airplanes of their allowance. When a ship's allowance is less than six, it is considered to have one complete assembling crew attached to it, provided it normally carries airplanes.

(b) One assembly crew can assemble or disassemble:

1 VF, VO or VS in 8 hours,

1 VTB or VB in 24 hours,

1 VP in 48 hours.

(c) Assembly of spare airplanes cannot be carried out by squadron personnel concurrently with checking squadron airplanes.

TIME ALLOWANCES FOR RENEWING OPERATIONS.

Rule J-7.

(a) After completing one flight, airplanes may not make a subsequent flight until sufficient time has elapsed for refueling, re-arming, or checking, in accordance with the following rules, which may be varied by the Director to meet exceptional conditions. Re-servicing times indicated include the times necessary for take-off and landing, except in the case of carriers.

(b) TIMES REQUIRED FOR RE-FUELING

Times indicated for VB, VTB or VP are NOT ADDITIVE to those for VF, VO or VS airplanes.

AIRPLANE CLASS	LANDPLANES AT FLYING FIELD OR ON CARRIER	SEAPLANES AT PERMANENT RAMP	SEAPLANES AT EACH TENDER (AV)
1 to 20 VO,VF,VS	25 minutes	1 hour	1 hour
Each additional 20	Add 20 minutes	Add 5 minutes for each plane.	Add 1 hour
1 to 12 VB,VTB,VP	30 minutes	2 hrs. 30 minutes.	1 hour
Each additional 12	Add 25 minutes		

Seaplanes refueling from AVPs or at temporary ramp require 15 minutes for each plane regardless of number.

Battleships, cruisers and submarines require 30 minutes to refuel one or more small seaplanes of their allowance after they have been hoisted on board. AT NIGHT, the above times are increased by 50%. In the open sea, in smooth water, ships with gasoline may refuel one VP in one hour. They may not refuel planes in the open sea except in smooth water.

(c) Re-arming with bombs, machine gun ammunition, or torpedoes may be carried on concurrently with re-fueling, but may take a longer time. To load bombs, machine gun ammunition, or torpedoes on airplanes on a carrier requires 30 minutes longer than does refueling alone (at NIGHT, one hour). For tender or shore-based squadrons, it is assumed that one large bomb or torpedo, regardless of size, requires the same time for loading, and that each squadron has on hand half the number of bomb trucks or floats as the allowance of airplanes.

(d) RE-ARMING TABLE FOR TENDER AND SHORE-BASED AIRPLANES

CONDITION	LANDPLANES AT FLYING FIELD	SEAPLANES AT PERMANENT RAMP	SEAPLANES AT TEMPORARY RAMP OR TENDER
Time per truck or float to load each bomb or torpedo.	10 minutes	15 minutes	30 minutes

(e) After operating in the air for a period of not more than 30 hours, airplanes must be laid up for checking.

Airplanes operating from their regular base, with all squadron personnel available, may be checked as follows:

1st	6 airplanes	6 hours	
2nd	6 "	2 "	additional
3rd	6 "	2 "	"

(Note: Total time required for one 18 plane squadron is therefore 10 hours.)

Airplanes operating from other than their regular base, or with reduced squadron personnel, require double the above time

(f) One pilot is allowed for every VF, VO, VB or VS, and two for every VB (Army), VTB or VP airplane of the operating allowance. No spare pilots are carried. Multi-place airplanes making flights longer than 8 hours must carry two pilots.

Two pilots must be carried in sight-bombing planes if it is desired to operate the bomb sight.

(g) Due to fatigue, the limit of endurance for pilots in the air is as follows:

VF, VO, VB, VTB and VS airplanes: Flights aggregating more than 12 hours may not be made in any one day. Flights aggregating between 9 and 12 hours in any one day must be succeeded by a 12-hour rest period. No VF, VO, VB, VTB or VS pilot is permitted to fly more than 50 hours in one week, nor more than 80 hours in one month.

VB (Army), and VP airplanes: A flight longer than 20 hours, or aggregating more than 20 hours in any one day, must be succeeded by a rest period of 24 hours. Flights aggregating between 9 and 20 hours in one day, must be succeeded by a rest period of 12 hours. No VB (Army), or VP pilot is permitted to fly more than 70 hours in the week, nor more than 120 hours in one month.

(h) Pilots in squadrons or airplanes that are not in the air during one or more days, may relieve pilots in other squadrons of airplanes of the same general type for that period.

(i) When pilots have flown under unusually hazardous conditions, or have been repeatedly exposed to heavy anti-aircraft fire or aerial combat, the Director may rule some of them temporarily out of action due to excessive fatigue, or minor wounds.

AIRPLANE OPERATIONAL LOSSES.

Rule J-8.

(a) Airplane operational losses occur from engine failure, landing and take-off crashes, collision, hoisting in and out of ships, crashes during thick weather or high winds, and forced landings due to fuel exhaustion, the latter usually being due to uncertain navigation or failure to make an expected rendezvous with the parent vessel. During game maneuvers a percentage of loss will be applied to all flights, and whenever the percentage of loss for a squadron adds to 100, one airplane of that squadron will be removed permanently from the game. Penalties involving temporary delay due to minor damage may be assigned by the Director. In connection with the following table, conditions at point of take-off and landing, and those encountered en route, will govern the application of the loss penalty; in a sheltered harbor a smooth sea is always considered to exist, regardless of the force of the wind.

(b) PERCENTAGE OF LOSS DURING OPERATION

TYPE OF AIRPLANE	CLASS OF AIRPLANE	SMOOTH SEA	MODERATE SEA	ROUGH SEA
Seaplane	VF, VO, VS	0.5%	1% to 50%	20% to 100%
do	VTB, VB	0.5%	10% to 50%	100%
do	VP	0.2%	1%	25%
do	Any class, wind above force 6 - 50%			100%
Add for catapulting, any class		0.0%	0.0%	1%
Carrier Plane, any class		0.5%	0.7%	1%

Landplanes operating from shore have a crash percentage of 0.1% per flight.

FOG take-offs of ship based planes have a crash percentage of 50%. Fog landing of seaplanes have a crash percentage of 50% in smooth seas; all other fog landings, 100%.

NIGHT SEAPLANE LANDINGS IN STRANGE HARBORS have a crash percentate of 5%. Night seaplane landings in the open sea have a crash percentage triple that for day landings.

SEAPLANES IN THE OPEN SEA may land and remain on the water without penalty other than that in the foregoing table for the following periods.

DAYLIGHT: Smooth sea, throughout daylight,
Moderate sea, four hours,
Rough sea, one hour.
NIGHT: Smooth sea, four hours.
Rough and moderate sea, one hour.

For longer periods, a crash percentage of 25% is incurred.

(c) Airplanes subjected to the blast of guns may be damaged. The Director will assign the damage, taking into consideration the caliber of the guns and their relative position with respect to the airplanes. Crash losses from gun blast involve airplanes but do not involve pilots, (see Rule J-3(i)).

(d) In planning flights, a fuel reserve of 20% should be allowed for formation-keeping, rendezvous, climb, and possible adverse weather or navigational conditions. Airplanes whose flights are planned to use more than 80% of their fuel on any flight will be assessed a crash probability of 20%; if more than 90% of their fuel, they will be assessed a crash probability of 50%.

SPEED AND NAVIGATION.

Rule J-9.

(a) Air speed is given in "AIRPLANE CHARACTERISTICS". For simplicity in the maneuvers, ground speed will be obtained by adding or subtracting the full force of the wind to the air speed on any course that has a wind component with or against the airplane's course, respectively, and will be taken to the nearest ten knots. Time of flight will be taken to the nearest 5 minutes.

(b) Also for simplicity, airplanes will be considered to make good the courses steered, lateral drift being disregarded.

(c) the Director may adjudge the navigation of airplanes to be erroneous in accordance with Rule A-9.

(d) On a partly cloudy day, airplanes flying above the lower level of the clouds will have a 50% chance of seeing or being seen in accordance with the visibility tables of SECTION D or Rule J-10. If they attempt to bomb from above the lower cloud level, they will be able to drop their bombs within one-half hour after the time the player sets, in whichever 10-minute interval the Director determines by the throw of a die. For bombing through a Chemical Blanket Screen see Rule K-15.

DISTANCE OF SIGHTING AIRCRAFT.

Rule J-10.

(a) Airplanes can be seen in the air from other aircraft at the horizontal distances given below, (figures in miles), provided the difference of altitude between the observer and the plane observed is not over 2000 feet. For greater differences of altitude decrease the figures in columns 1 and 2 below by one-half miles for each additional 1000 feet.

(1) Normal visibility:

Class seen	Number in group	-- Col. 1 Same altitude or higher than observer	Col. 2 Lower than observer
VP, VTB, VB (Army)	1	5	3
VP, VTB, VB (Army)	2-6	7	4
VP, VTB, VB (Army)	7 plus	8	5
VF, VS, VO, VB	1	4	2
VF, VS, VO, VB	2-6	6	3
VF, VS, VO, VB	7 plus	7	4

(2) High Visibility.

Add one mile to distances in foregoing table.

(3) Low Visibility.

Use 1/3 distances in foregoing table.

(b) Airplanes can be seen by an observer on a surface vessel or on land 1 mile farther than the distances of column 1 above (visibility conditions being modified as in "(a)" and in "a(2)" and "a(3)").

Airplanes can be seen by submarine periscopes the same distance as by observers on surface craft, but the chances of seeing for each all-around observation are according to the following table:

Range	Chance
Maximum	1 in 10
3/4 max.	1 in 8
1/2 max.	1 in 5
1/4 max.	1 in 3

(c) Distances that rigid airchips may be seen will be considered to be one-third the distance farther than that which large vessels may be seen from aircraft under the various conditions of visibility.

Non-rigid airships may be seen one-third the distance farther than the distance at which intermediate sized vessels can be seen from aircraft.

(d) While the sun is visible, the above figures will be considerably reduced in the general direction of the sun from the observer; each case will be decided by the Director.

SOUND DETECTION OF AIRPLANES.

Rule J-11.

Sound detectors on shore can locate approaching aircraft according to the following table:

No. planes in flight.	Located accurately yards.	Located approximately yards.
1	11,000	20,000
3	12,000	22,000
7	13,000	25,000
13	14,000	27,000
18	15,000	30,000

Ground winds decrease the ranges as follows:

Wind Beaufort	Decrease range percent of above.
1	0
2	10
3	20
4	30
5	40, etc.

A few installations exist of other (secret) means of detecting airplanes at a distance of several miles. The Director will rule as to their availability on request.

AERIAL PHOTOGRAPHY

Rule J-12.

Photographs may be taken and prints made by planes except single seaters at any altitude up to their maximum, provided previous arrangements have been made, and predicted on the Flight Form.

Under normal visibility conditions, such photographs will be considered to record vessels of intermediate or larger size to a maximum distance of 20 miles and to permit recognition of the above vessels as to type to a maximum distance of 15 miles. Corresponding figures for small size vessels are 15 miles and 12 miles.

Photographs from hand-held cameras may be considered developed and printed either in the air or on the ground 30 minutes after the last exposure has been made. Photographs from mapping cameras require three hours for developing and printing after return to base.

AIRCRAFT SIGHTING SUBMARINES, MINES AND TORPEDOES.

Rule J-13.

(a) Submarines submerged to a depth of 80 feet or less, and mines submerged to a depth of 10 feet, can be seen from aircraft under favorable conditions. These conditions are affected by the following, - depth and clarity of water, nature of bottom, condition of surface, light effect, altitude and relative position of observer. The Director will decide each case after considering the attending conditions. (See Rule H-11).

(b) 500-pound and 1,000-pound bombs have delayed action fuses, and are effective against submarines to a depth of 40 feet.

(c) Depth charges may be dropped from airplanes if they are listed in the statement of the problem as being available. When they are used against a submerged submarine, they will have the same percentage of hitting as has bombing on an "Intermediate" size target. One full hit by a depth charge will be considered as sinking the submarine.

(d) The wake of torpedoes can be seen from aircraft detailed for observation, in general, as follows:

1. Can be seen best at altitude of 500-1000 feet over torpedo.
2. Can be seen at a maximum altitude of 7000 feet over torpedo.
3. Can be seen at an altitude of 5000 feet and a horizontal distance of 2 miles from torpedo under usual visibility conditions.
4. Cannot be seen in a moderate or rough sea.

AIRCRAFT SMOKE SCREENS.

Rule J-14.

(a) Aircraft may lay smoke screens by means of smoke boxes dropped on the ground or water, or by discharging a chemical carried in tanks in lieu of bombs. Smoke screens are effective for eighteen minutes, and drift with the wind.

(b) Smoke boxes may be carried in lieu of 100-pound bombs, and in the same numbers as allowed for the various classes of airplanes. They may be dropped from any altitude; to be effective, a screen must be laid with at least 6 boxes not over 200 feet apart.

(c) Smoke curtains are laid by Heavy Smokers, which may be VS, VB or VTB airplanes, or by Light Smokers, which may be VS, VJ, or VO airplanes. Airplanes can carry smoke in tanks in accordance with the table in the current "Airplane Characteristics".

(d) Smoke curtains are laid at from 50 to 150 feet from the surface; the lower edge drops to the surface and the upper edge rises about 100 feet. One large tank will lay an effective curtain about 2000 yards in length, and one small tank will lay an effective curtain about 600 yards in length.

(e) Due to hostile opposition and incorrect estimate of position, 25% of aircraft smoke screens are improperly placed, and may be as much as 5000 yards out of position, or laid too high to be effective. The amount and direction screens are displaced will be decided by the Director.

(f) It requires one hour to rig filled smoke tanks on airplanes, and two hours to re-fill them.

(g) Allowances of smoke tanks for vessels will be found in the publication "Fleets".

EFFECTS OF AERIAL COMBAT.

Rule J-15.

The Director will assign permanent or temporary losses after consideration of the conditions of the combat, making due allowance for the dispositions of aircraft with respect to altitude, formation, and positions allowing mutual support. Situations will so vary that certain conventions have been adopted as guides in arriving at decisions; these conventions, while they

may not always be strictly accurate, are in general sufficiently so for the purposes of the Chart and Board Maneuvers.

AERIAL COMBAT CONVENTIONS.

(1) Each aerial combat expends one-half of the available machine-gun ammunition.

(2) A group making one aerial attack cannot again engage in less than 10 minutes.

(3) Groups of airplanes attacked by three times their number of other airplanes incur losses as shown in the table, and in addition may be driven off so as to be unable to resume their original mission before 30 minutes have elapsed.

(4) Aerial combat will not take place unless one combatant has the tactical advantage of speed or position which permits him to force it, or unless the defender accepts the hazard of combat in order to maintain his station or course.

TABLE "A". AERIAL COMBAT LOSSES.

"Attackers" refer to those planes making the combat attack, and "Defenders" refers to those receiving the combat attack.

ATTACKERS	DEFENDERS	ATTACKERS' LOSS	DEFENDERS' LOSS
n VF	m VF	m x .1	n x .15
n VF	m VOS(s)	m x .2	n x .3
n VF	m VSB, VB, VTB	m x .2	n x .2
n VF	m VP	m x .3	n x .3

Attackers with but one fixed machine gun, (VOS, VS, VTB and VB), inflict 50% of the damage inflicted by ordinary VF.

EFFECTS OF ANTI-AIRCRAFT FIRE.

Rule J-16.

(a) Losses from anti-aircraft fire will be as given in the following "Conventions for scoring Anti-Aircraft Gunfire". The Director may modify the application of these conventions when it appears that unusual conditions exist. Airplanes of

a bombing or torpedo unit are here considered to suffer fire losses prior to dropping bombs or torpedoes, and the number of effective bombs or torpedoes will be reduced accordingly. The airplane losses on retirement will be decided by the Director.

(b) Conventions for Scoring AA Gunfire.

(1) To establish a standard condition for scoring anti-aircraft gunfire, it is assumed that aircraft attacking ships will operate in divisions comprising six to nine planes; and that, in order to minimize the effects of gunfire, several divisions, will concentrate into one group and attack from one direction as rapidly as possible. Although about 100 planes of different classes can be handled tactically in the same group when cruising, it is assumed that during the attack they will split up into smaller type groups as follows:

(aa) Strafing planes, sight bombers, dive bombers, and torpedo planes attack in separate groups; consequently, except as noted under (cc), they can be fired upon successively by vessels which have AA guns which bear on them.

(bb) Not more than 60 planes can attack in one such group.

(cc) Only one group at a time is able to attack vessels in the same division, or concentrated destroyer squadron, but two groups are able to make simultaneous attacks upon different divisions of the same disposition.

(dd) A group may withdraw from an attack at the discretion of its commander if faced with the certainty of losses not commensurate with the results anticipated.

(2) AA gun fire (guns more than 2" in bore) is considered effective for scoring purposes as follows:

(aa) Only when the target airplanes are within a slant range of 7000 yards;

(bb) When from a maximum of not more than a total of eight BBs, (or equivalent), firing at the same group of airplanes;

(cc) Against dive bombers and strafers only during their approach.

(3) AA machine gun fire (guns less than 2" in bore) is effective only within a slant range of 3,000 feet.

(4) In computing the effectiveness of AA fire, the AA gun battery of a BB is taken as a unit. Batteries of machine guns also have their effectiveness computed in terms of the AA gun batteries of BBs. Except under special circumstances, the effectiveness of the batteries of all classes of vessels, in terms of the BB unit of fire, will be as shown in Table "B".

(5) The effectiveness of the AA fire of each firing unit may be reduced below unity by certain unfavorable conditions. These fractional reductions, which are cumulative when more than one unfavorable condition exists for any vessel, are shown in Table "C".

(6) The percentages of planes of any attack group shot down is based upon Table "D", which indicates estimated loss percentages sustained by sight bombers attacking from an altitude of 3,000 feet, and fired at only by AA guns. For other conditions of attack, the basic percentages taken from Table "D" are reduced by multiplying them by an appropriate reduction factor found in Table "E".

(7) To ascertain the airplane losses from AA fire, and thus to find the number of airplanes that remain effective for discharging bombs or torpedoes:

(aa) Obtain the number of airplanes in each attack group;

(bb) Determine from Table "B" the number of units firing against each attack group;

(cc) Obtain effectiveness of AA fire by appropriate reductions taken from Table "C";

(dd) With (aa) as ordinate, and (cc) as abscissa, find from Table "D" the "Basic percentage of loss" for each attack group;

(ee) Multiply (dd) by the appropriate reduction factor taken from Table "E";

(ff) Multiply (aa) by (ee) to obtain airplane losses in each group.

TABLE "B". AA FIRE EFFECTIVENESS OF SHIPS IN TERMS OF BB FIRE AS ONE UNIT

Kind of AA Fire	Class of Vessel							
	BB-CC, CA-CL with 8 AA guns over 4"	CV	CA-CL with 4 AA guns over 4"	Small CL	DD with dual purpose guns	DL,DD with small AA guns	ODD	Aux. Type
AA guns	1.0	1.5	.5	.3	.7	0	.05	.1
AA Machine guns	1.0	2.0	1.0	.5	.5	1.0	.2	.2

NOTE: Not more than 8 units can fire effectively against one airplane group. The actual fire effectiveness of each unit will be less than 1.0, if unfavorable conditions exist as listed in Table "C".

TABLE "C". LOSS OF EFFECTIVENESS OF GUNFIRE OF AA UNITS

Condition	Fractional Reduction
Firing ship under effective gunfire	0.20
Firing ship firing main or secondary battery	0.20
Firing ship strafed by at least 6 small planes just before attack	0.50
AA battery permanently damaged by previous strafing	0.30
Firing ship has 50% AW damage	1.0
Firing ship in rough seas	0.20

NOTE: If more than one unfavorable condition exists, the losses of effectiveness are cumulative.

TABLE "D". BASIC PERCENTAGES OF AIRPLANE LOSSES BY AA FIRE

NOTE: An airplane group which loses 40% of its units by combat and by AA fire, after computation of losses in Table D as reduced by Table E, is unable to complete the attack during which these losses occur.

Number of Planes	Number of Firing Units in Terms of BBs.							
	1	2	3	4	5	6	7	8
5	60	80	100	100	100	100	100	100
10	50	70	90	100	100	100	100	100
15	40	60	70	80	80	80	90	90
20	30	50	60	60	70	70	80	80
30	20	40	50	50	60	60	70	70
40	17	30	40	40	50	50	60	60
60	12	20	25	30	40	40	50	50
80	10	15	20	25	30	35	40	45
100	8	12	17	22	25	30	35	40

TABLE "E". REDUCTION FACTORS FOR DIFFERENT CONDITIONS OF ATTACK

Condition	Multiplier for Table "D"
Sight bombing, 3000' and up	1.0
Sight bombing, 7000' and up	0.6
Sight bombing, 11000' and up	0.2
Dive bombing approach (Use only AA gun units)	0.1*
Dive bombing dive (Use only AA machine gun units)	0.5*
Strafing (Use only AA machine gun units)	0.4
Torpedo attack, no smoke	0.6
Torpedo attack, with smoke	0.3

Night bombing, planes illuminated by searchlight, or day bombing from behind clouds, reduce losses by 50%.
Night bombing, planes not illuminated, AA fire is ineffective.

NOTE: The Director may increase the effect of the AA fire by as much as 30 percent to take care of special or unusual conditions.

*Compute these items separately, and then add them.

EFFECTS OF AERIAL BOMBING

Rule J-17.

(a) The sizes of bombs considered supplied to aircraft are 1000-pound, 500-pound, 100-pound, and 25-pound. The latter are effective only against personnel.

(b) Bombing methods. Bombing operations are at present conducted by two methods. These are known as "Sight Bombing" (also termed "Horizontal Bombing") and "Dive Bombing". Planes

bombing from 1000 feet or less are considered destroyed by their own bombs. The minimum bombing altitude permissible for sight bombing is 3000 feet. Small planes, (VO, VS, VF, VB) may also attack vessels by strafing them with small bombs and machine guns.

VTB, VJ and VP planes are not capable of dive bombing.

(c) Direct Bomb Hits. Under battle conditions, with adequate visibility, planes meeting with no resistance, and target on steady course, the numbers of bomb hits for a given number of bombs dropped on different sizes of targets have been assumed from analysis of available data.

(d) The factors which may operate to reduce the above percentages of hits are (1) attack by other planes, (2) anti-aircraft fire, and (3) maneuvers of target during bombing approach.

(1) Attack by hostile planes during the approach may reduce the number of bombers. It is assumed that defending planes discontinue their attack when bombers come under effective anti-aircraft fire. The table in Rule J-15 gives the losses to be expected in an aerial battle.

(2) If a bombing unit comes under effective anti-aircraft fire before releasing its bombs, the planes that are shot down by such fire will be determined in accordance with Rule J-16. It will be assumed that only the remaining planes drop their bombs.

(3) If the target maneuvers during the bombing approach, the accuracy of bombing will be reduced.

(e) The effects of strafing by small airplanes will be as follows:

(1) Ships subjected to strafing attacks by the equivalent of 12 VF airplanes, each carrying one .30 caliber and one .50 caliber machine gun,

and two 100-lb bombs will, for the remainder of the day, have their remaining fire effect reduced as follows: turret guns, 10%; secondary battery guns, 20%; AA guns, 30%.

(2) Ships subjected, just prior to a bombing attack, to strafing by 6 or more VF airplanes will have the effectiveness of AA batteries reduced by 50% during the succeeding bombing attack.

(3) As a special rule, it is considered that one VF airplane armed both with a 0.50 caliber machine gun and two 100-lb bombs, may inflict 30% damage on one DD smaller than 1500 tons, or 15% damage on one DD of 1500 or more tons. Small planes armed with either one 0.50 caliber gun, or two 100-lb bombs, may inflict half that amount of damage.

(4) In each strafing attack, airplanes are considered to drop all of their bombs, and to fire all of their .50 caliber and one half of their .30 caliber ammunition.

(f) If any unusual conditions arise for which the tables are not properly applicable, the Director will decide the amount of increase or decrease in the effectiveness of the attack.

(g) Reduced visibility as affecting Bomb Hits. Reduced visibility will not affect the accuracy of bombing provided the bomber can actually see his target.

(h) Night Bombing. In the case of night bombing, the Director will decide the amount of change, due to the low or reduced visibility, in any factors upon which the effectiveness of the attack depends. Normally night bombing planes attacking under favorable visibility conditions, or when the target is

illuminated with flares or searchlights, will drop their bombs with an accuracy 50% of that of a daylight attack.

(i) The percentage of hits is determined by the standard deck area of different sized targets. In addition to above-water direct bomb hits on a target, an additional number of hits alongside within 40 feet will be considered to have been made. For each above-water bomb hit, therefore, damage in 14" penetrative hits will be allowed both above-water and under-water, the latter depending upon the average value of one under-water bombing explosion within 40 feet, and the ratio of "probability of an above-water hit", for targets of each size and class. Fractional hits will be computed and scored as such.

(j) To summarize the method of determining the damage due to aerial bombing:

1st, Obtain from Table "A" the number of aircraft lost in combat prior to the bombing (Rule J-15);

2nd, Determine aircraft losses from AA fire (Rule J-16);

3rd, From Table "F" take percentage of direct bomb hits;

4th, Multiply this percentage by the "effectiveness factor" against maneuvering targets taken from Table "G";

5th, Multiply this figure by the number of bombs remaining after deducting those lost in combat and by AA fire; this gives the number of direct bomb hits;

6th, Multiply the number of direct hits by the appropriate values taken from Table "H" to get Above-water, Under-water, and Total Damage in 14" penetrative hits.

TABLE "F". PERCENTAGE OF DIRECT BOMB HITS, ALL CONDITIONS OF BOMBING

Target size	Dive Bombing	Sight Bombing 11000'	7000'	3000'
Large	16	8	15	30
Intermediate	9	5	9	20
Small	6	3	5	14
DD and SS	3	1	3	9

TABLE "G". EFFECTIVENESS FACTOR AGAINST TARGET IF IT MANEUVERS

Speed of Target	Single Ship				Ship in Formation			
	Dive Bombing	Sight Bombing 11000'	7000'	3000'	Dive Bombing	Sight Bombing 11000'	7000'	3000'
0 to 12 kts.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
12 to 25 kts.	0.7	0.5	0.6	0.7	0.8	0.6	0.7	0.8
Over 25 kts.	0.5	0.3	0.4	0.5	0.6	0.4	0.5	0.6

TABLE "H". DAMAGE CAUSED BY ONE DIRECT HIT IN 14" PENETRATIVE HITS

	BB	CV	CA	CL	DD-SS	AUX.TYPE
100-POUND BOMB						
Above Water	0.15	0.15	0.15	0.25	0.25	0.25
Under Water	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.15	0.15	0.15	0.25	0.25	0.25
500-POUND BOMB						
Above Water	1.00	1.25	1.25	1.75	1.75	1.75
Under Water	0.25	0.25	0.75	1.00	1.50	0.75
Total	1.25	1.50	2.00	2.75	3.25	2.50
1000-POUND BOMB						
Above Water	2.00	2.50	2.50	3.50	3.50	3.50
Under Water	0.75	0.75	1.50	2.50	3.50	1.50
Total	2.75	3.25	4.00	6.00	7.00	5.00

BOMB DAMAGE TO FLIGHT DECK AND AIRPLANES ON BOARD CARRIER.

Rule J-18.

It is assumed that:

(a) One full 1000-pound bomb hit or one full 500-pound bomb hit will temporarily destroy one-half the flight deck and one elevator of an aircraft carrier, i.e., either the forward or after portion. Such a hit over the hangar will destroy all airplanes and spare airplanes in the hangar.

(b) Such damage may be repaired in accordance with the following table:

TIME REQUIRED TO REPAIR FLIGHT DECK

NOTE: These times are applicable only to CVs, not to XCVs. If statement of problem specified that special repair equipment is not available, the time of repair by ship is doubled.

Damage	Temporary Repairs by Ship	Permanent Repairs by Base
Less than 2 500# hits	4 hours	10 days
Less than 2 1000# hits	6 hours	10 days
2 to 4 large bomb hits	36 hours	15 days
More than 4 large bomb hits	Cannot be repaired on board	30 days
5 or less small bomb hits	½ hour delay	None
6 to 10 small bomb hits	4 hours	2 days
11 to 20 small bomb hits	8 hours	5 days
More than 20 small bomb hits	Cannot be repaired on board	7 days

(c) Before temporary repairs have been completed. When either half of flight deck is destroyed, and after one-half hour has elapsed, planes may fly on or off in double normal interval, but only one-half the allowance of planes can be parked on deck. Carriers are assumed to have arresting gear both forward and aft; depending upon which half of the flight deck is destroyed, the carrier must back either for launching or for recovering planes.

(d) After temporary repairs have been completed. Planes may fly off in normal time, and may fly on in double that time required under normal conditions. Parking restrictions in (c) above are removed.

(e) Each large above-water full bomb hit will destroy 20% of the assembled airplanes actually on board a carrier at the time of the bombing, proportionately distributed as to class. Each 100-lb bomb will destroy 5% of the planes on deck.

EFFECTS OF AIRCRAFT TORPEDO ATTACK.

Rule J-19.

(a) Torpedo planes attacked in combat or by anti-aircraft fire will suffer losses prior to dropping torpedoes in accordance with Rules J-15 and J-16; the torpedoes of lost planes will not be considered effective. Aircraft torpedoes will be considered fired from a single point with a spread and course designated by the player who will also indicate the relation of this point to the target. The Director may adjudge the position of this point to be in error by a maximum of 1500 yards.

(b) Of the torpedoes that are effective, (that is, as arriving at the firing point), 60% are assumed to function properly throughout their run, unless curved fire is used, in which case only 40% function. Hits will be determined from a plot of the movement of torpedoes and target.

SPECIAL RULES FOR AIRSHIPS.

Rule J-20.

(a) Airships.

(1) Operate from hangars and mooring masts at land bases or from mooring masts on ships specially fitted, provided such ships are operating in waters that cause no undue motion to ship. Can make and maintain physical contact with airplane carriers in waters that cause no undue motion to ship for purposes of refueling, rearming and transfer of personnel. The carrier can launch but not receive planes during this time.

(2) Can enter or leave hangar when wind is force 5 or less, provided direction of wind is within 45 degrees of longitudinal axis of hangar.

(3) Can enter or leave hangar only with wind less than force 4 when direction of wind is more than 45 degrees away from longitudinal direction of hangar.

(4) Can moor to mooring mast with wind from any direction and not exceeding force 8.

(5) Can land on the ground with wind up to force 6, provided men and facilities are available.

(6) Can remain in the air with wind of any force but the dangerous sectors of circular storms must be avoided.

(7) Rigid airships can carry, launch and recover up to 5 airplanes, especially equipped for the purpose. The airship's speed must be at least 50 knots to recover, and the altitude above 1000' to launch, aircraft.

(b) Upon the completion of a flight the airship will not be considered available for a subsequent flight until an interval has elapsed that is sufficient for re-servicing in accordance with the existing conditions.

Under normal conditions this interval of time will be a minimum of 2 hours and a maximum, of 6 hours, depending on the duration of the previous flight.

The Director will adjudge the time required under special conditions.

(c) Airships filled with helium are considered to have a range as follows:

Type	At speed of 40	50	70
Rigid	10,000	9,000	4,000
Non-rigid	800	500	

(d) A helium filled rigid airship can remain in the air and operate for a limited space with 30% of its gas capacity lost through gunfire. A loss of 40% of its gas capacity will bring it down a wreck.

SECTION K - CHEMICAL WARFARE

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Note: The effect that can be obtained with chemicals will depend upon:

(a) Weather conditions.- Generally, strong wind and wet weather will decrease their effectiveness. Cold weather or cloudy days will retard the evaporation of the liquids and thereby increase their persistency as liquids; hot sunny weather will increase the rate of dissipation.

(b) The type of ship used against.- New combatant ships may be expected to be fairly well protected, but the cost of the necessary alterations is almost prohibitive in the case of older ships and auxiliaries.

(c) Whether the chemical is carried into the ship or is expended against the outside shell. Non-persistents will dissipate almost immediately from the weather decks, but if such gases are carried into the interior by shell, or bomb, an extremely powerful concentration might be built up and might be sufficient to pierce gas masks. The persistent gases, mustard for example, can be cleared from a ship provided decontamination agents are available. See Rule K-14.

(d) The condition of the ship at the time of the chemical attack. If surprise is effected and the ship is caught with ventilation systems running and doors open (i.e. Condition B), the effect will be much greater than if she were gassed with the crew at general quarters and all openings sealed (i.e. Condition A).

(e) The degree of gas discipline, training and gas experience of the crews.

(f) The quantity and quality of available protective clothing and decontamination agents.

Because of the above factors the efficiency of gas munitions will vary within the same wide limits that the efficiency of gunfire varies under different conditions of visibility, range and target.

As it is obviously impossible to evaluate these various factors, and also undesirable to make the Maneuver Rules too complicated, the following rules are somewhat arbitrary and the Director is authorized to modify them as necessary to suit a particular situation.

Chemical Agents, When Used.

Rule K-1. In game maneuvers at the War College, unless specifically prohibited by the Staff, chemical agents may be used, provided that:

(a) Previous to the beginning of the maneuver the Director is so notified.

(b) The Student C-in-C authorizes the use of chemical agents by his forces.

(c) Each student commander at the start of the maneuver specifies what percentage of the number of shells and aircraft bombs, which are allowed in "Fleets" are loaded with chemical agents or displaced with spray tanks or thin wall shells, and the kind of chemical agents so used.

(d) Their use is indicated as specified in Rule K-4.

Rule K-2 (a). Kinds of Chemicals and Methods of Use.

HS - Mustard
Ml - Lewisite
CG - Phosgene
CN - Tear gas
CNS - Tear gas solution
WP - White phosphorus
PS - Chlorpicrin

(b) These agents may be used in the following manner:

CNS
HS
Ml
IG
WP (1) By aircraft bombs, all sizes but most effective in small bombs. These bombs have no damage effect on material. They effect personnel only.

Note. (WP will create a smoke screen around a ship struck such that nothing can be seen to leeward for a period of 1 1/2 minutes). (A 30 lb. bomb will contaminate an area of 1250 sq.yds.).

HS
Ml
CNS
PS (2) By spraying from airplanes.

(aa) Two general methods can be used. The "atomization" or "gravity", or "small drop" method is particularly suitable for use by small planes at low altitudes against marching troops or landing boats, but it can be used against ships also. The "pressure" or "large drop" method is suitable for use by large planes and is more accurate than the "atomization" method. Tanks used for chemical spray are considered to be of two sizes, 15 gallons for the atomization method, and 50 gallons for the pressure method. Airplanes may carry these to replace their allowance of "small smoke tanks" or "large smoke tanks" respectively, as indicated in the tables shown in the N.W.C. publication "Airplane Characteristics". The tanks used for "atomization" discharges in 10 seconds, and that used for "pressure" discharges in 30 seconds. In both cases the length of the spray is determined by the speed of the plane.

(bb) For use when it is desired to contaminate an area, such as a landing beach, camp, etc., the effective width of the spray will be assumed to be as shown in the following tables:

Altitude	Wind across line of flight			
	0 kts.	10	20	Over 20
Atomization Method				
150	10 yds.	30 yds.	90 yds.	Ineffective
500	20 "	150 "	300 "	"
1000	100 "	350 "	700 "	"
Over 1000	Ineffective			
Pressure Method				
150	10 yds.	30 yds.	50 yds.	Ineffective
500	20 "	50 "	80 "	"
1000	30 "	60 "	100 "	"
2000	50 "	100 "	180 "	"
Over 2000	Ineffective			

(cc) The chances of hitting a specific target or ship will be found in Rule K-7.

(dd) Area Contaminated.

Actually the area will be more heavily contaminated and the agent will persist longer along the upwind edge of the shower and will drop off at zero along the down wind edge; on the other hand, the area to leeward of such sprays will be dangerous because of the vapor for a distance of about 1000 yards. For War College purposes, these two factors will be considered to cancel out and the area designated in the foregoing table will be considered as contaminated for the period indicated in Rule K-10 or K-13. It is not considered practicable to decontaminate land areas contaminated by plane spray. See Rule K-9 (f) for penalties applying to contaminated land areas. Except for the length of time during which the chemical will persist (Rule K-10 or K-13), all sprays, regardless of type of tanks used and regardless of altitude of plane, will be considered (for War College purposes) effective and equally potent if they hit.

HS
Ml
CG
CNS

(3) By tin can bombs. The container is an ordinary one gallon can such as contains lubricating oil. Weight 8.5 lbs. They may be thrown from an airplane, or may be set up as "mines" in land areas or secured to stakes above water a short distance from the shore. In the latter case, the mustard is floated by adding fuel oil to the liquid. Such cans are exploded by electric squibs and will be considered to contaminate 250 square yards.

HS
CNS
Ml
WP
PS

(4) By shell fire (all kinds except star shell). These are special thin wall shells for use against shore objectives only. But, in war, there is always the chance that the enemy will do the unexpected and their use by destroyers against armored ships is always a possibility. They may replace weight for weight all ammunition allowances. After considering Rule K-9 and K-13, the effect will be determined by the Director. A 75 mm shell will contaminate an area of 150 square yards; a 155 mm shell will contaminate an area of 1900 square yards. (See Rule K-13 for persistency).

Specifying Use of Chemical Agents.

Rule K-4.

(a) Student commanders will specify on their flight forms when chemical bombs or spray tanks are carried by planes and the kind of chemical agent with which they are loaded.

(b) Student commanders will specify on their move blanks when CN shells or thin wall shells are being fired.

Rule K-5. To be effective, the shells, bombs and spray must directly hit the target.

Chemical Penalties, When Applied.

Rule K-6.

(a) Shells loaded with a partial filler of CN will hit in accordance with the rules of gunfire. When these hits ac-

cumulate so that the damge by gunfire has reached a percentage equal to one-sixth the life of the ship within the contamination period (Rule K-10), penalties for wearing masks will be applied in accordance with Rule K-9.

(b) Shells and bombs loaded only with chemical agents have no damaging effect upon materiel but will hit in accordance with the rules of gunfire and aircraft bombing. The effect will be:

(1) Chemical bombs, or tin cans, will be considered to explode on the upper deck without penetrating. One hit by such a bomb (any size) containing CNS, HS, M1, ED will force masking upon all topside personnel to leeward of the area contaminated by the hit for the period indicated in Rule K-10. The Director will decide by throwing dice the location of the hit (whether AA and broadside batteries, engine room force, turrets through ventilation, etc.) to which the chemical penalty will be applied (Rule K-9).

(2) One white phosphorus shell or bomb (any size) will create a smoke ribbon the size of which will be calculated by combining the wind velocity with an emission of 1 1/2 minutes. This ribbon will drift to leeward and be opaque for 2 moves. (6 minutes). It will be plotted in the same manner as a smoke screen.

(c) Chemical sprays. A ship or shore target hit by a chemical spray will be penalized in accordance with Rule K-9 for the period indicated in Rule K-10 or K-13.

Rule K-7. (a) Chemicals sprayed by aircraft are ineffective if dropped from over 1000 feet on a maneuvering target or from 2000 feet on a shore target, and in any case if the apparent wind over the target is more than 20 knots.

(b) Subject to the above, one chemical spray (one or two tanks at discretion of player) from each group of planes, remaining after the plane losses due to AA fire have been calculated, will hit if the group of remaining planes equals the figures indicated below (i.e. these figures take into account the percentage of hits that can be made by planes after they have reached the spraying position).

Number of planes necessary to hit a target, using "Pressure" Method.

Target	Altitude	Apparent wind over target		
		0 kts.	10 kts.	20 kts.
Maneuvering ship	150	1*	1	2
	500	2	2	3
	1000	4	6	9
Fixed target, of same size as a large ship	150	1*	1*	1
	500	1	1	2
	1000	2	3	5
	2000	4	6	9

Note: Using "Atomization" Method, the number of planes required is double that shown above except for the numbers marked (*), and except that the atomization method is ineffective from an altitude of above 1000 feet.

Chemical Penalties Effected.

Rule K-9. If the agent hits, as determined by Rules K-5, K-6 and K-7, the following will be the effect on the target during the contamination period (Rule K-10). It is assumed that all chemical agents will give sufficient warning to permit individual protection by masks and clothing. This rule does not reflect war experience but is necessary for War College rules. These penalties are the result of loss in efficiency

due to wearing masks and/or protective clothing.

(a) Gunfire. (Main, secondary or AA) will be reduced by a second correction of two tenths (.2) during the first hour after being hit by gas; thereafter by four tenths (.4) until contamination is removed. (See Rules K-10 and K-13).

(b) Maximum remaining individual speed will be reduced on a coal burning ship three tenths (.3) during first hour; thereafter six tenths (.6) until contamination is removed.

(c) No speed reduction will be made on an oil-burning ship.

(d) All messages sent or received will have their time of coding and decoding doubled during the first hour, then quadrupled thereafter until contamination is removed. (See Rules E-4, K-10 and K-13).

(e) The times of plane handling on all ships will be doubled until contamination is removed.

(f) The times of the accomplishment of all activities will be doubled when these activities are performed in land areas that have been effectively contaminated. For example, the time for reservicing planes at a contaminated airdrome will be doubled.

Time of Contamination.

Rule K-10. (a) Contamination on ships will be removed to the point where masks and protective clothing are unnecessary in the following times after the last gas hits:

Mustard (HS) - 1 hour if an effective decontamination agent is available (See Rule K-14); otherwise in accordance with the periods indicated in Rule K-13.

Lewisite (Ml) - 1/2 hour (i.e. time to wash down with water).

Phosgene (CG) - 1 hour.

CNS as a partial filler in 7-inch and larger shell - 15 hours. (Hits must be equivalent to one sixth the life of the ship).

CNS (spray) - 1 hour.

(b) Contamination on shore can be removed as follows:

(1) HS, Ml, CNS, CG - if sprayed by plane, removal by decontaminating agent is not practicable. Therefore:

HS will be considered to persist in accordance with the table in Rule K-13.

Ml will be considered to persist for one half the periods indicated in Rule K-13 or until rain falls.

CNS and CG will evaporate in 2 hours. (See Rule K-2 (b)(2)(bb) for size of areas) - One man in one hour can spade under and neutralize with chloride of lime 18 sq. yds. A tank truck sprinkling chloride of lime can decontaminate 9000 sq. yds. per hour of terrain suitable for its operation. Lewisite in shells, bombs, or tin cans is neutralized in the same manner except that water is the agent used. Lewisite is considered removed 10 minutes after rain falls.

CG - 2 hours by evaporation.

CNS - 2 hours by evaporation.

Length of Masking.

Rule K-11. Personnel cannot be continuously masked longer than twelve hours and a period of at least 4 hours must elapse before masks can again be worn.

Simplification of handling Chemical Penalties.

Rule K-12. When gunfire between two forces has been underway for such length of time that most ships or both sides have been subjected to the chemical penalty, the Director, at his discretion, may direct that individual records of chemical penalties be discontinued and that all ships on both sides be considered subject to the chemical penalty during the time they remain heavily engaged; or, he may alternatively direct that

the chemical effects on both sides cancel out, and that the chemical penalties will be discontinued during the time the forces continue heavily engaged.

Rule K-13. Unless decontamination is resorted to, mustard will be considered to persist in dangerous concentrations requiring the wearing of protective clothing and masks for the periods indicated below:

	Ship			Shore		
Temperature	100°	80°	60°	100°	80°	60°
*Plane spray (Atomization)	2 hr.	4 hr.	7 hr.	4 hr.	6 hr.	10 hr.
*Plane spray (Pressure)	10 "	13 "	25 "	15 "	20 "	36 "
Tin can bomb or land mine	3 days	4 d.	7 d.	5 d.	7 d.	12 d.
30 lb. bomb	2 "	3 "	4 d.	4 "	5 "	7 "
100 lb. bomb	4 "	6 "	8 "	8 "	12 "	15 "
6 inch shell	1 "	1 "	2 "	2 "	4 "	5 "

* It is not practicable to decontaminate land areas hit by a plane spray.

Rule K-14. BLUE BB, CV, and new CL will be considered to have an effective decontaminating agent for mustard at the outbreak of war. Whether or not other BLUE vessels (both combatant and auxiliary) have the agent during this period will be decided by the Director. After six months have elapsed, all BLUE vessels will be considered to carry the agent.

Whether or not ships of other navies carry a decontaminating agent will be decided in each problem by the Director.

Rule K-15. (a) Chemical Smoke Screens. BLUE DD (later than ODD 347) DL and the BROOKLYN class of CL, carry a battery of 8 cylinders filled with FS. Each cylinder contains sufficient chemical to smoke for a total of 21 minutes. In order

to produce an opaque screen it is necessary to use at least the following number of cylinders simultaneously:

Minimum requirements for "Standard Screen"

Apparent Wind	Number of Cylinders
0-10 kts.	1
10-20 "	3
20-30 "	5
Etc.	Etc.

The cylinders in use may be distributed among any number of ships in formation up to a division. The "Standard Screen" will be considered to be opaque for 30 minutes. A "double standard screen", which is made by using twice the number of cylinders required for a standard screen, will be considered to be opaque for 45 minutes.

The screens will be plotted in the same manner as stack smoke screens (Rule D-207), except that they may be turned on or off at any time and become effective immediately regardless of weather conditions. (In other words, the quality of a screen depends on the number of cylinders used and not on its length).

(b) Blanket Screens. The "double standard screen" as described above may be laid as a protection against airplanes, in which case it is termed a "Blanket Screen". It will to some degree provide protection against bombing and against fall of shot observation (or "airplane spot"). In order for it to be considered effective the following must be carried out:

1. At least four vessels are smoking.

2. The tracks of the smoking vessels are not more than 150 yards apart.

3. The smokers have been smoking for 15 minutes and the vessel being screened has been maneuvering to take accurate position under the screen for that time.

4. The course of the formations is cross wind or down wind (not upwind).

Under these conditions the vessel can remain in the screen for a maximum of one hour, during which time it can fire against surface targets by indirect fire only and cannot launch or land airplanes. For one period of 5 minutes of each 15 minutes under the screen (as determined by the throw of a die) the vessel is subject to aerial bombing and observation, and may use anti-aircraft fire effectively.

(c) Aircraft Blanket Screens.

Airplanes carrying FS smoke tanks can lay a blanket screen, or cloud, which may provide protection against bombing and fall of shot observation from the air, or it may provide protection against observation of aerial movements from the ground. In order for it to be considered effective the following conditions govern:

1. It must be laid at or below 1500 feet altitude.

2. The cloud becomes effective not sooner than 3 minutes after the time the planes begin to smoke.

3. The effective width of the cloud is 500 yards for each pair of planes laying it.

4. The effective length of cloud produced by each plane is 600 yards for a small tank or 2000 yards for a large tank.

5. The cloud drifts with the wind, and is effective for 30 minutes.

6. As initially laid, the cloud may be as much as 2000 yards out of position, as may be decided by the Director.

7. Not less than four planes must make smoke simultaneously to screen a fixed objective, and not less than nine planes, to screen a ship underway. The ship must maneuver to attempt to remain under the cloud.

8. The degree of protection afforded a ship which maneuvers to remain under the cloud is the same as that of the "Blanket Screen" above.

Rule K-16. Probable Casualties, on Shore

Situation		% Casualties of men on or immediately down wind from area gassed. No protection available	Gas Mask worn	Gas mask and Protective clothes worn.
Column marching on road or in an area when actually sprayed with persistent vesicants from planes		80	50	20
Column marching on hard surface road previously neutralized with persistent vesicants. No dust.	On area 30 min.	50	10	5
	On area 10 min. or less	5	2	0
Troops occupying area previously neutralized by persistent vesicants (vapor effect only)		80	40	10
Troops attacked by Livens projectors with phosgene type agents		80	20	20
Troop marching over fields or through brush neutralized by persistent vesicant chemical agents. Area 400 yards across		50	25	10
Troops in position attacked by phosgene type agents in gas shell	Wooded	80	10	10
	Open	40	10	10
Troops in position attacked by persistent vesicant type agents in gas shell. Area evacuated at once.	Wooded	50	25	20
	Open	25	20	10