

Harpoon Player's Handbook

Fifth Edition

by
Larry Bond
& Chris Carlson



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Introduction

This is a collection of the charts and tables that appear in the *Harpoon*, 5th edition rules booklet. The page numbers in *italics* in the corner of each table refer to the original page number in the fifth edition rules book.

Designed for quick reference, this booklet provides all the charts and tables needed for tactical play. Only rules-related charts and tables are included here.

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Includes all corrections & changes through 26 October 2021.

Turn Sequence Summary

<u>Intermediate (30 min)</u>	<u>Tactical (3 min)</u>
Plotting	Plotting
Movement	Movement
Detection	Planned Fire
	Detection
	Reaction Fire
	Resolution

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Grounding Chances

<u>Distance from shore (yds)</u>	<u>Grounding %</u>	<u>Size Class</u>	<u>Modifier</u>
1001-2000	10	A	+20%
501-1000	20	B	+10%
0 - 500	30	C&D	0
		E, F, G	-20%

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

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

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Sea State / Speed

<u>Sea State</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>D-E</u>	<u>F - G</u>
0, 1	M	M	M	M	M
2	M	M	M	M	M
3	M	M	M	M	3/4
4	M	M	M	3/4	1/2
5	M	M	3/4	1/2	1/4
6	3/4	3/4	1/2	1/2	H
7	1/2	1/2	1/2	1/4	H
8	1/4	1/4	1/4	H	H
9	H	H	H	H	H

M = Maximum speed, no restrictions

H = Ship must heave to or be sunk

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Ship Size Classes

<u>Size Class</u>	<u>Standard Displacement</u>	<u>Size Description</u>
A	18001+	Large
B	5501- 18000	Medium
C	1501 - 5500	Small
D	351 - 1500	Small
E	101 - 350	VSmall
F	21- 100	VSmall
G	≤20	Stealthy/VSmall*

Size Classes F and G are called "Small Craft" by some rules.

(*)Size Class G vessels have a Stealthy radar signature, but are otherwise described as "Very Small," e.g., for maneuvering and visual detection.

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Underway Times

<u>Non-Steam Propulsion</u>		<u>Steam Propulsion</u>	
<u>Size Class</u>	<u>Tac Turns</u>	<u>Size Class</u>	<u>Minutes</u>
A & B	D10/2	A & B	2D6*10
C & D	D10/3	C & D	2D6/2*10
E	D10/4	E	2D6/3*10

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Starshell Miss Diagram

Each square is 1,000 yards on a side.

31 - 35	36 - 40	16 - 20	41 - 45	46 - 50
21 - 25	01 - 05	06 - 10	11 - 15	26 - 30
51 - 55	56 - 60		61 - 65	66 - 70
71 - 75	76 - 80	81 - 85	86 - 90	91 - 95

Direction of fire

Starshell Maximum Range

<u>Gun Caliber Inches</u>	<u>Gun Caliber Millimeters</u>	<u>Max Range</u>
5.0 - 6.1	127 - 155	9 kyds
3.9 - 4.7	100 - 120	7 kyds
3.0 - 3.5	76 - 88	5 kyds

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Ship Turning Distance

<i>Warship Size Class</i>	<i>Distance with Stand Rudder (yds)</i>	<i>Speed Loss per 45° turn (kts)</i>	<i>Distance with Hard Rudder (yds)</i>	<i>Speed Loss per 45° turn (kts)</i>
A	400	2	300	3
B	300	2	200	3
C	300	1	200	2
D, E	200	1	100	2
Slow F, G	100	1	50	2
Fast F, G	100	0.5	50	1
Subm Sub*	300	1	200	2

<i>Merchant & Auxiliaries Size Class</i>	<i>Distance with Stand Rudder (yds)</i>	<i>Speed Loss per 45° turn (kts)</i>	<i>Distance with Hard Rudder (yds)</i>	<i>Speed Loss per 45° turn (kts)</i>
A	400	4	300	5
B, C	300	3	200	4
D, E	200	2	100	3
F, G	100	1	50	2

- All values are for a single 45° turn.
- Move the required distance (the "advance") first, then turn the ship up to 45°.
- Ships with waterjet propulsion turn as one size class smaller, and can turn 60° at a time instead of 45°
- * Surfaced submarines maneuver based on their Size Class, e.g., a C/Small sub uses the "C" line when it maneuvers on the surface.

Ship Speed Change

<i>Warship Size Class</i>	<i>Accel per Tac Turn from 0 - 75% Max. Speed</i>	<i>Accel from 76 - 100% Max. Speed</i>	<i>Deceleration per Tac Turn Any Speed</i>
Slow A	4 kts	2 kts	6 kts
Fast A	6 kts	3 kts	9 kts
B	10 kts	5 kts	12 kts
B w/CPP	15 kts	8 kts	18 kts
C - E	12 kts	6 kts	15 kts
C- E w/CPP	18 kts	9 kts	18 kts
Slow F, G	15 kts	8 kts	18 kts
Fast F, G	25 kts	12 kts	30 kts

<i>Merchant & Auxiliaries Size Class</i>	<i>Accel per Tac Turn from 0 - 75% Max Speed</i>	<i>Accel per Tac Turn from 76 - 100% Max Speed</i>	<i>Deceleration per Tac Turn Any Speed</i>
A	4 kts	3 kts	8 kts
B	6 kts	3 kts	10 kts
C- E	8 kts	4 kts	12 kts
F, G	12 kts	6 kts	15 kts

- *Note:* Merchant passenger liners, because of their engine power and high speeds, are treated as combatants for acceleration/deceleration purposes.
- "Slow" Size Class A ships have undamaged maximum speeds less than 25 knots. There is no distinction between fast and slow ships for Size classes B through E.
- "Slow" small craft (Size Class F and G) have undamaged maximum speeds less than 25 knots.
- Coasting to a stop halves the deceleration rate.
- Changing course 45° or more in a Tactical Turn halves the acceleration rate.
- Astern acceleration is half the ahead rate.
- Ships with waterjets accelerate and decelerate as per vessels with controllable pitch propellers (CPP) for size classes B through D, and as Fast Small Craft (Size Class F and G).
- Submarines running silent can only accelerate/decelerate up to 50% of the listed amount. Any greater acceleration/deceleration will increase their noise level (cavitation passive sonar modifier, see 5.4.6.5).

Critical Hit Table

D20 Roll	Pre 1955 Surf Cmbts (Size A-E)	1955+ Surf Cmbts (Size A-E)	Guided vs Surf Cmbts (Size A-E)	Small Craft Combatant (Size F-G)	Aviation Ship	Underwater Attacks	Airburst & Frag. Hits ⁵	Merchant/Auxiliary (Size A-E)	Small Cargo Craft (Size F-G)	Sub Major Dam.	Sub Minor Dam.
1	Weapon*	Weapon	Weapon	Weapon	Weapon	Weapon	Weapon	Weapon ¹	Weapon ¹	Weapon	Weapon
2	Weapon*	Weapon	Weapon	Weapon	Flt Deck*	Weapon	Weapon	Weapon ¹	Weapon ¹	Weapon	Weapon
3	Weapon*	Weapon	Sensor	Weapon	Flt Deck*	Weapon	Weapon	Sensor	Sensor	Weapon	Weapon
4	Weapon*	Weapon	Sensor	Weapon	Flt Deck*	Sensor	Weapon	Engineering	Engineering	Sensor	Sensor
5	Weapon*	Sensor	Sensor	Sensor	Flt Deck*	Sensor	Sensor	Engineering	Engineering	Hull Pen	Hull Deform
6	Weapon*	Sensor	CIC	Sensor	Hangar*	CIC	Sensor	CIC ¹	Personnel	Hull Pen	Hull Deform
7	Sensor	Sensor	CIC	CIC	Hangar*	Engineering*	Sensor	Cargo	Personnel	Hull Pen	Hull Deform
8	Sensor	CIC	CIC	Engineering*	Hangar*	Engineering*	Sensor	Cargo	Cargo	Battery	Battery
9	Sensor	CIC	Engineering*	Engineering*	Ammo/Fuel*	Engineering*	Sensor	Cargo	Cargo	Battery ³	Battery ³
10	CIC	Engineering*	Engineering*	Engineering*	Sensor	Engineering*	Sensor	Cargo	Cargo	Engineering	Engineering
11	Engineering*	Engineering*	Engineering*	Personnel	CIC	Flooding*	Sensor	Cargo	Cargo	Engineering	Engineering
12	Engineering*	Engineering*	Engineering*	Personnel	Engineering*	Flooding*	Engineering	Cargo	Cargo	Flooding	1/2 Flooding
13	Flooding*	Flooding*	Engineering*	Flotation	Engineering*	Flooding*	Wpn/Flt Deck ²	Flooding	Flotation	Flooding	1/2 Flooding
14	Flooding*	Flooding*	Flooding*	Flotation	Flooding*	Flooding*	Wpn/Flt Deck ²	Flooding	Flotation	Flooding	1/2 Flooding
15	Flooding*	Flooding*	Flooding*	Flotation	Flooding*	Flooding*	Wpn/Flt Deck ²	Flooding	Flotation	Fire	1/2 Fire
16	Fire	Fire	Flooding*	Flotation	Fire	Flooding*	Wpn/Flt Deck ²	Fire	Flotation	Fire	1/2 Fire
17	Fire	Fire	Fire	Fire	Fire	Fire	Wpn/Flt Deck ²	Fire	Fire	Fire	1/2 Fire
18	Fire	Fire	Fire	Fire	Fire	Fire	Wpn/Flt Deck ²	Fire	Fire	Sensor	Sensor
19	Bridge*	Bridge	Fire	Fire	Brdg/Air Plot ⁴	Brdg/Air Plot ⁴	Flt Deck	Bridge	Fire	Control	Control
20	Rudder*	Rudder	Bridge	Bridge	Rudder	Rudder	Brdg/Air Plot ⁴	Rudder	Bridge	Rudder	Rudder

* Armored location. Any armor must be penetrated before the critical hit is inflicted.

• Guided weapon attacks on aviation ships and small craft combatants are resolved on the column for that ship type.

• Aviation ships are CVs, CVHs, LHAs, CVHGs, CHG, or other vessels that have at least half of their main deck devoted to aircraft land/launch facilities. A ship with a one- or two-spot helo pad is not an aviation ship.

• Surfaced subs are treated as surface combatants.

• Amphibious ships (e.g., LST, LPD) should use the Merchant/Auxiliary column, unless they have a flight deck (LHA, LPH), in which case use the Aviation Ship column.

Notes:

1. Merchant/Auxiliary/Small Cargo Craft: If the ship doesn't have a CIC or weapons treat it as a Cargo critical hit.
2. Wpn/Flt D critical hits are flight deck critical hit for aviation ships, and a weapon critical hit for all other types.
3. Nuclear subs treat #9 Battery hits as Engineering Critical hits.
4. For aviation ships, roll D6: 1 - 3 Bridge, 4 - 6 Air Plot.
5. Fragments from airbursts are stopped by any level of armor protection (CHP or Armor Rating of 1 or greater).

Critical Hit Damage Ratios

Damage Ratio	D6 Die Roll					
	1	2	3	4	5	6
<.10						1
0.10					1	2
0.20				1	2	3
0.30			1	2	3	4
0.40		1	2	3	4	5
0.50	1	2	3	4	5	6
0.60	2	3	4	5	6	7
0.70	3	4	5	6	7	8
0.80	4	5	6	7	8	9
0.90	5	6	7	8	9	10
1.00	6	7	8	9	10	11

Note: Higher ratios can be extrapolated by adding one to the number of criticals for each .2 that the Damage Ratio exceeds 1.00. Ratios of 3.0 or greater should be treated as reducing the ship to 10% DP remaining (see 14.2.1 Massive Damage).

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Light Weapons Critical Hits

Largest gun fired	Criticals allowed against Size class E and larger
<12.7mm	Bridge, Weapon
12.7 - 15mm	Aircraft, Bridge, Weapon, Sensor (not sonar), Cargo
20 - 27mm	Aircraft, Bridge, Weapon, Sensor (not sonar), Cargo
30 - 45mm	Aircraft, Bridge, Fire, Weapon, Sensor (not sonar), Cargo
57 - 65mm	Aircraft, Weapon, Bridge, Fire, Flooding (-2 severity), Sensor (not sonar), Cargo

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Cargo Damage

Contents	Result
Ammo:	
1-2	D100% of the ammo is lost
3-7	D100% ammo lost. Fire, add one to the fire severity and reduction die rolls. There is a 25% risk of explosion each following Intermediate Turn.
8-10	Explosion. Nearby ships take damage points according to the amount of ammo, in tons, in the hold.
500 yds away	tons/5 DP
1000 yds away	tons/25 DP
2000 yds away	tons/200 DP
There is a 70% chance ammo in each adjacent hold will explode. Fires or the chance of explosion can be stopped by flooding the hold, but all the cargo in that hold is lost.	
Petroleum Products: Fire. Add one to the severity die roll for crude oil. If it is a refined product, add two. If it is avgas, add three. Add the same number to the reduction die roll.	
Troops:	
1-3	DP casualties
4-6	2*DP casualties
7-9	3*DP casualties
10	4*DP casualties
General Cargo:	DP/2 tons destroyed
Vehicles:	DP/2 Destroyed
Aircraft:	DP/5 Destroyed

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Contact-Fuzed Damage Reduction from Belt Armor

Target's Belt Armor	0-5	5-10	11-20	21-30	31+
DP Reduction	None	10%	25%	40%	50%

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Fire and Flooding Severity Levels

Add up the percentage of the fire and flooding critical hits from existing and newly inflicted hits. For example, a ship with two fires at 4% and 9% and a 3% flooding critical has a severity level of 16%. This affects how well damage control teams will be able to fight the casualties, and if it's bad enough, will affect the ship's ability to move and fight.

The ship's damage control ability is affected by its size:

Severity Level

Size Class	Minor	Major	Severe	Overwhelmed
A - B	1 - 10%	11 - 15%	16 - 17%	18%+
C - D	1 - 8%	9 - 12%	13 - 14%	15%+
E - G	1 - 6%	7 - 10%	11 - 12%	13%+

These levels are modified by the age of the ship. Over time, designers have made ships more resistant to damage.

Ship In Service Date	before 1908	1908-1924	1925-1941	1942-1959	1960+
% Reduction	-2%	-1%	0%	+1%	+2%

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Fire and Flooding Reduction

D10	Minor	Major	Severe	Overwhelmed
1	-2D6%	-2D6%	-2D6%	-D6%
2	-2D6%	-2D6%	-D6%	-D6%
3	-2D6%	-D6%	-D6%	-D6%
4	-D6%	-D6%	-D6%	NC
5	-D6%	-D6%	NC	NC
6	-D6%	NC	NC	+D6%
7	NC	NC	+D6%	+D6%
8	NC	+D6%	+D6%	+D6%
9	+D6%	+D6%	+D6%	+2D6%
10	+D6%	+D6%	+2D6%	+2D6%

"NC" means "No Change"

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Impulse Movement

<u>Speed (Kts)</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>Comp</u>
1 - 7							x
8 - 14			x				x
15 - 22		x			x		x
23 - 29	x		x		x		x
30 - 37	x	x		x	x		x
38 - 44	x	x	x	x	x		x
45 - 52	x	x	x	x	x	x	x

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Impulse Breakdown

<u>Speed</u> <u>kts</u>	<u>Yds per</u> <u>Tac Turn</u>	<u>Full</u> <u>Impulses</u>	<u>Remaining</u> <u>Distance (yds)</u>
1	100		100
2	200		200
3	300		300
4	400		400
5	500		500
6	600		600
7	700		700
8	800	1	50
9	900	1	150
10	1000	1	250
11	1100	1	350
12	1200	1	450
13	1300	1	550
14	1400	1	650
15	1500	2	0
16	1600	2	100
17	1700	2	200
18	1800	2	300
19	1900	2	400
20	2000	2	500
21	2100	2	600
22	2200	2	700
23	2300	3	50
24	2400	3	150
25	2500	3	250
26	2600	3	350
27	2700	3	450
28	2800	3	550
29	2900	3	650
30	3000	4	0
31	3100	4	100
32	3200	4	200
33	3300	4	300
34	3400	4	400
35	3500	4	500
36	3600	4	600
37	3700	4	700
38	3800	5	50
39	3900	5	150
40	4000	5	250
41	4100	5	350
42	4200	5	450
43	4300	5	550
44	4400	5	650
45	4500	6	0
46	4600	6	100
47	4700	6	200
48	4800	6	300
49	4900	6	400
50	5000	6	500
51	5100	6	600
52	5200	6	700

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Submarine Depth Bands

<u>Depth Band</u>	<u>Depth Limits (m)</u>
Periscope/Snorkeling	0 - 25
Shallow	26 - 50
Intermediate I	51 - 100
Intermediate II	101 - 200
Intermediate III	201 - 300
Intermediate IV	301 - 400
Intermediate V	401 - 500
Deep I	501 - 600
Deep II	601 - 750
Deep III	751 - 900
Deep IV	901 - 1050
Deep V	1051 - 1200+
Very Deep	1201+

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The Submarine Speed/Depth Change table lists the number of zones, up to Shallow, a sub can change at each speed.

Submarine Speed/Depth Change

<u>Sub Speed (kts)</u>	<u>1-5</u>	<u>6-10</u>	<u>11-20</u>	<u>21-30</u>	<u>31+</u>
Depth Change					
(# of zones)	1	2	3	5	8

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Battery Discharge Rates

<u>Speed</u> <u>knots</u>	<u>(units/Int Turn)</u>		<u>(units/Tac Turn)</u>	
	<u>pre-1970</u>	<u>1970+</u>	<u>pre-1970</u>	<u>1970+</u>
4	2	2	0.2	0.2
5	2	2	0.2	0.2
6	3	3	0.3	0.3
7	5	5	0.5	0.5
8	6	6	0.6	0.6
9	8	8	0.8	0.8
10	20	10	2	1
11	24	12	2.4	1.2
12	32	16	3.2	1.6
13	38	19	3.8	1.9
14	48	24	4.8	2.4
15	60	30	6	3
16	76	38	7.6	3.8
17	94	47	9.4	4.7
18	122	61	12.2	6.1
19	144	72	14.4	7.2
20	168	84	16.8	8.4
21	196	98	19.6	9.8
22	240	120	24	12
23	294	147	29.4	14.7
24	328	164	32.8	16.4
25	384	192	38.4	19.2

Battery Charge Rate

<u>Battery Level</u>	<u>0-70%</u>	<u>71-100%</u>
Charge Rate (units/Int Turn)	10	5

Lithium-ion batteries charge at twice the rate (x2) listed

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Collisions and Ramming

3.3.1 Collision Resolution. To find out whether the ships actually collide, roll 2D10. For an accidental collision, each player involved can roll one D10 to help spread the blame around. In an attempted ram, the attacker rolls both dice. Apply the following modifiers to the 2D10 roll:

Accidental Collision:

- Low Visibility ($\leq 20\%$): +2
- Per ship with an unrepaired Bridge Critical hit: +2
- Per ship with an unrepaired rudder critical hit: +2
- Per Small size ship involved (Size class D or less): -1
- Per Large size ship involved (Size class A): +1
- Per Ship over 20 knots: +1
- Both ships are in formation and one suffers a casualty that affects its mobility: +2 (i.e., a casualty affecting a ship's speed or rudder control leaves little time for other ships to react)

Attempted Ram:

- Deliberate attempt to ram: +2
- Target is a submerged submarine: +1 (visually detected by the attacker)
- Target has an unrepaired Bridge Critical Hit: +2 (not applicable if target is DIW)
- Rammer has an unrepaired Bridge Critical Hit: Ramming is prohibited
- Target has a unrepaired Rudder casualty: +2 (not applicable if target is DIW)
- Rammer has a unrepaired Rudder casualty: -6
- Target is dead in the water (DIW): +4
- Speed Modifier (Divide target's speed by striking ship's speed) (not applicable if target is DIW):

<u>Ratio</u>	<u>Modifier</u>
<0.10	+4
0.25	+3
0.50	+2
0.75	+1
1.00	+0
1.25	-1
1.50	-2
1.75	-3
2.00+	-4

If the results of the die roll, including modifiers, is 16 or more, then a collision has occurred.

3.3.2 Collision Damage. The damage depends on the angle between the two ships and their relative size; see the Aspect Diagram on page 10-2.

- *Glancing:* If each ship presents a narrow aspect to the other vessel, whether bow or stern, then it is a glancing collision. The ships' sides will scrape against each other and they will continue on their ordered courses and speeds. Both ships halve any damage.

- *Quarter:* If one of the ships presents a bow or stern quarter aspect to the other, then both ships suffer normal damage and both have their speeds reduced 25% by the force of the impact.

- *Size:* If there is a size class difference between the ships, increase the speed reduction 25% per size class if the other ship is larger; reduce the speed penalty 25% for every two size classes if the other ship is smaller.

- *Bow-on:* if one ship presents a broad aspect to the other, then the other vessel (which will have a narrow aspect), makes a bow-on ram – also known as a “T-bone” collision. The vessel striking with its bow has its damage reduced by half, but its maximum speed is permanently reduced by 25% because of the drag caused from the damaged bow, in addition to any other damage suffered.

If the striking ship inflicts sufficient damage to sink the other vessel outright, then it has literally cut the unfortunate vessel in two and the striking ship's speed is reduced by 25%. Otherwise, the pair will rapidly decelerate until they are both DIW (use double the normal deceleration rate of the largest ship). The direction of movement will be along the larger ship's course, or in the direction of the faster ship if they are the same size class.

The ships will remain joined until one sinks or until the striking vessel backs down for one turn at any speed, which will automatically pull it clear.

- *Damage Points:* In a collision, each ship inflicts damage on the other based on its size. A bigger ship inflicts much more damage on another vessel than a smaller ship.

If any civilian vessels are involved, double their damage points before calculating the damage.

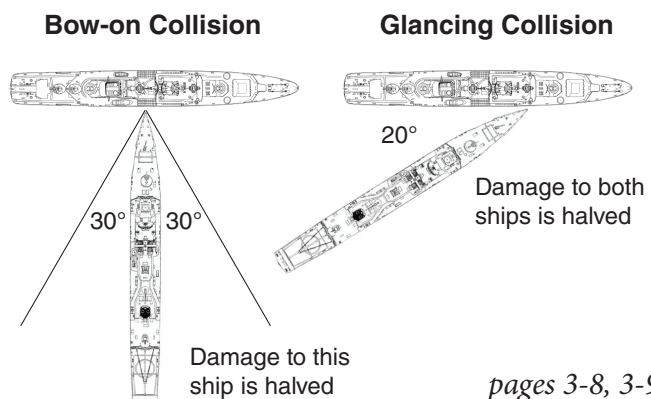
Each player rolls 3D10 (read as a value between 3% and 30%) and uses any of the applicable modifiers below:

- *Armor:* For each five points of belt armor, reduce the percent damage inflicted by 1%.

Special case: If it is not a glancing collision, and the striking vessel has a reinforced bow (e.g., icebreaker), then the ship struck cannot have its damage reduced by the armor modifier.

- *Speed:* Add 1% to the damage percentage for both ships for each five knots of relative speed. To determine the relative speed, in the case of a glancing blow, add the two speeds if the two bows are pointed toward each other, subtract the lower from the higher if the bows are pointed in the same direction. For a quarter collision, follow the same procedure for a glancing blow but multiply the sum by 0.75. Use the striking vessel's speed if it is a bow-on collision.

The final value (die roll plus armor and speed modifiers) is the percent of the ship's original damage points that is applied to the other vessel. If any critical hits result, they are rolled on the Underwater Attacks column of the Critical Hit Table. The first Critical Hit, if any, is automatically a Flooding critical. Damage results are applied immediately, during the Movement Phase.



pages 3-8, 3-9

Very Low/NOE Crash Chance

<i>Speed (kts)</i>	<i>150</i>	<i>151-</i>	<i>251</i>	<i>351</i>	<i>451-</i>	<i>551-</i>
<i>or less</i>	<i>250-</i>	<i>350</i>	<i>450</i>	<i>550</i>	<i>650</i>	
Chance of of Crash	0%	1%	2%	3%	5%	8%

Modifiers:

- +1% per turn (cumulative, up to 5% maximum) if the aircraft is traveling faster than 150 kts.
- +2% if the aircraft turns more than 30° in one turn.
- +2% if the aircraft is being fired on by AA (gun) fire (including infantry weapons), surface-to-air missiles, or aircraft.

The roll is made in the Resolution Phase, based on the plane's movement and attacks on it in that turn.

page 4-2

Land/Launch Safe Sea State

Ships: Carrier aircraft and helicopters may launch from or land on a ship safely in sea state 3 or less.

Sea Surface: Seaplanes, amphibians and float-equipped helicopters may launch from or land on the sea surface in sea state 2 or less.

Modifiers: (modifications are cumulative):

If ship has stabilizers +1

If ship has dual stabilizers +2

Note: Stabilizers do not work unless the ship's speed is at least 8 knots.

If ship is Size class A +2

If ship is Size class B +1

If aircraft is medium-sized or larger +1

If ship has a helo recovery system (Bear Trap, RAST, etc.)+1 (for landing helicopters only)

page 4-4

Altitude Bands

<i>Trilogy</i>	<i>Meters</i>	<i>Feet</i>	<i>Characteristics</i>
<i>Altitude Band</i>	<i>above S/L*</i>	<i>above S/L</i>	
Real High	30001+	98426+	Missiles only. No fixed-wing a/c. No helicopters, seriously.
Very High	15501 - 30000	50856 - 98425	Cruise for jet a/c. No helicopters.
High	7501-15500	24607-50853	Cruise for jet & TP, some IP, RP a/c. No helicopters.
Med	2001-7500	6563-24606	Cruise for jet and IP, RP, TP and helicopters.
Low	0-2000	0-6562	Cruise for IP, RP, TP and helicopters.
Nap of the Earth	0-100*	0-328	Risks for fixed wing. Special mode over land only.
Very Low flight	0-30	0-98	Risks for fixed wing. Special mode over water only.

Note: VLow is used over water and NOE is used over land to fly very close to the surface. The NOE and Very Low altitudes are special-purpose flight conditions by aircraft within the Low altitude band. They are not separate altitude bands.

* NOE altitude is measured above ground level, not sea level

Contrails occur only at High Altitude

Altitude Changes

<i>Aircraft</i>	<i>Abbrev-</i>	<i>Rate of Climb Multiplier</i>		<i>Rate of Descent</i>		<i>Max Dive</i>
<i>Engine Type</i>	<i>iation</i>	<i>(times Maneuver Rating)</i>	<i>(times Maneuver Rating)</i>	<i>(times Maneuver Rating)</i>	<i>(times Maneuver Rating)</i>	<i>Speed</i>
		<i>per 3 min</i>	<i>per 30 sec</i>	<i>per 3 min</i>	<i>per 30 sec</i>	
Piston or Turboprop	RP, IP, TP	900 m	150 m	1800 m	300 m	1.33 Level Speed
Turbojet, Turbofan	TJ, TF					
Man Rtng: 2.0-		1500 m	250 m	2400 m	400 m	1.5 Level Speed
Man Rtng: 2.5+		3000 m	500 m	4500 m	750 m	1.5 Level Speed
Helicopter	--	200 m	33 m	300 m	50 m	1.1 Level speed

These rates apply to aircraft starting at Medium altitude. Double them for Low altitude and halve them at High altitude and above. If the aircraft is fully loaded, halve the climb rate.

Example: The F-16A has a turbofan engine and a lightly loaded Maneuver rating of 4.5. In a three-minute Tactical Turn, starting at Medium Altitude, it can climb $3000 * 4.5 = 13,500$ meters, or dive $4500 * 4.5 = 20,250$ meters.

All Maneuver Ratings:

Rocket	RT	5000 m	833 m	7500 m	1250 m	1.5 Level Speed
--------	----	--------	-------	--------	--------	-----------------

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Aircraft Ready Times (Minutes)

A/C Size:	<u>VSmall</u>	<u>Small</u>	<u>Med</u>	<u>Large</u>
To Arm				
AAM & gun ammo only	20	30	40	40
Unguided air-to-surface	20	30	40	180
Guided air-to-surface	30	50	60	240
ASW	--	20	40	60
To Fuel:	10	20	30	90
To Alert:	20	40	40	120

To catapult launch: 2 minutes per plane per catapult
Helicopters halve the time to Alert

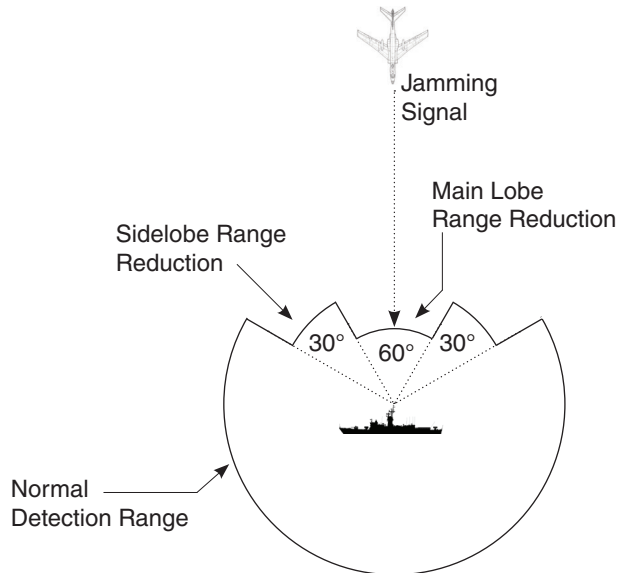
page 4-4

Inflight Refuel Times

(All times are in 3-minute Tactical Turns)

<u>Aircraft Size</u>	<u>Hookup</u>	<u>Boom Refuel</u>	<u>Probe Refuel</u>	<u>Buddy Refuel</u>
Large	2	6	8	--
Small & Medium	1	1	2	3

page 4-6



Main and sidelobe arcs for noise jamming against a 3rd-generation radar.

Noise Jamming Arcs

	<u>Victim Radar Generation</u>					
	<u>1st</u>	<u>2nd</u>	<u>3rd</u>	<u>4th</u>	<u>5th</u>	<u>6th</u>
Main Lobe	120°	90°	60°	45°	5°	1°
Sidelobe	120°	90°	30°	15°	1°	--

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Radar Clutter Values

<u>Clutter Type</u>	<u>Ship SS, Nav Radars</u>	<u>Airborne AS, SS, Ship LAS Radars</u>
Land		
Flat land/Beach	3	6
Flat land w/brush/Lt Woods	6	9
Heavy Woods/Jungle	9	12
Hills/Towns	12	15
Mountains/Cities	14	17

Sea State

0, 1	0	0
2	1	3
3	2	5
4	4	7
5	6	9
6	8	12
7	12	15
8	15	18
9	18	21

Precipitation

Drizzle/Lt Fog	0	0
Light Rain/Mod Fog	2	2
Moderate Rain/Heavy Fog	5	5
Heavy Rain	8	8
Torrential Rain	11	11

AS radar looking at VLow targets suffers twice the clutter of the Airborne AS, SS, Ship LAS column.

Clutter Resistance

<u>Generation</u>	<u>Resistance Value</u>
First	2
Second	5
Third	8
Fourth	12
Fifth	15
Sixth	18

Clutter Effects on Range

<u>Net Clutter Value</u>	<u>Radar Range Modifier</u>
1	.85
2	.70
3	.60
4	.50
5	.40
6	.35
7	.30
8	.25
9 - 10	.20
11- 12	.15
13 - 14	.10
15 - 16	.05
17 - 18	.03
19 - 20	.01

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Evaporative Duct Height

<i>D100 Roll</i>	<u>01 - 10</u>	<u>11 - 40</u>	<u>41 - 80</u>	<u>81 - 95</u>	<u>96-100</u>
Usable by	Peris./				
Size Class	Sub Mast	VSmall	Small	Med	Large

Modifiers:

Fall/Spring months: -15

Winter months: -30

Wind speeds ≤ 10 knots: -20

page 5-5

Surface Duct Probability

<u>Season</u>	<u>Summer</u>	<u>Spring/Fall</u>	<u>Winter</u>
% Chance	20%	15%	5%

Modifiers:

Within 50 nmi of land: +10%

Hot climate locations: +10%

Cold climate locations: -10%

page 5-6

ES Generations Range Modifiers

<u>ES Generation</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
Multiplier	1.1	1.2	1.3	1.4	1.5	1.6

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Towed Array Stabilization Time in Tactical Turns

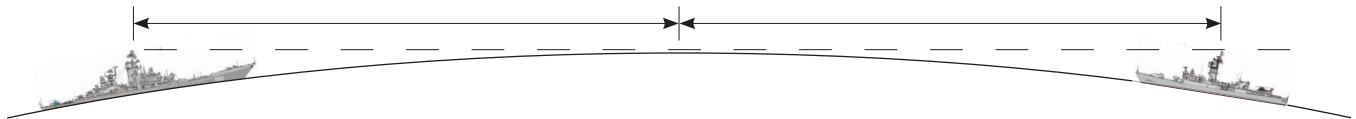
<u>Speed (kts)</u>	<u>5</u>	<u>10</u>	<u>15+</u>
Short Array	2	1	1
Long Array	3	2	1

page 5-9

Russian targeting complexes ("SS-T" systems) ES multipliers against different radar types are increased by the following modifiers. These apply to both ducting and non-ducting conditions:

Long Range AS radar (150 nmi or more):	+0.7
Medium Range AS radars (less than 150 nmi):	+0.4
LAS/Surface Search Radars:	+0.3

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**Radar Line of Sight**

<u>Height</u> <u>(m)</u>	<u>Obsrv</u> <u>Unit</u>	<u>RHigh</u>	<u>VHigh</u>	<u>High</u>	<u>Med</u>	<u>Low</u>	<u>VLow</u>	<u>Horizon</u>	<u>Large</u>	<u>Med</u>	<u>Small</u>	<u>VSmall</u>	<u>Peris.</u>
35000	RHigh	835	730	640	575	465	430	415	435	430	425	420	415
20000	VHigh	730	630	540	475	365	325	315	330	325	325	320	315
10000	High	640	540	445	380	275	235	225	240	235	235	230	225
5000	Med	575	475	380	315	205	170	160	175	170	170	165	160
500	Low	465	365	275	205	100	60	50	65	60	60	55	50
30	VLow	430	325	235	170	60	25	12	26	24	22	19	14
0	Horizon	415	315	225	160	50	12	0	14	12	10	7	2
40	Large	435	330	240	175	65	26	14	26	25	23	20	16
30	Medium	430	325	235	170	60	24	12	24	23	21	18	14
20	Small	425	325	235	170	60	22	10	22	21	19	16	12
10	VSmall	420	320	230	165	55	19	7	19	18	16	13	9
1	Peris.	415	315	225	160	50	14	2	14	12	10	8	3

Line of sight distances are in nautical miles. Observer and contact heights are of aircraft or radar antennas in meters.

The detection range of a radar is either the Annex J range for a particular signature or the radar horizon, whichever is shorter.

HFSW radars are limited by their range, not by the radar horizon.

<u>Obsrv</u> <u>Unit</u>	<u>Horizon</u>	<u>Large</u>	<u>Med</u>	<u>Small</u>	<u>VSmall</u>	<u>Peris.</u>	<u>VLow</u>
Large	35	70	65	60	50	40	70
Medium	30	65	60	55	45	35	65
Small	25	60	55	50	40	30	60
VSmall	20	50	45	40	30	22	50
Peris.	5	35	30	25	20	8	35

<u>Obsrv</u> <u>Unit</u>	<u>Horizon</u>	<u>Large</u>	<u>Med</u>	<u>Small</u>	<u>VSmall</u>	<u>Peris.</u>	<u>VLow</u>
Large	75	145	135	125	110	85	145
Medium	70	135	125	115	100	75	135
Small	55	120	115	100	90	65	120
VSmall	40	105	95	85	70	45	105
Peris.	9	75	65	55	40	17	75

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Passive Sonar Detection Modifiers

Noise Signature

Contact Noise Rating						Active
	<u>Loud</u>	<u>Noisy</u>	<u>Quiet</u>	<u>VQuiet</u>	<u>EQuiet</u>	<u>Sonar</u>
Modifier	+6	+3	0	-3	-6	+8

Signature Modifiers

Sub using diesels	+3	Snorkeling or surfaced
Tgt Cavitating	+4	
Ultra Quiet	-1	Nuclear sub, max speed 3 kts
Ultra Quiet	-2	Conventional sub, max spd 3 kts

Relative Speed Modifier

Contact	Searcher Speed (kts)					
<u>Speed (kts)</u>	<u>0-8</u>	<u>9-15</u>	<u>16-20</u>	<u>21-25</u>	<u>26-30</u>	<u>30+</u>
0 - 8	0	-1	-3	-6	-8	Blind
9 - 15	+1	0	-2	-4	-6	Blind
16 - 20	+2	+1	-1	-3	-5	Blind
21 - 25	+3	+2	0	-2	-4	Blind
26 - 30	+4	+3	+1	-1	-3	Blind
30+	+5	+4	+2	0	-2	Blind

Note: High speed towed array reduces the searcher speed by 7 knots.

Environmental Modifiers

Sea State	<u>0-1</u>	<u>2-3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8-9</u>
Modifier	+1	0	-1	-2	-4	-6	-8

Shipping Traffic	<u>Moderate</u>	<u>Heavy</u>
Modifier	-1	-2

Rain	<u>Light</u>	<u>Moderate</u>	<u>Heavy</u>	<u>Torrential</u>
Modifier	-2	-4	-6	-8

Shallow Water (\leq Int II)	Sonar Frequency		
	<u>VLF/LF/LMF</u>	<u>MF</u>	<u>HF</u>
Modifier	-3	-2	-1

Ice	
MIZ	-3 for LMF - HF
	-2 for VLF - LF
Pack Ice	-3

Active Sonar Detection Modifiers

Target Strength

Contact Size Class	<u>Large</u>	<u>Med</u>	<u>Small</u>	<u>VSmall</u>
<u>Contact Size Class</u>	<u>A</u>	<u>B</u>	<u>C - D</u>	<u>E - G</u>
Modifier	+3	+2	+1	-1

Target Strength Modifiers

Anechoic Coating	-1
Narrow Aspect	-1
Broad Aspect	+1

Relative Speed Modifier

Contact	Searcher Speed (kts)					
<u>Speed (kts)</u>	<u>0-8</u>	<u>9-15</u>	<u>16-20</u>	<u>21-25</u>	<u>26-30</u>	<u>30+</u>
0 - 8	0	0	-1	-2	-4	Blind
9 - 15	0	0	0	-1	-3	Blind
16 - 20	+1	0	0	0	-2	Blind
21 - 25	+1	+1	+1	0	-1	Blind
26 - 30	+2	+2	+1	+1	0	Blind
30+	+2	+2	+2	+1	0	Blind

Environmental Modifiers

Sea State	<u>0-1</u>	<u>2-3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8-9</u>
Modifier	0	-1	-2	-3	-5	-7	-9

Shallow Water (\leq Int II)	Sonar Frequency		
	<u>VLF/LF/LMF</u>	<u>MF</u>	<u>HF</u>
Modifier	-3	-2	-1

Ice	
MIZ	-2
Pack Ice	+3

Ocean Type	Applicable Environment Modifiers
Open Ocean	(Sea State + Shipping) or Rain Whichever is greater
Marginal Ice Zone	Sea State + MIZ
Pack Ice	Pack Ice

Layer Modifiers (apply to both the Active and Passive Sonar)

Direct Path - Sonar Above Layer

Contact	Layer Depth		
<u>Depth</u>	<u>Shallow</u>	<u>Moderate</u>	<u>Deep</u>
Surface/PD	0	+2	+3
Shallow	-5	+2	+3
Intermediate I	-5	-5	+3
Intermediate II+	-5	-5	-5

Passive VLF capable sonars are immune to the effects of Shallow and Moderate layers. For Deep layers, reduce the negative cross-layer loss modifier to -2 (not -5). There is no modifier, good or bad, when a VLF sonar and contact are on the same side of the layer.

Direct Path - Sonar Below Layer

Contact	Layer Depth		
<u>Depth</u>	<u>Shallow</u>	<u>Moderate</u>	<u>Deep</u>
Surface/PD	-5	-5	-5
Shallow	-3	-5	-5
Intermediate I	-2	-2	-5
Intermediate II	-1	-1	-2
Intermediate III	0	0	-1
Intermediate IV+	0	0	0

Layer	Layer	Sonars	Surface
<u>Depth (m)</u>	<u>Title</u>	<u>Affected</u>	<u>Duct</u>
25	Shallow	MF/HF	No
50	Moderate	LMF/MF/HF	Weak
100	Deep	VLF/LF/LMF/MF/HF	Strong

Detection Range Modifiers

Modifier Total:	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
Range Mod:	0.05	0.10	0.15	0.20	0.25	0.30	0.40	0.50	0.60	0.80	1.0	1.25	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0

Multiply the sonar system's base range from Annex K1 or K2 with the Range Modifier above to find the 50% probability of detection range.

Sonar Range/Probability

Range (nmi)	Probability of Detection																				
	90%	85%	80%	75%	70%	65%	60%	55%	50%	45%	40%	35%	30%	25%	20%	15%	10%				
0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9				
0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8				
0.3	0.5	0.6	0.8	0.9	0.9	1.1	1.2	1.4	1.5	1.7	1.8	2.0	2.1	2.3	2.4	2.6	2.7				
0.4	0.6	0.8	1.0	1.2	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6				
0.5	0.8	1.0	1.3	1.5	1.5	1.8	2.0	2.3	2.5	2.8	3.0	3.3	3.5	3.8	4.0	4.3	4.5				
0.6	0.9	1.2	1.5	1.8	1.8	2.1	2.4	2.7	3.0	3.3	3.6	3.9	4.2	4.5	4.8	5.1	5.4				
0.7	1.1	1.4	1.8	2.1	2.1	2.5	2.8	3.2	3.5	3.9	4.2	4.6	4.9	5.3	5.6	6.0	6.3				
0.8	1.2	1.6	2.0	2.4	2.4	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2				
0.9	1.4	1.8	2.3	2.7	2.7	3.2	3.6	4.1	4.5	5.0	5.4	5.9	6.3	6.8	7.2	7.7	8.1				
1.0	1.5	2.0	2.5	3.0	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0				
1.1	1.7	2.2	2.8	3.3	3.3	3.9	4.4	5.0	5.5	6.1	6.6	7.2	7.7	8.3	8.8	9.4	9.9				
1.2	1.8	2.4	3.0	3.6	3.6	4.2	4.8	5.4	6.0	6.6	7.2	7.8	8.4	9.0	9.6	10.2	10.8				
1.3	2.0	2.6	3.3	3.9	3.9	4.6	5.2	5.9	6.5	7.2	7.8	8.5	9.1	9.8	10.4	11.1	11.7				
1.4	2.1	2.8	3.5	4.2	4.2	4.9	5.6	6.3	7.0	7.7	8.4	9.1	9.8	10.5	11.2	11.9	12.6				
1.5	2.3	3.0	3.8	4.5	4.5	5.3	6.0	6.8	7.5	8.3	9.0	9.8	10.5	11.3	12.0	12.8	13.5				
1.6	2.4	3.2	4.0	4.8	4.8	5.6	6.4	7.2	8.0	8.8	9.6	10.4	11.2	12.0	12.8	13.6	14.4				
1.7	2.6	3.4	4.3	5.1	5.1	6.0	6.8	7.7	8.5	9.4	10.2	11.1	11.9	12.8	13.6	14.5	15.3				
1.8	2.7	3.6	4.5	5.4	5.4	6.3	7.2	8.1	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2				
1.9	2.9	3.8	4.8	5.7	5.7	6.7	7.6	8.6	9.5	10.5	11.4	12.4	13.3	14.3	15.2	16.2	17.1				
2.0	3.0	4.0	5.0	6.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0				
2.1	3.2	4.2	5.3	6.3	6.3	7.4	8.4	9.5	10.5	11.6	12.6	13.7	14.7	15.8	16.8	17.9	18.9				
2.2	3.3	4.4	5.5	6.6	6.6	7.7	8.8	9.9	11.0	12.1	13.2	14.3	15.4	16.5	17.6	18.7	19.8				
2.3	3.5	4.6	5.8	6.9	6.9	8.1	9.2	10.4	11.5	12.7	13.8	15.0	16.1	17.3	18.4	19.6	20.7				
2.4	3.6	4.8	6.0	7.2	7.2	8.4	9.6	10.8	12.0	13.2	14.4	15.6	16.8	18.0	19.2	20.4	21.6				
2.5	3.8	5.0	6.3	7.5	7.5	8.8	10.0	11.3	12.5	13.8	15.0	16.3	17.5	18.8	20.0	21.3	22.5				
2.6	3.9	5.2	6.5	7.8	7.8	9.1	10.4	11.7	13.0	14.3	15.6	16.9	18.2	19.5	20.8	22.1	23.4				
2.7	4.1	5.4	6.8	8.1	8.1	9.5	10.8	12.2	13.5	14.9	16.2	17.6	18.9	20.3	21.6	23.0	24.3				
2.8	4.2	5.6	7.0	8.4	8.4	9.8	11.2	12.6	14.0	15.4	16.8	18.2	19.6	21.0	22.4	23.8	25.2				
2.9	4.4	5.8	7.3	8.7	8.7	10.2	11.6	13.1	14.5	16.0	17.4	18.9	20.3	21.8	23.2	24.7	26.1				
3.0	4.5	6.0	7.5	9.0	9.0	10.5	12.0	13.5	15.0	16.5	18.0	19.5	21.0	22.5	24.0	25.5	27.0				

Sonar Range/Probability (continued)

Range (nmi)	Probability of Detection															
	90%	85%	80%	75%	70%	65%	60%	55%	50%	45%	40%	35%	30%	25%	20%	10%
3.2	4.8	6.4	8.0	9.6	11.2	12.8	14.4	16.0	17.6	19.2	20.8	22.4	24.0	25.6	27.2	28.8
3.4	5.1	6.8	8.5	10.2	11.9	13.6	15.3	17.0	18.7	20.4	22.1	23.8	25.5	27.2	28.9	30.6
3.6	5.4	7.2	9.0	10.8	12.6	14.4	16.2	18.0	19.8	21.6	23.4	25.2	27.0	28.8	30.6	32.4
3.8	5.7	7.6	9.5	11.4	13.3	15.2	17.1	19.0	20.9	22.8	24.7	26.6	28.5	30.4	32.3	34.2
4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0
4.4	6.6	8.8	11.0	13.2	15.4	17.6	19.8	22.0	24.2	26.4	28.6	30.8	33.0	35.2	37.4	39.6
4.8	7.2	9.6	12.0	14.4	16.8	19.2	21.6	24.0	26.4	28.8	31.2	33.6	36.0	38.4	40.8	43.2
5.2	7.8	10.4	13.0	15.6	18.2	20.8	23.4	26.0	28.6	31.2	33.8	36.4	39.0	41.6	44.2	46.8
5.6	8.4	11.2	14.0	16.8	19.6	22.4	25.2	28.0	30.8	33.6	36.4	39.2	42.0	44.8	47.6	50.4
6.0	9.0	12.0	15.0	18.0	21.0	24.0	27.0	30.0	33.0	36.0	39.0	42.0	45.0	48.0	51.0	54.0
6.4	9.6	12.8	16.0	19.2	22.4	25.6	28.8	32.0	35.2	38.4	41.6	44.8	48.0	51.2	54.4	57.6
6.8	10.2	13.6	17.0	20.4	23.8	27.2	30.6	34.0	37.4	40.8	44.2	47.6	51.0	54.4	57.8	61.2
7.2	10.8	14.4	18.0	21.6	25.2	28.8	32.4	36.0	39.6	43.2	46.8	50.4	54.0	57.6	61.2	64.8
7.6	11.4	15.2	19.0	22.8	26.6	30.4	34.2	38.0	41.8	45.6	49.4	53.2	57.0	60.8	64.6	68.4
8.0	12.0	16.0	20.0	24.0	28.0	32.0	36.0	40.0	44.0	48.0	52.0	56.0	60.0	64.0	68.0	72.0
8.4	12.6	16.8	21.0	25.2	29.4	33.6	37.8	42.0	46.2	50.4	54.6	58.8	63.0	67.2	71.4	75.6
8.8	13.2	17.6	22.0	26.4	30.8	35.2	39.6	44.0	48.4	52.8	57.2	61.6	66.0	70.4	74.8	79.2
9.2	13.8	18.4	23.0	27.6	32.2	36.8	41.4	46.0	50.6	55.2	59.8	64.4	69.0	73.6	78.2	82.8
9.6	14.4	19.2	24.0	28.8	33.6	38.4	43.2	48.0	52.8	57.6	62.4	67.2	72.0	76.8	81.6	86.4
10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0	65.0	70.0	75.0	80.0	85.0	90.0
10.4	15.6	20.8	26.0	31.2	36.4	41.6	46.8	52.0	57.2	62.4	67.6	72.8	78.0	83.2	88.4	93.6
10.8	16.2	21.6	27.0	32.4	37.8	43.2	48.6	54.0	59.4	64.8	70.2	75.6	81.0	86.4	91.8	97.2
11.2	16.8	22.4	28.0	33.6	39.2	44.8	50.4	56.0	61.6	67.2	72.8	78.4	84.0	89.6	95.2	100.8
11.6	17.4	23.2	29.0	34.8	40.6	46.4	52.2	58.0	63.8	69.6	75.4	81.2	87.0	92.8	98.6	104.4
12.0	18.0	24.0	30.0	36.0	42.0	48.0	54.0	60.0	66.0	72.0	78.0	84.0	90.0	96.0	102.0	108.0
12.4	18.6	24.8	31.0	37.2	43.4	49.6	55.8	62.0	68.2	74.4	80.6	86.8	93.0	99.2	105.4	111.6
12.8	19.2	25.6	32.0	38.4	44.8	51.2	57.6	64.0	70.4	76.8	83.2	89.6	96.0	102.4	108.8	115.2
13.2	19.8	26.4	33.0	39.6	46.2	52.8	59.4	66.0	72.6	79.2	85.8	92.4	99.0	105.6	112.2	118.8
13.6	20.4	27.2	34.0	40.8	47.6	54.4	61.2	68.0	74.8	81.6	88.4	95.2	102.0	108.8	115.6	122.4
14.0	21.0	28.0	35.0	42.0	49.0	56.0	63.0	70.0	77.0	84.0	91.0	98.0	105.0	112.0	119.0	126.0
14.4	21.6	28.8	36.0	43.2	50.4	57.6	64.8	72.0	79.2	86.4	93.6	100.8	108.0	115.2	122.4	129.6
14.8	22.2	29.6	37.0	44.4	51.8	59.2	66.6	74.0	81.4	88.8	96.2	103.6	111.0	118.4	125.8	133.2
15.2	22.8	30.4	38.0	45.6	53.2	60.8	68.4	76.0	83.6	91.2	98.8	106.4	114.0	121.6	129.2	136.8
15.6	23.4	31.2	39.0	46.8	54.6	62.4	70.2	78.0	85.8	93.6	101.4	109.2	117.0	124.8	132.6	140.4
16.0	24.0	32.0	40.0	48.0	56.0	64.0	72.0	80.0	88.0	96.0	104.0	112.0	120.0	128.0	136.0	144.0
16.4	24.6	32.8	41.0	49.2	57.4	65.6	73.8	82.0	90.2	98.4	106.6	114.8	123.0	131.2	139.4	147.6
16.8	25.2	33.6	42.0	50.4	58.8	67.2	75.6	84.0	92.4	100.8	109.2	117.6	126.0	134.4	142.8	151.2
17.2	25.8	34.4	43.0	51.6	60.2	68.8	77.4	86.0	94.6	103.2	111.8	120.4	129.0	137.6	146.2	154.8
17.6	26.4	35.2	44.0	52.8	61.6	70.4	79.2	88.0	96.8	105.6	114.4	123.2	132.0	140.8	149.6	158.4
18.0	27.0	36.0	45.0	54.0	63.0	72.0	81.0	90.0	99.0	108.0	117.0	126.0	135.0	144.0	153.0	162.0
18.4	27.6	36.8	46.0	55.2	64.4	73.6	82.8	92.0	101.2	110.4	119.6	128.8	138.0	147.2	156.4	165.6
18.8	28.2	37.6	47.0	56.4	65.8	75.2	84.6	94.0	103.4	112.8	122.2	131.6	141.0	150.4	159.8	169.2
19.2	28.8	38.4	48.0	57.6	67.2	76.8	86.4	96.0	105.6	115.2	124.8	134.4	144.0	153.6	163.2	172.8
19.6	29.4	39.2	49.0	58.8	68.6	78.4	88.2	98.0	107.8	117.6	127.4	137.2	147.0	156.8	166.6	176.4
20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0

Cavitation SpeedsContact's
Noise

<u>Rating</u>	<u>Target Speed</u>				
	<u>0 - 8</u>	<u>9 - 15</u>	<u>16 - 20</u>	<u>21 - 25</u>	<u>26+</u>
Loud	-	Shallow	Int I	Int II	Int III
Noisy	-	Shallow	Int I	Int II	Int III
Quiet	-	-	Shallow	Int I	Int II
Very Quiet	-	-	-	Shallow	Int I
Ext Quiet	-	-	-	-	Shallow

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Passive Convergence Zone Capability

<u>Target Noise Rating</u>	<u># of CZs by Sonar Type</u>			
	<u>MF*</u>	<u>LMF</u>	<u>LF</u>	<u>VLF</u>
Loud	1	1	2	2
Noisy	1	1	1	2
Quiet	0	0	0	0
Very Quiet	0	0	0	0
Ext Quiet	0	0	0	0

* CZ-capable only in the Mediterranean.

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Passive Sonar Classification Chance

<u>Classification</u>	<u>Ship/Submarine</u>	<u>Torpedo</u>
<u>Die Roll</u>	<u>Data</u>	<u>Data</u>
%	Ship/Sub Class	Torpedo Type
% + 10	Ship or Sub, Nationality, Propulsion Type	Propulsion Type (thermal, electric, rocket, etc.)
% + 20	Ship or Submarine	It's a Torpedo(!)
% + 21	No data	No data

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Passive Convergence Zone Speed Modifiers

<u>Target Noise Rating</u>	<u>CZs added based on Target Speed (knots)</u>					
	<u>0-8</u>	<u>9-15</u>	<u>16-20</u>	<u>21-25</u>	<u>26-30</u>	<u>30+</u>
Loud	+0	+1	+2	+3	+3	+4
Noisy	+0	+1	+2	+2	+3	+3
Quiet	+0	+1	+1	+2	+2	+3
Very Quiet	+0	+0	+1	+1	+2	+2
Ext Quiet	+0	+0	+0	+1	+1	+2
Searching Platform Speed	+0	-1	-2	-3	-3	-4

Bottom Bounce Depth/Range

<u>Water Depth</u> <u>(meters)</u>	<u>Minimum</u> <u>Range (nmi)</u>	<u>Maximum</u> <u>Range (nmi)</u>
2,000	4.0	8.0
2,500	5.0	10.0
3,000	6.0	12.0
3,500	7.0	14.0
4,000	8.0	16.0
4,500	9.0	18.0
5,000	10.0	20.0

<u>Sonar</u> <u>Generation</u>	<u>CZ Detection</u> <u>Modifier</u>
3	-2
4	-1
5	+0
6 - 7	+1

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<u>Sonar</u> <u>Generation</u>	<u>BB Detection</u> <u>Modifier</u>
3	-2
4	-1
5	+0
6 - 7	+1

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Infrared Sensor Ranges

<u>IR Sensor</u> <u>Generation</u>	<u>Small & Med</u> <u>Ships/Subsonic</u>		<u>Lge Ship or Aircr./</u> <u>Supersonic Aircr.</u>
	<u>Stealthy</u>	<u>Aircr. or Msl</u>	<u>or Missile</u>
1	2 nmi	3 nmi	5 nmi
2	3 nmi	5 nmi	10 nmi
3	4 nmi	8 nmi	15 nmi
4	5 nmi	10 nmi	20 nmi
5	7 nmi	15 nmi	30 nmi

IR ranges are reduced by water in the air. The more moisture, the shorter the range.

<u>Precipitation</u>	<u>Range Mod</u>
Drizzle/Misty/Lt Fog	x 0.90
Lt Rain/Moderate Fog	x 0.75
Moderate Rain/Heavy Fog	x 0.50
Heavy Rain	x 0.25
Torrential Rain	No Detection

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Acoustic Intercept Receivers

<u>Gener- ation</u>	<u>LMF</u> <u>Range</u>	<u>MF</u> <u>Range</u>	<u>HF</u> <u>Range</u>	<u>Bearing</u> <u>Accuracy</u>	<u>Ranging</u> <u>Capability</u>
1	x3	x3	x2	±20°	No
2	x3	x3	x2	±15°	No
3	x4	x4	x3	±10°	No
4	x4	x4	x3	±5°	No
5	x5	x5	x4	±3°	Yes

• First and second generation receivers provide only the frequency band of the detected sonar (e.g., "HF").

• Third and fourth generation AIRs can identify the active sonar by type (e.g., "SQS-26C").

• Fifth generation receivers will provide a range out to a limit of 12 nmi. They receive the wave front curvature bonus of +3 on the Acoustic Fire Control Solution table.

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Sonobuoy Field Search Area (square nmi) for Wide-Area MAD Search

<u>Depth</u>	<u>200 -</u>	<u>400 -</u>	<u>600 -</u>	<u>800 -</u>	<u>1000 -</u>	<u>1200 -</u>	<u>1400 -</u>	<u>1700 -</u>	<u>2100 -</u>	<u>2600 -</u>
<u>Band</u>	<u>399</u>	<u>599</u>	<u>799</u>	<u>999</u>	<u>1199</u>	<u>1399</u>	<u>1699</u>	<u>2099</u>	<u>2599</u>	<u>3000</u>
Shallow	27%	16%	11%	9%	7%	6%	5%	4%	3%	3%
Intermediate I	27%	16%	11%	9%	7%	6%	5%	4%	3%	3%
Intermediate II	26%	15%	11%	8%	7%	6%	5%	4%	3%	3%
Intermediate III	24%	14%	10%	8%	6%	5%	4%	4%	3%	2%
Intermediate IV	21%	12%	8%	6%	5%	4%	4%	3%	3%	2%
Intermediate V	16%	9%	6%	5%	4%	3%	3%	2%	2%	1%
Deep +	--	--	--	--	--	--	--	--	--	--

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Acoustic Layer Effects

<u>Layer</u>	<u>Depth Band</u>	<u>Affected Fre-</u>	<u>Surface</u>	<u>General</u>
<u>Depth</u>	<u>Boundary</u>	<u>quency Bands</u>	<u>Duct</u>	<u>Occurrence</u>
Shallow	Periscope Depth - Shallow	MF/HF	None	35%
Moderate	Shallow - Intermediate I	LMF/MF/HF	Weak	55%
Deep	Intermediate I - Intermediate II	VLF/LF/LMF/MF/HF	Strong	10%

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MAD Detection Modifiers

<u>Depth Band</u>	<u>Modifier</u>	<u>Size Class</u>	<u>Modifier</u>
Shallow	0%	A	+10%
Intermediate I	0%	B	0%
Intermediate II	-10%	C-D	-10%
Intermediate III	-20%	E-G	-20%
Intermediate IV	-40%		
Intermediate V	-60%		
Deep +	--		

- Base detection chance is 70%
- Titanium submarines are treated as an E - G size target.
- Masked submarine signature: -30%
- No localization sonobuoy pattern or radar contact before MAD run: modified detection chance is halved.

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Visual Classification Table

<u>D10</u>	<u>Hull Down</u>	<u>Hull Up</u>
1	Ship	Ship
2	Ship	Ship
3	Ship	Size
4	Ship	Size
5	Size	ST
6	Size	ST
7	ST	ST C
8	ST	ST C
9	ST C	ST C N
10	ST C	ST C N

Ship: There is a ship there.
Size (S): Large, Medium, Small, Very Small
Type (T): CV, BB, CG, DD, Merchant
Class (C): Individual ship class
Nationality (N): US, Russian, German, French, etc.

Wake Detection Chance

<u>System</u>	<u>Gen</u>	<u>Platform</u>	<u>75%</u>	<u>50%</u>	<u>25%</u>
MNK-100 Kolos	1	Submarine	0.5	1.0	1.5
MNK-200 Tukan	2	Submarine	1.0	2.0	3.0
MNK-300 Kaira	2	Ship (towed)	1.0	2.0	3.0

Time Late (hrs) modifiers

- Searching ship speed 9 -15 knots: halved
- Searching ship speed 16+ knots: detection not possible.
- Sea State 4: x 0.5 (Shallow/Intermediate I depth bands)
- Sea State 6 and greater: Detection not possible.
- Alerted operator: +15%

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Note: Some classes of ship are used by more than one country, e.g., the British-built Type 42 destroyers used by Argentina during the Falklands War.

Classification Modifiers

<u>Prob of Det</u>	<u>10%</u>	<u>25%</u>	<u>50%</u>	<u>75%</u>	<u>100%</u>
	-3	-2	-1	0	+1

For close contacts, less than 4 nmi (8 kyds)
in good visibility (60% or better) +2

Environment Modifiers

Visibility 40% or less -2
Visibility 20% or less -3
(Ignore these if using night vision sensors, e.g., LLLTV, FLIR in clear weather)

Contact Illuminated -1 (Night only)
Contact firing missile +2 (Night only)

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Surface-to-Surface Visibility

		100% Visibility Observing Unit						
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F/G</u>	<u>Per</u>
Target Unit	A	40.0	38.0	36.0	32.0	28.0	26.0	22.0
	B	38.0	36.0	34.0	30.0	26.0	24.0	20.0
	C	36.0	34.0	32.0	28.0	24.0	22.0	18.0
	D	32.0	30.0	28.0	24.0	20.0	18.0	14.0
	E	29.0	27.0	25.0	21.0	17.0	15.0	11.0
	F/G	27.0	25.0	23.0	19.0	15.0	13.0	9.0
	Per	4.0	4.0	4.0	4.0	4.0	4.0	2.0
	Horiz.	21.0	19.0	17.0	15.0	10.0	7.0	4.0

		80% Visibility Observing Unit						
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F/G</u>	<u>Per</u>
Target Unit	A	32.0	30.5	29.0	25.5	22.5	21.0	17.5
	B	30.5	29.0	27.0	24.0	21.0	19.0	16.0
	C	29.0	27.0	25.5	22.5	19.0	17.5	14.5
	D	25.5	24.0	22.5	19.0	16.0	14.5	11.0
	E	23.0	21.5	20.0	17.0	13.5	12.0	9.0
	F/G	21.5	20.0	18.5	15.0	12.0	10.5	7.0
	Per	3.0	3.0	3.0	3.0	3.0	3.0	1.5

		60% Visibility Observing Unit						
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F/G</u>	<u>Per</u>
Target Unit	A	24.0	23.0	21.5	19.0	17.0	15.5	13.0
	B	23.0	21.5	20.5	18.0	15.5	14.5	12.0
	C	21.5	20.5	19.0	17.0	14.5	13.0	11.0
	D	19.0	18.0	17.0	14.5	12.0	11.0	8.5
	E	17.5	16.0	15.0	12.5	10.0	9.0	6.5
	F/G	16.0	15.0	14.0	11.5	9.0	8.0	5.5
	Per	2.5	2.5	2.5	2.5	2.5	2.5	1.0

		40% Visibility Observing Unit						
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F/G</u>	<u>Per</u>
Target Unit	A	16.0	15.0	14.5	13.0	11.0	10.5	9.0
	B	15.0	14.5	13.5	12.0	10.5	9.5	8.0
	C	14.5	13.5	13.0	11.0	9.5	9.0	7.0
	D	13.0	12.0	11.0	9.5	8.0	7.0	5.5
	E	11.5	11.0	10.0	8.5	7.0	6.0	4.5
	F/G	11.0	10.0	9.0	7.5	6.0	5.0	3.5
	Per	2.0	2.0	2.0	2.0	2.0	2.0	1.0

		20% Visibility Observing Unit						
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F/G</u>	<u>Per</u>
Target Unit	A	8.0	7.5	7.0	6.5	5.5	5.0	4.5
	B	7.5	7.0	6.5	6.0	5.0	4.5	4.0
	C	7.0	6.5	6.0	5.5	4.5	4.0	3.5
	D	6.5	6.0	5.5	5.0	4.0	3.5	3.0
	E	6.0	5.5	5.0	4.5	3.5	3.0	2.5
	F/G	5.5	5.0	4.5	4.0	3.0	2.5	2.0
	Per	1.5	1.5	1.5	1.5	1.5	1.5	0.5

		5% Visibility Observing Unit						
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F/G</u>	<u>Per</u>
Target Unit	A	2.0	2.0	2.0	1.5	1.5	1.0	1.0
	B	2.0	2.0	1.5	1.5	1.5	1.0	1.0
	C	2.0	2.0	1.5	1.5	1.0	1.0	1.0
	D	1.5	1.5	1.5	1.0	1.0	1.0	1.0
	E	1.5	1.5	1.0	1.0	1.0	1.0	0.5
	F/G	1.5	1.5	1.0	1.0	1.0	0.5	0.5
	Per	1.0	1.0	1.0	1.0	1.0	1.0	0.5

		90% Visibility Observing Unit						
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F/G</u>	<u>Per</u>
Target Unit	A	36.0	34.0	32.0	29.0	25.0	23.5	20.0
	B	34.0	32.5	30.5	27.0	23.5	21.5	18.0
	C	32.5	30.5	29.0	25.0	21.5	19.5	16.0
	D	29.0	27.0	25.0	21.5	18.0	16.0	12.5
	E	26.0	24.5	22.5	19.0	15.5	13.5	10.0
	F/G	24.0	22.5	20.5	17.0	13.5	11.5	8.0
	Per	3.5	3.5	3.5	3.5	3.5	3.5	1.5

		70% Visibility Observing Unit						
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F/G</u>	<u>Per</u>
Target Unit	A	28.0	26.5	25.0	22.5	20.0	18.0	15.5
	B	26.5	25.0	24.0	21.0	18.0	17.0	14.0
	C	25.0	24.0	22.5	19.5	16.5	15.5	12.5
	D	22.5	21.0	19.5	17.0	14.0	12.5	10.0
	E	20.5	19.0	17.5	14.5	12.0	10.5	8.0
	F/G	19.0	17.5	16.0	13.5	10.5	9.0	6.5
	Per	3.0	3.0	3.0	3.0	3.0	3.0	1.5

		50% Visibility Observing Unit						
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F/G</u>	<u>Per</u>
Target Unit	A	20.0	19.0	18.0	16.0	14.0	13.0	11.0
	B	19.0	18.0	17.0	15.0	13.0	12.0	10.0
	C	18.0	17.0	16.0	14.0	12.0	11.0	9.0
	D	16.0	15.0	14.0	12.0	10.0	9.0	7.0
	E	14.5	13.5	12.5	10.5	8.5	7.5	5.5
	F/G	13.5	12.5	11.5	9.5	7.5	6.5	4.5
	Per	2.0	2.0	2.0	2.0	2.0	2.0	1.0

		30% Visibility Observing Unit						
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F/G</u>	<u>Per</u>
Target Unit	A	12.0	11.5	10.5	9.5	8.5	8.0	6.5
	B	11.5	11.0	10.0	9.0	8.0	7.0	6.0
	C	10.5	10.0	9.5	8.5	7.0	6.5	5.5
	D	9.5	9.0	8.5	7.0	6.0	5.5	4.0
	E	8.5	8.0	7.5	6.5	5.0	4.5	3.5
	F/G	8.0	7.5	7.0	5.5	4.5	4.0	2.5
	Per	1.5	1.5	1.5	1.5	1.5	1.5	0.5

		10% Visibility Observing Unit						
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F/G</u>	<u>Per</u>
Target Unit	A	4.0	4.0	3.5	3.0	3.0	2.5	2.0
	B	4.0	3.5	3.5	3.0	2.5	2.5	2.0
	C	3.5	3.5	3.0	3.0	2.5	2.0	1.5
	D	3.5	3.0	3.0	2.5	2.0	2.0	1.5
	E	3.0	3.0	2.5	2.0	2.0	1.5	1.0
	F/G	3.0	2.5	2.5	2.0	1.5	1.5	1.0
	Per	1.0	1.0	1.0	1.0	1.0	1.0	0.5

		2% Visibility Observing Unit						
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F/G</u>	<u>Per</u>
Target Unit	A	1.0	1.0	1.0	0.5	0.5	0.5	0.5
	B	1.0	0.5	0.5	0.5	0.5	0.5	0.5
	C	1.0	0.5	0.5	0.5	0.5	0.5	0.5
	D	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	E	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	F/G	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Per	0.5	0.5	0.5	0.5	0.5	0.5	0.5

All Distances are in Thousands of Yards (kyds)

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Visual Detection Chance

Visibility Range (kyds)	Probability of Detection and Visual Detection Range (kyds)					Visibility Range (kyds)	Probability of Detection and Visual Detection Range (kyds)				
	10%	25%	50%	75%	100%		10%	25%	50%	75%	100%
52.0	52.0	49.5	44.5	38.5	35.5	17.0	17.0	16.0	14.5	12.5	11.5
48.0	48.0	45.5	41.5	35.5	32.5	16.5	16.5	15.5	14.0	12.0	11.0
46.0	46.0	43.5	39.5	34.0	31.0	16.0	16.0	15.0	14.0	12.0	11.0
44.0	44.0	42.0	38.0	32.5	30.0	15.5	15.5	14.5	13.5	11.5	10.5
42.0	42.0	40.0	36.0	31.0	28.5	15.0	15.0	14.5	13.0	11.0	10.0
40.0	40.0	38.0	34.5	30.0	27.0	14.5	14.5	14.0	12.5	11.0	10.0
38.0	38.0	36.0	32.5	28.0	26.0	14.0	14.0	13.5	12.0	10.5	9.5
36.0	36.0	34.0	31.0	26.5	24.5	13.5	13.5	13.0	11.5	10.0	9.5
35.0	35.0	33.0	30.0	26.0	24.0	13.0	13.0	12.5	11.0	9.5	9.0
34.0	34.0	32.5	29.0	25.0	23.0	12.5	12.5	12.0	11.0	9.5	8.5
32.5	32.5	31.0	28.0	24.0	22.0	12.0	12.0	11.5	10.5	9.0	8.0
32.0	32.0	30.5	27.5	23.5	22.5	11.5	11.5	11.0	10.0	8.5	7.5
31.0	31.0	29.5	26.5	23.0	21.5	11.0	11.0	10.5	9.5	8.0	7.5
30.5	30.5	29.0	26.0	22.5	21.0	10.5	10.5	10.0	9.0	8.0	7.0
30.0	30.0	28.5	25.5	22.0	20.5	10.0	10.0	9.5	8.5	7.5	7.0
29.0	29.0	27.5	25.0	21.5	19.5	9.5	9.5	9.0	8.0	7.0	6.5
28.0	28.0	26.5	24.0	20.5	19.0	9.0	9.0	8.5	7.5	6.5	6.0
27.0	27.0	25.5	23.0	20.0	18.5	8.5	8.5	8.0	7.5	6.5	6.0
26.5	26.5	25.0	23.0	19.5	18.0	8.0	8.0	7.5	7.0	6.0	5.5
26.0	26.0	24.5	22.5	19.0	17.5	7.5	7.5	7.0	6.5	5.5	5.0
25.5	25.5	24.0	22.0	19.0	17.0	7.0	7.0	6.5	6.0	5.5	5.0
25.0	25.0	24.0	21.5	18.5	17.0	6.5	6.5	6.0	5.5	5.0	4.5
24.5	24.5	23.5	21.0	18.0	16.5	6.0	6.0	5.5	5.0	4.5	4.0
24.0	24.0	23.0	20.5	17.5	16.5	5.5	5.5	5.0	4.5	4.0	3.5
23.5	23.5	22.5	20.0	17.5	16.0	5.0	5.0	4.5	4.0	3.5	3.0
23.0	23.0	22.0	20.0	17.0	15.5	4.5	4.5	4.0	3.5	3.0	2.5
22.5	22.5	21.5	19.5	16.5	15.5	4.0	4.0	3.5	3.0	2.5	2.0
22.0	22.0	21.0	19.0	16.5	15.0	3.5	3.5	3.0	2.5	2.0	1.5
21.5	21.5	20.5	18.5	16.0	14.5	3.0	3.0	2.5	2.0	1.5	1.0
21.0	21.0	20.0	18.0	15.5	14.5	2.5	2.5	2.0	1.5	1.0	0.5
20.5	20.5	19.5	17.5	15.0	14.0	2.0	2.0	1.5	1.0	0.5	0.3
20.0	20.0	19.0	17.0	15.0	13.5	1.5	1.5	1.5	1.0	0.5	0.3
19.5	19.5	18.5	17.0	14.5	13.5	1.0	1.0	1.0	1.0	0.5	0.3
19.0	19.0	18.0	16.5	14.0	13.0	0.5	0.5	0.5	0.5	0.5	0.3
18.5	18.5	17.5	16.0	13.5	12.5						
18.0	18.0	17.0	15.5	13.5	12.0						
17.5	17.5	16.5	15.0	13.0	12.0						

At ranges of less than 0.3 kyds, detection is automatic.

Visibility Modifiers that change the table/row used: These are based on the lighting conditions or the target's contrast and will change the Surface-to-Surface Visibility table used or the row on the Air-to-Surface and Air-to-Air/Surface-to-Air Visibility tables.

- Carrier land/launch ops at night increase air-to-surface visibility by one table/row in good visibility conditions (60% or better).
- Ship stack smoke (see 5.8.11) or from fires doubles the daytime visible detection range by (visibility range x 2.0) up to a maximum of 52 kyds in good conditions (60% visibility or better).
- Firing missiles or other rocket-propelled weapons increases visibility at night by three tables/row, up to 70% visibility.
- 75mm and larger gunfire flashes increase visibility at night by three tables/row, up to 70% visibility.
- 20mm -74mm gun flashes increase visibility at night by two tables/row, up to 70% visibility.
- Ships on fire increase visibility at night by three tables/row, up to 70% visibility.
- Ship's wakes at high speed (≥ 20 knots) increase surface-to-surface visibility at night by one table/row.
- Ships and airships moving at 5 knots or less are reduced one table/row for both day and night.
- Aircraft may attempt to spot subs at P/S depth; subs moving at less than 8 knots are reduced two tables/rows in 70% visibility; they cannot be seen at night. Subs at P/S depth moving 8 knots or more are detected as surface craft.

Visibility Modifiers to the D100 detection roll: These will result in the range that a unit can visually detect a target.

- A cued visual search (knowing where to look): -20%
- Maritime Patrol aircraft conducting visual search (larger number of observers): -20%
- Sighting ships against a land background (within 3 nmi and ≤ 10 knots).
 - Daytime: +10% for size class A-D, +20% for size class E-G
 - At Night: +20% for size class A-D, +30% for size class E-G
- Narrow aspect Small Craft (Size Class (F-G): +10%

Air-to-Surface Visibility (Range in kyds)

Visibility (%)	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F-G</u>	<u>Per</u>
100	52.0	48.0	44.0	38.0	30.0	27.0	6.0
90	46.0	44.0	40.0	34.0	27.0	24.5	5.0
80	42.0	38.0	35.0	30.5	24.0	22.0	4.5
70	36.0	34.0	31.0	26.5	21.0	19.0	4.0
60	31.0	29.0	26.5	23.0	18.0	16.5	3.5
50	26.0	24.0	22.0	19.0	15.0	14.0	3.0
40	21.0	19.0	17.5	15.0	12.0	11.0	2.5
30	15.5	14.5	13.0	11.5	9.0	8.0	2.0
20	10.5	9.5	9.0	7.5	6.0	5.5	1.5
10	5.5	5.0	4.5	4.0	3.0	2.5	1.0
5	2.5	2.5	2.0	2.0	1.5	1.5	0.5
2	1.0	1.0	1.0	1.0	0.5	0.5	0.3

Air-to-Air / Surface-to-Air Visibility (Range in kyds)

Visibility (%)	VSmall, Small <u>A/C</u>	Medium, Large <u>A/C</u>
100	4.0	8.0
90	3.5	7.0
80	3.0	6.5
70	3.0	5.5
60	2.5	5.0
50	2.0	4.0
40	1.5	3.0
30	1.0	2.5
20	1.0	1.5
10	0.5	1.0
5	0.5	0.5
2	0.5	0.5

Visual Signals Range (kyds)

Visibility	Flag <u>Hoist</u>	Flashing Light <u>Daytime</u>	Flashing Light <u>Nighttime</u>
100%	8.0	16.0	--
90%	7.2	14.4	--
80%	6.4	12.8	--
70%	5.6	11.2	--
60%	4.8	9.6	--
50%	4.0	8.0	20.0
40%	3.2	6.4	20.0
30%	2.4	4.8	20.0
20%	1.6	3.2	20.0
10%	0.8	1.6	20.0/10.0*
5%	0.4	0.8	5.0*
2%	0.1	0.3	2.0*

* - Reduced signal range due to nighttime precipitation.

Land Sighting Visibility (Ranges in kyds)

Naval Target <u>Size</u>	Observation Post Height of Eye				
	<u>8 m</u>	<u>15 m</u>	<u>30 m</u>	<u>45 m</u>	<u>60m</u>
A	30	34	40	44	48
B	28	32	38	42	46
C	26	30	36	40	44
D	22	26	32	36	40
E	19	23	29	34	38
F/G	16	21	27	31	35
Horiz	11	16	23	28	32
Peris.	4	4	4	5	5

Periscope Visual Detection

Sea <u>State</u>	<u>Pd vs. Normal</u> <u>Periscope</u>	<u>Pd vs. Feathering</u> <u>Periscope</u>
0	.75	.95
1	.50	.65
2	.35	.45
3	.25	.30
4	.15	.20
5	.10	.15
6	.05	.10
7+	-	-

Land Target <u>Size</u>	Observing Naval or Air Unit						
	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F/G</u>	<u>Peris</u>
C	24	24	24	20	18	14	10
D	20	20	20	16	14	12	9
E	16	16	16	16	12	12	8
F	12	12	12	12	10	10	6
G	8	8	8	8	8	6	4
H	4	4	4	4	4	4	3

Sighting Conditions

% <u>Vis</u>	<u>Clear Day</u> <u>Conditions</u>	<u>Clear Night</u> <u>Conditions</u>	<u>Day</u> <u>Precip</u>	<u>Night</u> <u>Precip</u>
100	Unlimited			
90	Unlimited			
80	V Clear			
70	V Clear			
60	Clear			
50	Clear	Full Moon		
40	Clear	Gibbous		
30	Lt Haze	Quarter	Misty	
20	Hazy	Crescent	Light	
10	Lt Fog	New Moon	Interm	Misty
5	Thick Fog	Lt Fog	Heavy	Light
2	Dense Fog	Thick Fog	Torrential	Interm-Hvy

all: page 5-25

RF Fire Control Solution Tables

page 6-3

Active RF Fire Control Solutions

<i>Contact</i> <i>Track</i>	<i>Range (nmi)</i>				
	<i>0.0 - 25.0</i>	<i>25.1 - 50.0</i>	<i>50.1 - 100.0</i>	<i>100.1 - 150.0</i>	<i>150+</i>
-2	Poor	Poor	Poor	Poor	Poor
-1	Fair	Poor	Poor	Poor	Poor
0	Good	Fair	Fair	Fair	Poor
1	Good	Good	Fair	Fair	Fair
2	Good	Good	Good	Fair	Fair
3	Good	Good	Good	Good	Fair
4	Good	Good	Good	Good	Good

Passive RF Fire Control Solutions

<i>Contact</i> <i>Track</i>	<i>0.0 - 25.0</i>	<i>25.1 - 50.0</i>	<i>50.1 - 100.0</i>	<i>100.1 - 150.0</i>	<i>150+</i>
	<i>0.0 - 25.0</i>	<i>25.1 - 50.0</i>	<i>50.1 - 100.0</i>	<i>100.1 - 150.0</i>	<i>150+</i>
-2	Poor	Poor	NA	NA	NA
-1	Poor	Poor	Poor	NA	NA
0	Fair	Poor	Poor	Poor	NA
1	Good	Poor	Poor	Poor	Poor
2	Good	Fair	Poor	Poor	Poor
3	Good	Good	Fair	Poor	Poor
4	Good	Good	Fair	Fair	Poor
5	Good	Good	Good	Fair	Fair
6	Good	Good	Good	Fair	Fair
7	Good	Good	Good	Good	Fair
8	Good	Good	Good	Good	Fair
9	Good	Good	Good	Good	Good

Notes:

- 1) The turn a target is first detected (including a target that has been reacquired) has a base Contact Track of 0.
- 2) A negative Contact Track number means more time is needed to generate a Fair or Good quality fire control solution.
- 3) If a contact shifts from one range bracket to another, use the current Contact Track number in the new range bracket.

RF Solution Modifiers:

Combat System <i>Generation</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>
Passive Mod	-2	-2	-1	0	+1	+2
Active Mod	0	0	0	0	+1	+1

Combat aircraft have a combat system modifier of zero.

Contact Speed

<i>knots</i>	<i>≤5</i>	<i>6-10</i>	<i>11-25</i>	<i>26-35</i>	<i>36+</i>
Passive Mod	-2	-1	0	-1	-2
Active Mod	-1	0	0	0	-1

Aircraft Sensor

Aircraft SS radar or ES: Shifts one range column to the left on the active or passive table. Other aircraft in contact and sharing data by TDL use the applicable TDL modifier.

Long range missile seeker: +1

Long range missile seeker and Scout mode: +2

Tactical Data Link Cue

Other platforms in contact and sharing data by TDL, use applicable TDL modifier.

NRT TDL: +1

RT TDL: +2

Distraction Decoy

Passive Mod	-3
Active Mod	-2

ASCM Speed

	<i>Speed (kts)</i>	<i>Range (nmi)</i>				
		<i>0.0 - 25.0</i>	<i>25.1 - 50.0</i>	<i>50.1 - 100.0</i>	<i>100.1 - 150.0</i>	<i>≥150</i>
Subsonic	≤500	+0	-1	-2	-4	-5
Transonic	501-750	+0	-1	-2	-3	-4
Low Supers.	751-1525	+0	+0	-1	-2	-2
Med Supers.	1526-2300	+1	+0	+0	-1	-1
High Supers.	2301-3075	+1	+1	+0	-1	-1
Low Hypers.	3076-4100	+1	+1	+1	+0	-1
Med Hypers.	4101-5125	+1	+1	+1	+0	-1
High Hypers.	5126+	+1	+1	+1	+1	+0

ASCM Seeker

<i>Gen</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Mod	-1	0	+1	+1

Fire Control Solution Quality for Non-OTH-T Systems

<i>Active RF</i> <i>Range (nmi)</i>	<i>Max FCS Quality</i>	<i>FCS Modifier</i>
≤35.0	Good	0
35.1 – 50.0	Fair	-1
50.1 – 65.0	Poor	-2
65.1+	NA	--

<i>Passive RF</i> <i>Range (nmi)</i>	<i>Max FCS Quality</i>	<i>FCS Modifier</i>
≤50.0	Good	0
50.1 – 65.0	Fair	-1
65.1 – 80.0	Poor	-2
80.1+	NA	--

Weapon Placement Chance

<i>Solution</i> <i>Quality</i>	<i>Good</i>	<i>Fair</i>	<i>Poor</i>
<i>Weapon</i> <i>Placement</i>	9	6	3

Modifiers:

Active acoustic homing torpedoes attacking a sub with anechoic coating: -2

Torpedo in reverberation conditions, see 7.5.6.

Missiles attacking ships within 5 nmi of land, unless missile has satellite inertial guidance: -2

Wake-Homing torpedo: +1

Localizing sonobuoys with GPS: +1

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page 6-2

Acoustic Fire Control Solution Tables

page 6-4

Active Acoustic Fire Control Solutions

Contact		Range (nmi)					
Track	0.0 - 3.0	3.1 - 6.0	6.1 - 10.0	10.1 - 15.0	15.1 - 20.0	1st CZ	2nd CZ
-2	Poor	Poor	Poor	Poor	NA	NA	NA
-1	Poor	Poor	Poor	Poor	Poor	NA	NA
0	Fair	Poor	Poor	Poor	Poor	Poor	NA
1	Good	Fair	Fair	Poor	Poor	Poor	Poor
2	Good	Good	Fair	Fair	Poor	Poor	Poor
3	Good	Good	Good	Fair	Fair	Poor	Poor
4	Good	Good	Good	Good	Fair	Fair	Poor
5	Good	Good	Good	Good	Good	Fair	Fair
6	Good	Good	Good	Good	Good	Good	Fair
7	Good	Good	Good	Good	Good	Good	Good

Passive Acoustic Fire Control Solutions

Contact		Range (nmi)						
Track	0.0 - 2.0	2.1 - 4.0	4.1 - 6.0	6.1 - 8.0	8.1 - 10.0	10.1 - 12.0	12.1 - 14.0	14.1 - 16.0
-2	Poor	Poor	NA	NA	NA	NA	NA	NA
-1	Poor	Poor	Poor	NA	NA	NA	NA	NA
0	Poor	Poor	Poor	Poor	NA	NA	NA	NA
1	Fair	Poor	Poor	Poor	Poor	NA	NA	NA
2	Good	Fair	Poor	Poor	Poor	Poor	NA	NA
3	Good	Good	Fair	Poor	Poor	Poor	Poor	NA
4	Good	Good	Fair	Fair	Poor	Poor	Poor	Poor
5	Good	Good	Good	Fair	Fair	Poor	Poor	Poor
6	Good	Good	Good	Fair	Fair	Poor	Poor	Poor
7	Good	Good	Good	Good	Fair	Fair	Poor	Poor
8	Good	Good	Good	Good	Fair	Fair	Fair	Poor
9	Good	Good	Good	Good	Good	Fair	Fair	Poor
10	Good	Good	Good	Good	Good	Fair	Fair	Fair
11	Good	Good	Good	Good	Good	Good	Fair	Fair
12	Good	Good	Good	Good	Good	Good	Fair	Fair
13	Good	Good	Good	Good	Good	Good	Good	Fair
14	Good	Good	Good	Good	Good	Good	Good	Fair
15	Good	Good	Good	Good	Good	Good	Good	Good

Modifiers:

Combat System

Generation	1	2	3	4	5	6
Passive Mod	-2	-2	-1	0	+1	+2
Active Mod	0	0	0	0	+1	+1

Contact Speed

knots	≤5	6-10	11-25	26-35	36+
Passive Mod	-2	-1	0	-1	-2
Active Mod	-1	0	0	0	-1

Mobile Decoy

Passive Mod	-3
Active Mod	-2

Passive Ranging/Localization Array

Wave front curvature array +4
Russian vertical flank array +3

Target Zig -2

A target zig is a course change of at least 20° or a speed change of at least 5 knots in one Tactical Turn. This temporarily throws off the fire control solution as the combat system tries to sort out the changes in bearing rate and range rate. This modifier is only applicable for the Tactical Turn immediately following the maneuver.

Torpedo Seeker

Generation	1	2	3	4
Mod	-1	0	+1	+2

If a contact shifts from one range bracket to another, use the current Contact Track number in the new range bracket.

Tactical Data Link Cue

Other platforms in contact and sharing data by TDL, use applicable TDL modifier.

TL: Alerted Operator only (1 time)

NRT TDL: +1

RT TDL: +2

Notes:

- 1) The turn a target is detected (including a target that has been reacquired), it has a base Contact Track of 0.
- 2) A negative Contact Track number means more time is needed to generate a Fair or Good quality fire control solution.
- 3) If a contact shifts from one range bracket to another, use the current Contact Track number in the new range bracket.
- 4) TL – time late, NRT – near real time, RT – real time

Radar-Guided SAM Procedure

page 8-1

8.1.1 Radar-Guided Surface-to-Air Missiles (SAMs).

To engage incoming bogeys (missiles or aircraft), mark the beginning and end of their 3-minute move.

1) *Detection Range:* During the detection phase, each defending ship's player measures out the range for the ship's air search, 3D or HF radars (remember the radar horizon, 5.2.8) and places detection markers along the flight path.

2) *Detection:* Move the missile in 30-second increments (speed divided by 120) along the bogey's flight path until it reaches the radar detection marker. This is the earliest that the ship can detect the incoming unit.

3) *Reaction Time:* Roll 2D6 on the Combat System Reaction table on page 8-4, and add it to the Combat System Reaction time to find the delay in 30-second increments between when the ship can detect the incoming missile and when it can react.

Example: A ship with 3rd Gen Combat System has a normal reaction time of 3 increments. Rolling 2D6 on the Combat System Reaction table, he gets a three, meaning an additional delay of 4 turns. The ship must wait 7 increments - more than a Tactical Turn - before it can engage.

4) *Intercept Range:* Count that many increments along the missile's flight path, and mark the spot with an "Engage" marker. Make sure the ship's 3D or HF radar is in range. If it is not, the ship's SAM system can't engage yet (*exception:* SAM engagements at ranges of 15 nmi or less do not need a 3D or HF radar). In this case, move the bogey along its flight path until it reaches the 3D/HF radar's range or the 15 nmi point.

5) *SAM Range Check:* See if the bogey is inside Intercept Range. The shooter may get a bonus against very fast targets with converging or closing geometry.

If a converging non-maneuvering target's speed is 2,001 knots or more, the Intercept Range is twice the SAM range listed in Annex D.

If the converging target's speed is 501 - 2,000 knots, the Intercept range is 1.5 times the listed SAM range.

This takes into account "f-pole," a calculation designed to intercept an oncoming bogey just as it enters maximum SAM range. If the incoming bogey turns 90° or more for a full Tactical Turn after the defender shoots, the Intercept range drops to the SAM range listed in Annex D, and missiles already fired will miss.

If the bogey is out of Intercept range, keep moving the marker along its flight path until it reaches Intercept range.

6) *Bearing Rate:* Measure the bogey's bearing change between the start and end of its movement for the 3-minute Tactical Turn. If it is less than 20°, it is a "closing" target; from 20° to 45°, it is "diverging"; over 45°, it is a crossing target. This affects how hard it is to hit.

7) *Punch the Table:* Find the SAM Intercept table that matches the bogey's type. For example, a Kh-22 has a speed of 2003 knots and flies at VHigh altitude. The defender would use the Intercept table for "High & VHigh, Medium Supersonic Missiles." The speed descriptions are listed in the Target Speed Modifiers table on page 8-4.

Use the smaller of either the SAM's range listed in Annex D or the actual Intercept Range to find the column on the Intercept table. It shows how many shots the ship gets at the incoming missiles at long, medium, short, and point defense range bands. *Exception:* SAMs with a minimum range greater

than 2.5 nmi cannot fire into the Point Defense range band, even if the table allows a shot.

8) *Missile Salvoes:* Each missile salvo may have more than one missile firing at more than one target. The SAM Salvo Summary table on page 6-1 lists the number of missiles each director can control and how many targets each director can engage. For example, each director for the SM1ER Blk IV (SARH guidance) controlled by a 4th Gen combat system can engage 1 target with two missiles each.

9) *Chance to Hit:* Subtract the bogey's Maneuver Rating from the missile's ATA Rating and apply any modifiers from the Anti-air Missile Attack table.

In this example, the SM1ER Blk IV has an ATA value of 2.0 with the following modifiers:

- Attacker speed: Med Supersonic = -2
- Bearing Rate: Less than 20° ("closing target") = 0
- Range: Medium1 range band intercept = 0
- Target Size: Small = 0
- Sea Skimmer: N/A
- Terminal Maneuver: N/A
- Combat System Mod: 4th Gen = +0.5

The final value is 0.5, which is the Missile Index; Cross-referenced on the Anti-air Missile Attack table (page 8-8), this gives a single-missile hit chance of 35%, and a two-missile hit chance of 58%.

The defending player rolls D100, and if the result is less than or equal to the chance to hit, then the target was shot down.

All defending ship players should roll each range band's salvoes at the same time, before proceeding to the next range band.

SAM Salvo Summary

<u>Combat System</u>	<u>Channels</u>	<u>Missiles</u>
	<u>Per Director</u>	<u>Per Channel</u>
1st Gen Cbt Sys		
Beam-R, Cmd	1	1
2nd Gen Cbt Sys		
Beam-R, Cmd	1	1
SARH	1	2
3rd Gen Cbt Sys		
Cmd	1	2
SARH	1	2
I&M/TSARH	1	2
TVM	6	2
4th Gen Cbt Sys		
SARH	1	2
I&M/TSARH	1	2
TVM	6	2
5th, 6th Gen Cbt Sys/Human		
SARH	2	2
I&M/TSARH, TARH	2	2
5th Gen Cbt Sys Auto		
SARH	3	2
I&M/TSARH, TARH	3	2
6th Gen Cbt Sys Auto		
SARH	4	2
I&M/TSARH, TARH	4	2

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SAM & AAM Missile Attacks

all: page 8-8

Antiair Missile Attack Table

<i>Missile Index</i>	<i>One Msl Pk</i>	<i>Two Msl Pk</i>
-4.5	01%	02%
-4.0	02%	04%
-3.5	04%	08%
-3.0	06%	12%
-2.5	08%	15%
-2.0	10%	19%
-1.5	15%	28%
-1.0	20%	36%
-0.5	25%	44%
-0.0	30%	51%
+0.5	35%	58%
+1.0	40%	64%
+1.5	45%	70%
+2.0	50%	75%
+2.5	55%	80%
+3.0	60%	84%
+3.5	65%	88%
+4.0	70%	91%
+4.5	75%	94%
+5.0	80%	95%
+5.5	85%	95%

Target Signature Modifier

<i>Target Signature</i>	<i>Msl ATA Mod</i>
Large, Medium, Small	0
VSmall	-1
Stealthy	-2

Combat System Modifier

<i>Ship CS Gen</i>	<i>AI Radar Gen</i>	<i>Missile Tgt ATA Mod</i>	<i>Aircraft Tgt ATA Mod</i>
2	1-2	-1.0	0.0
3	3	0.0	1.0
4	4	0.5	2.0
5/6H	5	1.0	2.5
5/6A	6	1.5	3.0

AAMs using HOJ mode have their ATA rating halved before applying modifiers.

Target Modifiers (Modifies Missile ATA Rating)

Non-maneuvering aircraft ATA	0.0
Terminal Maneuvers	-1.0
Seaskimmer Capable?	
Full Capability (min altitude VLow)	0
Partial Capability (min altitude PVLow)	-2
Not Capable (min altitude Low)	-4

Target Speed Modifiers

<i>(kts)</i>	<i>Mach</i>	<i>Descriptor</i>	<i>ATA Mod</i>
≤250	0.4	Slow	+2
251-500	0.8	Subsonic	+1
501-750	0.9-1.2	Transonic	0
751-1525	1.3-2.5	Low Supers.	-1
1526-2300	2.6-3.8	Med Supers.	-2
2301-3075	3.9-5.0	High Supers.	-3
3076-4100	5.1-6.7	Low Hypers.	-4
4101-5125	6.7-8.3	Med Hypers.	-5
5126+	8.4+	High Hypers.	-6

Bearing Rate Modifier

<i>Description</i>	<i>Tac Turn Bearing Shift</i>	<i>Msl ATA Mod</i>
Closing	0 - 20°	0
Divergent	21 - 45°	-2.0
Crossing	45+°	-4.0
High Diving*		-2.0

*Short Range and Point Defense engagements for 1st - 3rd Gen Combat Systems only.

Range Band Modifiers

<i>Range Band</i>	<i>Range (nmi)</i>	<i>Msl ATA Mod</i>
Point Defense	≤4.0	0
Short	4.1 - 15.0	0
Medium 1	15.1 - 30.0	0
Medium 2	30.1 - 45.0	-0.5
Long 1	45.1 - 60.0	-0.5
Long 2	60.1 - 90.0	-1.0
Very Long	90.1 - 135.0	-1.5
Extreme	135.1+	-2.0

- SAMs with a minimum range greater than 2.5 nmi cannot fire into the Point Defense Range Band
- If there is more than one engagement within the Long or Medium range bands, the first one uses the outer band, the rest use the inner band.

Antiair Missile Countermeasures Table

<i>Msl Seeker Gen</i>	<i>1st Gen Jam</i>	<i>2nd Gen Jam</i>	<i>3rd Gen Jam</i>	<i>4th Gen Jam</i>	<i>1st Gen Decoy</i>	<i>2nd Gen Decoy</i>	<i>3rd Gen Decoy</i>	<i>4th Gen Decoy</i>	<i>1st Gen J&D</i>	<i>2nd Gen J&D</i>	<i>3rd Gen J&D</i>	<i>4th Gen J&D</i>
1	-1.5	-2.0	-2.5	-3.5	-1.0	-1.5	-2.0	-3.0	-2.5	-3.5	-4.5	-5.5
2	-1.0	-1.5	-2.0	-3.0	-0.5	-1.0	-1.5	-2.5	-2.0	-3.0	-3.5	-5.0
3	-0.5	-1.0	-1.5	-2.5	-0.5	-0.5	-1.0	-2.0	-1.0	-2.0	-3.0	-4.5
4	--	-0.5	-1.0	-2.0	--	-0.5	-0.5	-1.5	-0.5	-1.0	-2.0	-3.5
5	--	--	-0.5	-1.5	--	--	-0.5	-1.0	--	-0.5	-1.0	-2.5

Note: If the defending aircraft cannot or chooses not to maneuver, then halve the countermeasure modifier before applying it to the Missile Index. Its Maneuver Rating is also reduced to 0.0.

The Three-Second Rule

Very fast missiles destroyed close to their target (within three seconds of flight time) still are a threat to the defending ship. Instead of being struck by a warhead, the missile's target may get hit by flaming debris. It's a little better, but not a lot.

Whether the ship gets hit by debris or not depends on exactly how far from the ship the intercept occurs. For each missile destroyed by SAMs or gunfire in the Point Defense band, roll D100 on the following table:

<i>Defending Weapon</i>	<i>Missile Speed</i>		
	<i>750 kts or less</i>	<i>751 - 1525 kts</i>	<i>1526+ kts</i>
30mm or less	10%	50%	90%
65mm or less	0%	40%	70%
66mm or more	0%	10%	20%
SAM	0%	10%	30%

The table shows the percent chance of missile fragments striking the defender. These will not inflict any damage points, but will cause half the airframe critical hits, rolled as airburst damage. The first critical hit inflicted does not have to be a fire.

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PRH Airburst Damage

<i>Warhead Size (kg):</i>	<i>0-10</i>	<i>11-20</i>	<i>21-50</i>	<i>51-100</i>	<i>100+</i>
Critical Hits:	1	D6/2	D6	D6+2	D6+3

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Antiship Missile Seeker Acquisition Ranges

Seeker Range in Nautical Miles

<i>Seeker Type</i>	<i>Target Signature</i>			
	<i>Large/ Medium</i>	<i>Small</i>	<i>VSmall</i>	<i>Stealthy</i>
TARH/SARH 1st Gen	8	6	5	3
TARH/SARH 2nd Gen	15	12	10	5
TARH/SARH 3rd Gen	25	20	15	8
TARH/SARH 4th Gen	35	28	20	10
TIRH 1st Gen	5	4	3	2
TIRH 2nd Gen	10	8	4	3
TIRH 3rd Gen	15	12	6	4
TIRH 4th Gen	20	16	8	5

*See also 7.4.8 for Russian Long-Range Missile Seekers

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Seeker Random Lock-On Chance

<i>Signature</i>	<i>Large</i>	<i>Med</i>	<i>Small</i>	<i>VSmall</i>	<i>Stealthy</i>
<i>Lock-on Chance</i>	15	10	5	2	1

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Combat System Reaction Time

<i>Combat System</i>	<i>Normal Delay (Increments)</i>
1st Gen Cbt Sys	8
2nd Gen Cbt Sys	6
3rd Gen Cbt Sys	3
4th Gen Cbt Sys	2
5th, 6th Gen Cbt Sys/Human	1
5th Gen Cbt Sys Auto	0
6th Gen Cbt Sys Auto	0

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Combat System Reaction

<i>2D6 Roll</i>	<i>1st Gen</i>	<i>2nd, 3rd Gen</i>	<i>4th Gen, 5th & 6th Human</i>	<i>5th Gen Auto</i>	<i>6th Gen Auto</i>
	<i>Gen</i>	<i>Gen</i>	<i>Human</i>	<i>Auto</i>	<i>Auto</i>
2	+4	+4	+4	+3	+2
3	+4	+4	+3	+2	+1
4	+4	+4	+2	+1	+1
5	+4	+3	+1	+1	0
6	+3	+2	+1	0	0
7	+2	+1	0	0	0
8	+1	+1	0	0	0
9	+1	0	0	0	-1
10	0	0	0	-1	-2
11	0	0	-1	-2	-2
12	0	0	-2	-2	-2

Own Ship ES cue: +1 to the die roll.

page 8-4

Tactical Data Link Cue (see also 5.2.1, page 5-2)

Other platforms in contact and sharing active sensor data by TDL, use applicable TDL modifier.

NRT TDL: +1

RT TDL: +2

Note: A negative result means the radar was able to detect the target that number of increments earlier, that is, at a longer range than the listed range in Annex J for that signature. The range is limited by the radar horizon.

AAW Range Bands

<i>Range Bands</i>	<i>Range (nmi)</i>
Point Defense	0 - 4.0
Short	4.1 - 15
Medium 1	15.1 - 30
Medium 2	30.1 - 45
Long 1	45.1 - 60
Long 2	60.1 - 90
Very Long	90.1 - 135
Extreme	135.1+

page 8-4

• SAMs with a minimum range greater than 2.5 nmi cannot fire into the Point Defense range band.

• Incoming missiles with final-stage sprint vehicles (listed in the Remarks in Annex D or H2) have a Medium Supersonic speed in the Short and Point Defense range bands. They also allow one less engagement in either the Short range band, or if there are no possible engagements there, in the Point Defense range band.

SAM Intercept Table - High & VHigh Altitude Targets

Intercept Range (135.1+ nmi) - Extreme

<i>CS Generation</i>	<i>Subsonic & Transonic</i>	<i>Low Supersonic</i>	<i>Med Supersonic</i>	<i>High Supersonic</i>	<i>Low Hypersonic</i>
2nd	E-V-2L-3M-S-P	--	--	--	--
3rd	E-V-3L-3M-2S-P	--	--	--	--
4th	E-2V-2L-3M-3S	E-V-L-M-2S-P	--	--	--
5th/6th Human	E-2V-2L-3M-3S	E-V-L-M-2S-P	--	--	--
5th Auto	E-2V-2L-3M-3S-P	E-V-L-2M-2S-P	--	--	--
6th Auto	E-2V-2L-3M-3S-P	E-V-L-2M-2S-P	--	--	--

Intercept Range (90.1 - 135.0 nmi) - Very Long

2nd	V-2L-3M-2S	V-L-M-S-P	--	--	--
3rd	V-3L-3M-2S-P	V-L-2M-S-P	--	--	--
4th	V-3L-3M-3S	V-L-2M-2S-P	V-L-M-S-P	--	--
5th/6th Human	V-3L-3M-3S	V-L-2M-2S-P	V-L-M-S-P	--	--
5th Auto	V-3L-3M-3S-P	V-2L-2M-2S-P	V-L-M-2S-P	--	--
6th Auto	V-3L-3M-3S-P	V-2L-2M-2S-P	V-L-M-2S-P	--	--

Intercept Range (60.1 - 90.0 nmi) - Long 2

2nd	2L-3M-2S	2L-M-S	L-M-S	--	--
3rd	3L-2M-3S-P	2L-M-2S	L-M-S-P	L-M-P	--
4th	3L-3M-2S-P	2L-2M-S-P	L-2M-S	L-M-S	L-M-P
5th/6th Human	3L-3M-2S-P	2L-2M-S-P	L-2M-S	L-M-S	L-M-P
5th Auto	3L-3M-3S-P	2L-2M-2S-P	L-2M-S-P	L-M-S-P	L-M-S
6th Auto	3L-3M-3S-P	2L-2M-2S-P	L-2M-S-P	L-M-S-P	L-M-S

Intercept Range (45.1 - 60.0 nmi) - Long 1

2nd	L-2M-2S-P	L-M-S-P	L-M-P	--	--
3rd	2L-2M-2S	L-2M-S	L-M-S	L-M-P	L-S
4th	2L-2M-3S-P	L-2M-S-P	L-M-S-P	L-M-S	L-M-P
5th/6th Human	2L-2M-3S-P	L-2M-S-P	L-M-S-P	L-M-S	L-M-P
5th Auto	2L-3M-3S-P	L-2M-2S-P	L-M-2S	L-M-S-P	L-M-S
6th Auto	2L-3M-3S-P	L-2M-2S-P	L-M-2S	L-M-S-P	L-M-S

Intercept Range (30.1 - 45.0 nmi) - Medium 2

2nd	2M-2S-P	2M-S	M-S	M-S	--
3rd	3M-2S-P	2M-S-P	M-S-P	M-S	M-S
4th	3M-2S-P	2M-2S	2M-S	M-S-P	M-S
5th/6th Human	3M-2S-P	2M-2S	2M-S	M-S-P	M-S
5th Auto	3M-3S-P	2M-2S-P	2M-S-P	M-2S	M-S-P
6th Auto	3M-3S-P	2M-2S-P	2M-S-P	M-2S	M-S-P

Intercept Range (15.1 - 30 nmi) - Medium 1

2nd	2M-S-P	M-S-P	M-S	M-P	M
3rd	2M-2S-P	M-S-P	M-S	M-P	M-P
4th	2M-3S-P	M-2S-P	M-S-P	M-S	M-S
5th/6th Human	2M-3S-P	M-2S-P	M-S-P	M-S	M-S
5th Auto	3M-3S-P	2M-S-P	M-2S	M-S-P	M-S
6th Auto	3M-3S-P	2M-S-P	M-2S	M-S-P	M-S

Intercept Range (≤ 15 nmi) - Short

2nd	2S-P	S-P	S	S	S
3rd	2S-P	2S	S-P	S	S
4th	3S-P	2S-P	S-P	S-P	S
5th/6th Human	3S-P	2S-P	S-P	S-P	S
5th Auto	3S-P	2S-P	2S-P	S-P	S-P
6th Auto	3S-P	2S-P	2S-P	S-P	S-P

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- 1) Any SAM with 3,000+ knots speed gets an additional engagement at either Long - 1 or Medium - 2, at the player's discretion.
- 2) A "--" this means the attack is impossible. Drop down to the first Intercept Range that allows an attack to take place.
- 3) The number of engagements in the above tables are for each missile fire control channel.

SAM Intercept Table - Medium Altitude Targets

Intercept Range (90.1 - 135.0 nmi) - Very Long

CS	Subsonic &	Low	Med	High
<u>Generation</u>	<u>Transonic</u>	<u>Supersonic</u>	<u>Supersonic</u>	<u>Supersonic</u>
2nd	V-2L-2M-2S-P	--	--	--
3rd	V-2L-3M-2S-P	--	--	--
4th	V-3L-3M-2S-P	V-L-2M-S-P	--	--
5th/6th Human	V-3L-3M-2S-P	V-L-2M-S-P	--	--
5th Auto	V-3L-3M-3S-P	V-L-2M-2S-P	--	--
6th Auto	V-3L-3M-3S-P	V-L-2M-2S-P	--	--

Intercept Range (60.1 - 90.0 nmi) - Long 2

2nd	2L-3M-2S	L-M-2S	--	--
3rd	3L-2M-3S-P	2L-M-2S	--	--
4th	3L-3M-2S-P	2L-2M-S-P	L-M-S-P	--
5th/6th Human	3L-3M-2S-P	2L-2M-S-P	L-M-S-P	L-M-S
5th Auto	3L-3M-3S-P	2L-2M-2S-P	L-2M-S-P	L-M-S-P
6th Auto	3L-3M-3S-P	2L-2M-2S-P	L-2M-S-P	L-M-S-P

Intercept Range (45.1 - 60.0 nmi) - Long 1

2nd	L-2M-2S-P	L-M-S-P	--	--
3rd	2L-2M-2S	L-2M-S	L-M-S	L-S
4th	2L-2M-3S-P	L-2M-S-P	L-M-S-P	L-M-S
5th/6th Human	2L-2M-3S-P	L-2M-S-P	L-M-S-P	L-M-S
5th Auto	2L-3M-3S-P	L-2M-2S-P	L-M-2S	L-M-S-P
6th Auto	2L-3M-3S-P	L-2M-2S-P	L-M-2S	L-M-S-P

Intercept Range (30.1 - 45.0 nmi) - Medium 2

2nd	2M-2S-P	2M-S	M-S	--
3rd	3M-2S-P	2M-S-P	M-S-P	M-S
4th	3M-2S-P	2M-2S	2M-S	M-S-P
5th/6th Human	3M-2S-P	2M-2S	2M-S	M-S-P
5th Auto	3M-3S-P	2M-2S-P	2M-S-P	M-2S
6th Auto	3M-3S-P	2M-2S-P	2M-S-P	M-2S

Intercept Range (15.1 - 30 nmi) - Medium 1

2nd	2M-S-P	M-S-P	M-S	--
3rd	2M-2S-P	M-S-P	M-S	M-P
4th	2M-3S-P	M-2S-P	M-S-P	M-S
5th/6th Human	2M-3S-P	M-2S-P	M-S-P	M-S
5th Auto	3M-3S-P	2M-S-P	M-2S	M-S-P
6th Auto	3M-3S-P	2M-S-P	M-2S	M-S-P

Intercept Range (≤ 15 nmi) - Short

2nd	2S-P	S-P	S	S
3rd	2S-P	2S	S-P	S
4th	3S-P	2S-P	S-P	S-P
5th/6th Human	3S-P	2S-P	S-P	S-P
5th Auto	3S-P	2S-P	2S-P	S-P
6th Auto	3S-P	2S-P	2S-P	S-P

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- 1) Any SAM with 3,000+ knots speed gets an additional engagement at either Long - 1 or Medium - 2, at the player's discretion.
- 2) A "--" this means the attack is kinematically impossible. Drop down to the first Intercept Range that allows an attack to take place.
- 3) The number of engagements in the above tables are for each missile fire control channel.

SAM Intercept Table - Low Altitude Targets

Intercept Range (45.1 - 60.0 nmi) - Long

CS Generation	<i>Subsonic & Transonic</i>	<i>Low Supersonic</i>	<i>Med Supersonic</i>	<i>High Supersonic</i>
2nd	--	--	--	--
3rd	L-2M-3S	--	--	--
4th	2L-2M-3S-P	L-M-2S-P	--	--
5th/6th Human	2L-2M-3S-P	L-M-2S-P	--	--
5th Auto	2L-3M-3S-P	L-2M-2S-P	--	--
6th Auto	2L-3M-3S-P	L-2M-2S-P	--	--

Intercept Range (30.1 - 45.0 nmi) - Medium 2

2nd	2M-2S-P	--	--	--
3rd	3M-2S-P	--	--	--
4th	3M-2S-P	2M-2S	M-S-P	--
5th/6th Human	3M-2S-P	2M-2S	M-S-P	--
5th Auto	3M-3S-P	2M-2S-P	2M-S-P	--
6th Auto	3M-3S-P	2M-2S-P	2M-S-P	--

Intercept Range (15.1 - 30 nmi) - Medium 1

2nd	2M-S-P	--	--	--
3rd	2M-2S-P	M-S-P	--	--
4th	2M-3S-P	M-2S-P	M-S-P	M-S
5th/6th Human	2M-3S-P	M-2S-P	M-S-P	M-S
5th Auto	3M-3S-P	2M-S-P	M-2S	M-S-P
6th Auto	3M-3S-P	2M-S-P	M-2S	M-S-P

Intercept Range (≤ 15 nmi) - Short

2nd	2S-P	S-P	--	--
3rd	2S-P	2S	S-P	P
4th	3S-P	2S-P	S-P	S-P
5th/6th Human	3S-P	2S-P	S-P	S-P
5th Auto	3S-P	2S-P	2S-P	S-P
6th Auto	3S-P	2S-P	2S-P	S-P

SAM Intercept Table - VLow Altitude Targets

Intercept Range (15.1 - 30 nmi) - Medium 1

CS Generation	<i>Subsonic & Transonic</i>	<i>Low Supersonic</i>	<i>Med Supersonic</i>	<i>High Supersonic</i>
2nd	--	--	--	--
3rd	--	--	--	--
4th	--	--	--	--
5th/6th Human	--	--	--	--
5th Auto	M-3S-P	--	--	--
6th Auto	M-3S-P	--	--	--

Intercept Range (≤ 15 nmi) - Short

2nd	P	--	--	--
3rd	S-P	P	--	--
4th	2S-P	S	P	--
5th/6th Human	2S-P	S-P	S	P
5th Auto	3S-P	2S-P	S-P	S
6th Auto	3S-P	2S-P	S-P	S

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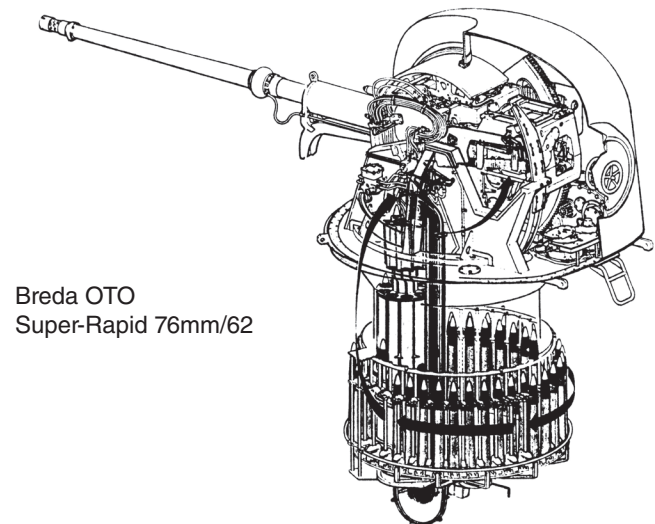
- 1) Any SAM with 3,000+ knots speed gets an additional engagement at either Long - 1 or Medium - 2, at the player's discretion.
- 2) A "--" this means the attack is kinematically impossible. Drop down to the first Intercept Range that allows an attack to take place.
- 3) The number of engagements in the above tables are for each missile fire control channel.

Antiair Gun Hit Chance

<u>AA Strength</u>	<u>Hit Chance</u>	<u>AA Strength</u>	<u>Hit Chance</u>
0.1	0.06	5.4	0.61
0.2	0.09	5.5	0.62
0.3	0.12	5.6	0.62
0.4	0.14	5.7	0.63
0.5	0.16	5.8	0.64
0.6	0.17	5.9	0.64
0.7	0.19	6.0	0.65
0.8	0.21	6.1	0.66
0.9	0.22	6.2	0.66
1.0	0.23	6.3	0.67
1.1	0.25	6.4	0.67
1.2	0.26	6.5	0.68
1.3	0.27	6.6	0.69
1.4	0.28	6.7	0.69
1.5	0.29	6.8	0.70
1.6	0.31	6.9	0.70
1.7	0.32	7.0	0.71
1.8	0.33	7.1	0.72
1.9	0.34	7.2	0.72
2.0	0.35	7.3	0.73
2.1	0.36	7.4	0.73
2.2	0.37	7.5	0.74
2.3	0.38	7.6	0.74
2.4	0.39	7.7	0.75
2.5	0.39	7.8	0.76
2.6	0.40	7.9	0.76
2.7	0.41	8.0	0.77
2.8	0.42	8.1	0.77
2.9	0.43	8.2	0.78
3.0	0.44	8.3	0.78
3.1	0.45	8.4	0.79
3.2	0.45	8.5	0.79
3.3	0.46	8.6	0.80
3.4	0.47	8.7	0.80
3.5	0.48	8.8	0.81
3.6	0.49	8.9	0.81
3.7	0.49	9.0	0.82
3.8	0.50	9.1	0.82
3.9	0.51	9.2	0.83
4.0	0.52	9.3	0.83
4.1	0.52	9.4	0.84
4.2	0.53	9.5	0.84
4.3	0.54	9.6	0.85
4.4	0.54	9.7	0.86
4.5	0.55	9.8	0.86
4.6	0.56	9.9	0.87
4.7	0.57	10.0	0.87
4.8	0.57	10.1	0.88
4.9	0.58	10.2	0.88
5.0	0.59	10.3	0.88
5.1	0.59	10.4	0.89
5.2	0.60	10.5	0.89
5.3	0.61	10.6	0.90

Antiair Gun Hit Chance Modifiers to AA Strength

	<u>Strength Modifier</u>	<u>Speed kts</u>
Target Speed		
Hovering	+3	0
Slow	+2	≤250
Subsonic	+1	251-500
Transonic	0	501-750
Low Supersonic	-1	751-1525
Med Supersonic	-2	1526-2300
High Supersonic	-4	2301-3075
Hypersonic	-6	3076+
Target Maneuvers		
Msl Terminal maneuvers	-1	
High Diving	-2	
Divergent	-2	
Crossing Target	-4	
Non-maneuvering Target	+2	
Target Signature		
Large	+1	
Medium	0	
Small	0	
VSmall	-1	
Stealthy	-2	
Target Altitude		
VLow flight	-3 (if gun is not SSC)	
Low & Medium	0	
High	-2	



Breda OTO
Super-Rapid 76mm/62

- The maximum AA hit chance, with modifiers, is 90%.
- Modified AA strengths of 0 or less means no shot is possible.
- RA- or EO-directed AA guns in local control have their base AA Strength divided by four.

Gunfire Hit Chance Modifiers

Base Chance of a Hit	GS4	GS5	GS6
Short	60%	70%	75%
Medium	40%	50%	55%
Long	15%	20%	25%
Extreme	5%	10%	15%

Visibility/Environmental Modifiers

Visibility 20% or less (Ignore with radar GFC or when target illuminated or silhouetted)				-4
Visibility 40% or less (Ignore with radar GFC or when target illuminated or silhouetted)				-2
Target in line with the sun - Target obscured. Must be within 10° of a line from observer to the sun				-2
Target in line with twilight sun - Target silhouetted. Must be within 30° of a line from observer to the sun				+1
Target is illuminated by starshell, fire, searchlight/is using a searchlight				-1
Dead Reckoning Fire - First turn of fire after loss of visual contact on a target				-4
Blind Fire - Firing at muzzle flashes (ignore visibility mod)				-6
Sea state (Heavy seas make it difficult to aim the guns properly)		A&B	C&D	E-G
Sea State 3		NA	NA	-2
Sea State 4		NA	-2	-4
Sea State 5		-2	-4	-6
Sea State 6 (No fire possible above sea state 6)		-4	-6	NFP

Fire Control/Gun Modifiers

Firing Ship is not being fired on				+1
Overconcentration. Using EO/OP fire control, more than one ship firing the same size shells at target, and the target is at Long or Extreme range from the firing ship (see 8.3.1).				-1 per ship above limit
More than one set of shell splashes confused range corrections.				
Point-blank fire (1/2 of Short range, 30% vis or better)				+4
Land within ±45° of target and inside unmodified fire control radar range				-1
Land return clutters the screen and obscures target echo				
Local Control (OP mode)				-3
Ships without stable elements changing course by 45° or more				-3
Firing ship steering evasively. Takes precedence over course change modifier.				-3
Number of barrels firing				
1 - 2				+0
3 - 4				+1
5 - 6				+2
7 - 8				+3
9 - 10				+4

Target Modifiers

Target Speed				
40+ knots				-3
30 - 39 kts				-2
10 kts or less				+1
Stationary ("Dead in the Water")				+2
Target Steering Evasively (minimum speed of 20 kts)				
Size Class B				-2
Size Class C - D				-4
Size Class E - G				-6
Target Aspect (Broad/Quarter/Narrow)		Brd	Qtr	Nrw
Size class A		+2	+1	+0
Size Class B		+1	+0	-1
Size Class C - D		+0	-1	-2
Size Class E - G		-2	-3	-4

Multiply the final modifier by 5% for Short or Medium range targets, and 3% for Long and Extreme range targets, and add it to the base chance to hit.

The chance to hit cannot be raised over 90%, even with modifiers.

Gun Damage Multipliers

<i>No. of Barrels Fired</i>	<i>Multiply by the Damage in Annex C</i>			
	<i>Short</i>	<i>Medium</i>	<i>Long</i>	<i>Extreme</i>
1 - 2	1	1	1	1
3 - 4	2	2	1	1
5 - 6	3	3	2	1
7 - 8	4	3	2	1
9 - 10	5	4	3	2
11 - 12	6	4	3	2

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Hit Chances for Manually-Aimed Light & Heavy Machine Guns less than 20mm

	<i><12.7 mm</i>	<i>12.7 - 14.5 mm</i>	<i>Base Ph</i>
Point Blank	00-50 yds	00-100 yds	70%
Short	51-100 yds	101-200 yds	50%
Medium	101-300 yds	201-500 yds	30%
Long	301-500 yds	501-800 yds	10%
Extreme	501-700 yds	801-1000 yds	5%

Hit Chances for Multiple Rocket Launchers, Recoilless Rifles, & RPGs from Small Craft

		<i>Base Ph</i>
Point Blank	00-75 yds	70%
Short	76-150 yds	50%
Medium	151-250 yds	30%
Long	251-350 yds	10%
Extreme	350-500 yds	5%

Modifier for shooter speed:

16 - 25 knots: Halved base chance to hit

26 knots or more: Quartered base chance to hit

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Field Artillery Hit Chances

<i>Range Band</i>	<i>Ph</i>	<i>No of barrels</i>	<i>Ph Modifier</i>
Short	20%	1 - 3	0%
Medium	15%	4 - 7	+1
Long	10%	8+	+2
Extreme	5%		

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Nuclear Weapons Effects Table

(ranges in nmi)

<i>Warhead Yield (kt)</i>	<i>Kill Radius Sub/Surf</i>	<i>Kill Radius Inflight</i>	<i>Damage Radius</i>
	<i>Ships</i>	<i>Aircraft</i>	
1	0.19	0.29	0.46
2	0.24	0.36	0.58
3	0.27	0.41	0.66
5	0.32	0.49	0.78
7	0.36	0.55	0.88
8	0.38	0.57	0.92
10	0.41	0.62	0.99
12	0.43	0.66	1.05
15	0.47	0.71	1.13
20	0.51	0.78	1.25
25	0.55	0.84	1.34
30	0.59	0.89	1.43
45	0.67	1.00	1.62
60	0.74	1.12	1.80
65	0.76	1.15	1.85
70	0.78	1.18	1.89
100	0.88	1.33	2.13
160	1.03	1.55	2.49
170	1.05	1.59	2.54
200	1.11	1.67	2.68
250	1.19	1.80	2.89
300	1.27	1.92	3.07
350	1.33	2.02	3.23
400	1.39	2.11	3.38
500	1.50	2.27	3.64
800	1.75	2.66	4.26
1000	1.89	2.86	4.59
1100	1.95	2.95	4.74
1200	2.01	3.04	4.88
1450	2.14	3.24	5.19
1500	2.16	3.28	5.25
1800	2.30	3.48	5.58
8900	3.92	5.93	9.51
9000	3.93	5.95	9.55
9500	4.00	6.06	9.72
50000	6.96	10.54	16.91

Static overpressure

in psi	8	4	2
Radius in m			
for 1 kt surf	350	530	850
Radius in nmi			
for 1 kt surf	0.19	0.29	0.46

Notes:

1) All ship damage calculations assume an 8 psi surface burst overpressure to sink or gravely damage a surface ship and a 2 psi overpressure is required to damage its weapons and sensors. Aircraft on the ground or on deck are included.

2) Aircraft and missiles in flight require a 4 psi overpressure to kill them or force a mission abort, or a 2 psi to damage them and force a mission abort.

3) Airbursts are assumed to detonate at the target's altitude. Nuclear SAMs may be used against surface targets. They will detonate at low altitude over the target vessel, if they hit.

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Antiship Missile Attack Table

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A/Large Target Signature

ECM Gen	Seeker Base Gen Ph	Jamming	Decoy	Jamming & Decoy
1	1	0.65	0.61	0.59
	2	0.75	0.75	0.69
	3	0.80	0.80	0.75
	4	0.85	0.85	0.82
2	1	0.65	0.60	0.56
	2	0.75	0.70	0.67
	3	0.80	0.80	0.73
	4	0.85	0.85	0.80
3	1	0.65	0.56	0.52
	2	0.75	0.67	0.63
	3	0.80	0.73	0.70
	4	0.85	0.80	0.78
4	1	0.65	0.45	0.36
	2	0.75	0.56	0.48
	3	0.80	0.65	0.58
	4	0.85	0.74	0.70

B/Medium Target Signature

ECM Gen	Seeker Base Gen Ph	Jamming	Decoy	Jamming & Decoy
1	1	0.65	0.56	0.52
	2	0.75	0.75	0.63
	3	0.80	0.80	0.70
	4	0.85	0.85	0.78
2	1	0.65	0.50	0.44
	2	0.75	0.62	0.56
	3	0.80	0.80	0.65
	4	0.85	0.85	0.74
3	1	0.65	0.47	0.39
	2	0.75	0.58	0.51
	3	0.80	0.67	0.61
	4	0.85	0.75	0.71
4	1	0.65	0.38	0.26
	2	0.75	0.50	0.39
	3	0.80	0.60	0.51
	4	0.85	0.71	0.65

C&D/Small Target Signature

ECM Gen	Seeker Base Gen Ph	Jamming	Decoy	Jamming & Decoy
1	1	0.65	0.48	0.40
	2	0.75	0.75	0.52
	3	0.80	0.80	0.62
	4	0.85	0.85	0.72
2	1	0.65	0.40	0.30
	2	0.75	0.52	0.43
	3	0.80	0.80	0.54
	4	0.85	0.85	0.67
3	1	0.65	0.38	0.26
	2	0.75	0.50	0.39
	3	0.80	0.60	0.51
	4	0.85	0.71	0.65
4	1	0.65	0.31	0.16
	2	0.75	0.44	0.30
	3	0.80	0.55	0.44
	4	0.85	0.67	0.60

E & F/Small Target Signature

ECM Gen	Seeker Base Gen Ph	Jamming	Decoy	Jamming & Decoy
1	1	0.65	0.42	0.33
	2	0.75	0.75	0.45
	3	0.80	0.80	0.56
	4	0.85	0.85	0.68
2	1	0.65	0.35	0.23
	2	0.75	0.48	0.36
	3	0.80	0.80	0.49
	4	0.85	0.85	0.63
3	1	0.65	0.31	0.16
	2	0.75	0.44	0.30
	3	0.80	0.55	0.44
	4	0.85	0.67	0.60
4	1	0.65	0.26	0.10
	2	0.75	0.39	0.24
	3	0.80	0.51	0.39
	4	0.85	0.65	0.56

G/Stealthy Target Signature

ECM Gen	Seeker Base Gen Ph	Jamming	Decoy	Jamming & Decoy
1	1	0.65	0.38	0.26
	2	0.75	0.75	0.39
	3	0.80	0.80	0.51
	4	0.85	0.85	0.65
2	1	0.65	0.31	0.16
	2	0.75	0.44	0.30
	3	0.80	0.80	0.44
	4	0.85	0.85	0.60
3	1	0.65	0.26	0.10
	2	0.75	0.39	0.24
	3	0.80	0.51	0.39
	4	0.85	0.65	0.56
4	1	0.65	0.24	0.07
	2	0.75	0.37	0.21
	3	0.80	0.50	0.37
	4	0.85	0.64	0.54

Ballistic Missile Random Lock-On Chance

Target Size class	Chance of Homing on the Desired Target
Large	15
Medium	10
Small	5
VSmall	2

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*FCS: Fire Control Solution

ASBM Attack Table

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Targeting: OTH-B/Missile: SRBM

<u>FCS* Die Roll</u>	<u>Target Average Speed (kts)</u>										
	<u>≤10</u>	<u>11-13</u>	<u>14 - 16</u>	<u>17-19</u>	<u>20 - 22</u>	<u>23-24</u>	<u>25-27</u>	<u>28-29</u>	<u>30-32</u>	<u>33-34</u>	<u>≥35</u>
1	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
2	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
3-6	0.80	0.80	0.80	0.75	0.75	0.75	0.70	0.70	0.65	0.65	0.60
7-8	0.60	0.60	0.60	0.55	0.55	0.55	0.50	0.50	0.50	0.50	0.45
9	0.45	0.45	0.45	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.35
10	0.35	0.35	0.35	0.35	0.35	0.30	0.30	0.30	0.30	0.30	0.30

Targeting: OTH-B/Missile: MRBM

<u>FCS* Die Roll</u>	<u>Target Average Speed (kts)</u>										
	<u>≤10</u>	<u>11-13</u>	<u>14 - 16</u>	<u>17-19</u>	<u>20 - 22</u>	<u>23-24</u>	<u>25-27</u>	<u>28-29</u>	<u>30-32</u>	<u>33-34</u>	<u>≥35</u>
1	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.77
2	0.80	0.80	0.80	0.80	0.80	0.75	0.70	0.65	0.60	0.60	0.55
3-6	0.75	0.70	0.65	0.60	0.60	0.55	0.50	0.50	0.45	0.45	0.40
7-8	0.55	0.50	0.50	0.45	0.45	0.40	0.40	0.40	0.35	0.35	0.30
9	0.40	0.40	0.40	0.35	0.35	0.35	0.30	0.30	0.30	0.25	0.25
10	0.35	0.30	0.30	0.30	0.25	0.25	0.25	0.25	0.25	0.20	0.20

Targeting: SAR Satellite/Missile: SRBM

<u>FCS* Die Roll</u>	<u>Target Average Speed (kts)</u>										
	<u>≤10</u>	<u>11-13</u>	<u>14 - 16</u>	<u>17-19</u>	<u>20 - 22</u>	<u>23-24</u>	<u>25-27</u>	<u>28-29</u>	<u>30-32</u>	<u>33-34</u>	<u>≥35</u>
1	0.80	0.80	0.80	0.80	0.75	0.60	0.50	0.45	0.40	0.35	0.30
2	0.80	0.80	0.80	0.80	0.70	0.55	0.50	0.40	0.35	0.30	0.30
3-6	0.80	0.80	0.80	0.75	0.65	0.50	0.45	0.40	0.35	0.30	0.25
7-8	0.80	0.80	0.80	0.70	0.60	0.50	0.45	0.35	0.35	0.30	0.25
9	0.80	0.80	0.80	0.65	0.55	0.45	0.40	0.35	0.30	0.25	0.25
10	0.80	0.80	0.75	0.60	0.50	0.45	0.40	0.35	0.30	0.25	0.25

Targeting: SAR Satellite/Missile: MRBM

<u>FCS* Die Roll</u>	<u>Target Average Speed (kts)</u>										
	<u>≤10</u>	<u>11-13</u>	<u>14 - 16</u>	<u>17-19</u>	<u>20 - 22</u>	<u>23-24</u>	<u>25-27</u>	<u>28-29</u>	<u>30-32</u>	<u>33-34</u>	<u>≥35</u>
1	0.80	0.80	0.80	0.65	0.55	0.45	0.40	0.35	0.30	0.25	0.20
2	0.80	0.80	0.80	0.60	0.55	0.45	0.40	0.30	0.30	0.24	0.20
3-6	0.80	0.80	0.75	0.60	0.50	0.40	0.35	0.30	0.25	0.20	0.20
7-8	0.80	0.80	0.70	0.55	0.45	0.40	0.35	0.30	0.25	0.20	0.20
9	0.80	0.80	0.65	0.50	0.45	0.35	0.30	0.25	0.25	0.20	0.20
10	0.80	0.75	0.60	0.50	0.40	0.35	0.30	0.25	0.20	0.20	0.15

Targeting: SAR Satellite/Missile: IRBM

<u>FCS* Die Roll</u>	<u>Target Average Speed (kts)</u>										
	<u>≤10</u>	<u>11-13</u>	<u>14 - 16</u>	<u>17-19</u>	<u>20 - 22</u>	<u>23-24</u>	<u>25-27</u>	<u>28-29</u>	<u>30-32</u>	<u>33-34</u>	<u>≥35</u>
1	0.80	0.80	0.65	0.50	0.40	0.35	0.30	0.25	0.20	0.20	0.15
2	0.80	0.75	0.60	0.45	0.40	0.30	0.25	0.20	0.20	0.15	0.15
3-6	0.80	0.70	0.60	0.45	0.40	0.30	0.25	0.20	0.20	0.15	0.15
7-8	0.80	0.65	0.55	0.40	0.35	0.30	0.25	0.20	0.20	0.15	0.15
9	0.80	0.60	0.50	0.40	0.35	0.25	0.20	0.20	0.20	0.15	0.10
10	0.80	0.60	0.50	0.35	0.30	0.25	0.20	0.20	0.20	0.15	0.10

Targeting: Aircraft/UAV w/ datalink/Missile: SRBM

<u>FCS* Die Roll</u>	<u>Target Average Speed (kts)</u>										
	<u>≤10</u>	<u>11-13</u>	<u>14 - 16</u>	<u>17-19</u>	<u>20 - 22</u>	<u>23-24</u>	<u>25-27</u>	<u>28-29</u>	<u>30-32</u>	<u>33-34</u>	<u>≥35</u>
1	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
2	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
3-6	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
7-8	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
9	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
10	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80

ASBM Attack Table (continued)

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Targeting: Aircraft/UAV w/ datalink/Missile: MRBM

<u>FCS* Die Roll</u>	<u>Target Average Speed (kts)</u>										
	<u>≤10</u>	<u>11-13</u>	<u>14 - 16</u>	<u>17-19</u>	<u>20 - 22</u>	<u>23-24</u>	<u>25-27</u>	<u>28-29</u>	<u>30-32</u>	<u>33-34</u>	<u>≥35</u>
1	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
2	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
3-6	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
7-8	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.70
9	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.74	0.65
10	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.70	0.60

Targeting: Aircraft/UAV w/ datalink/Missile: IRBM

	Target Average Speed (kts)										
<u>FCS* Die Roll</u>	<u>≤10</u>	<u>11-13</u>	<u>14 - 16</u>	<u>17-19</u>	<u>20 - 22</u>	<u>23-24</u>	<u>25-27</u>	<u>28-29</u>	<u>30-32</u>	<u>33-34</u>	<u>≥35</u>
1	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.70	0.60	0.55	0.45
2	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.70	0.60	0.50	0.45
3-6	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.65	0.55	0.50	0.45
7-8	0.80	0.80	0.80	0.80	0.80	0.80	0.75	0.60	0.55	0.45	0.40
9	0.80	0.80	0.80	0.80	0.80	0.80	0.70	0.55	0.50	0.45	0.40
10	0.80	0.80	0.80	0.80	0.80	0.75	0.65	0.55	0.50	0.40	0.35

FCS* Die Roll Modifiers:

Sea State 4:	+1
Sea State 5:	+2
Sea State 6+:	+3
Jamming:	+1
0000 - 0800	+1
(OTH-B only)	

ASBM Attack Countermeasure Modifiers

<u>Target</u>	<u>3rd Gen 3rd Gen 3rd Gen 4th Gen 4th Gen</u>							
	<u>Size Class</u>	<u>D</u>	<u>J</u>	<u>J & D</u>	<u>D</u>	<u>J</u>	<u>J & D</u>	
A		--	--	--	-0.10	-0.20	-0.30	
B		-0.10	-0.10	-0.20	-0.20	-0.25	-0.45	
E - G		-0.25	-0.10	-0.35	-0.30	-0.25	-0.55	
C & D		-0.20	-0.10	-0.30	-0.25	-0.25	-0.50	

All tables assume a 3rd Gen ASBM seeker. For a 2nd Gen seeker, subtract 5% (-0.05).

ASW Standoff Weapon Placement Modifiers

<u>Target Range (nmi)</u>	<u>D10 Modifier</u>
≤15	0
15.1 - 20.0	-1
20.1 - 25.0	-2
25.1 - 30.0	-3
30.1 - 35.0	-4
35.1 - 45.0	-5
45.1 - 55.0	-6
55.1 - 65.0	-7

Modifiers:

- Tactical Data Link: Other platforms in contact and sharing data by TDL, use applicable TDL modifier.
- NRT TDL: +1
- RT TDL: +2
- Anechoic coated submarine: -2 (for torpedo payloads only)
- Guided Standoff weapon: +1
- Nuclear Depth Bomb:
 - Yield ≤20 kT: +1
 - Yield 100-200 kT: +2

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ASW Projector and DC Modifiers

<u>Sub</u>	<u>Depth Band</u>			
	<u>Shallow</u>	<u>Interm</u>	<u>Interm</u>	<u>Deep I</u>
<u>Speed (kts)</u>	<u>I Int I</u>	<u>II & III</u>	<u>IV & V</u>	
≤5	x1.0	x.75	x.50	x.25
6 - 10	x.75	x.50	x.25	x.15
11 - 15	x.50	x.25	x.15	x.10
16 - 20	x.25	x.15	x.10	x.05
21 - 25	x.15	x.10	x.05	--
26 - 30	x.10	x.05	--	--
31+	x.05	--	--	--

-- = attack not possible

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ASW Projectile Contact Hit Hull Penetration

<u>Hull Design</u>	<u>Submarine Size Class</u>			
	<u>VSmall</u>	<u>Small</u>	<u>Medium</u>	<u>Large</u>
Single	90%	60%	30%	15%
Double	75%	45%	15%	5%
Submarine class in service before 1955: +30%				

If a pressure hull penetration critical hit does not occur, apply the damage points to the submarine's total and resolve any additional critical hits normally. Should a pressure hull penetration critical be rolled randomly, it is ignored.

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Dogfight Position Chance

<u>D100 Roll</u>	<u>Result</u>
01 - 50	Fail
51+	In position for all-aspect AAM
61+	In position for wide-angle AAM
71+	In position for narrow-aspect AAM
81+	In position for gun shot

D100 Modifiers:

Attacker's Man Rtnng - Defender's Man Rtnng * 5%

If the Attacker has a:

Helmet-Mounted Sight, +10% to AAMs

Helmet-Mounted Display, +20% to AAMs

Helmet-Mounted Vision system, +30% to AAMs

If the Attacker's Full Military Power speed at that altitude

is 150 knots faster +10%

is 150 knots slower -10%

*page 9-1***Cluster Munitions Hit Chance Modifiers**

<u>Target Size</u>	<u>Weapon Hang Weight</u>		
	<u>0-300 kg</u>	<u>301-600 kg</u>	<u>601+ kg</u>
A - B	+30%/40%	+30%/50%	+30%/60%
C - E	+20%/30%	+30%/40%	+30%/60%
F - G	+10%/20%	+20%/30%	+20%/40%

*page 9-5***Cluster Munitions Damage**

<u>Target Size</u>	<u>Weapon Size (Hang Weight)</u>		
	<u>0-300 kg</u>	<u>301-600 kg</u>	<u>601+ kg</u>
A - B (Large, Medium)	D6+2	2D6+1	2D6+4
C - D (Small)	D6+1	D6+2	D6+3
E - H (VSmall)	D6/2+1	D6/2+1	D6/2+1

*page 9-5***Chance of Surprise**

	<u>Number of Defending Aircraft</u>					
	<u>1</u>	<u>2</u>	<u>3-4</u>	<u>5-8</u>	<u>9+</u>	
Number of	1	30%	25%	15%	10%	5%
Attacking	2	25%	20%	15%	10%	5%
Aircraft	3-4	15%	15%	10%	5%	2%
	5-8	10%	10%	5%	2%	1%
	9+	5%	5%	2%	1%	0%

*page 9-2***GP Bomb Airburst Damage**

<u>Warhead Size (DP):</u>	<u>0-30</u>	<u>31-40</u>	<u>41-50</u>	<u>51+</u>
Critical Hits:	D6/3-1	D6/2-1	D6-2	D6-1

*page 14-4***Aircraft Gun Attack Table***page 9-3*

<u>Target Damage Rating</u>	<u>Aircraft Gun Rating</u>															
	<u>.05</u>	<u>.10</u>	<u>.25</u>	<u>.50</u>	<u>1.0</u>	<u>1.5</u>	<u>2.0</u>	<u>2.5</u>	<u>3.0</u>	<u>3.5</u>	<u>4.0</u>	<u>4.5</u>	<u>5.0</u>	<u>5.5</u>	<u>6.0</u>	
4	.05	.15	.20	.30	.45	.50	.60	.70	.75	.80	.85	.90	.90	.90	.90	
5	.05	.15	.20	.25	.40	.50	.55	.60	.65	.70	.75	.80	.85	.90	.90	
6	.05	.15	.15	.25	.35	.45	.50	.55	.60	.65	.70	.75	.80	.80	.85	
7	.03	.10	.15	.25	.30	.40	.45	.50	.55	.60	.65	.70	.70	.75	.80	
8	.03	.10	.15	.20	.30	.40	.45	.50	.50	.55	.60	.65	.70	.70	.75	
9	.03	.10	.15	.20	.30	.35	.40	.45	.50	.55	.60	.60	.65	.65	.70	
10	.03	.10	.10	.20	.30	.35	.40	.45	.50	.50	.55	.60	.60	.65	.65	
12	.03	.10	.10	.20	.25	.30	.35	.40	.45	.45	.50	.50	.55	.60	.60	
14	.03	.10	.10	.15	.25	.30	.30	.35	.40	.45	.45	.50	.50	.55	.55	
16	.03	.10	.10	.15	.20	.25	.30	.35	.40	.40	.45	.45	.50	.50	.50	
18	.03	.10	.10	.15	.20	.25	.30	.30	.35	.40	.40	.45	.45	.50	.50	
20	.03	.10	.10	.15	.20	.25	.30	.30	.35	.35	.40	.40	.45	.45	.45	
25	.01	.05	.10	.10	.20	.20	.25	.30	.30	.30	.35	.35	.40	.40	.40	
30	.01	.05	.10	.10	.15	.20	.20	.25	.30	.30	.30	.35	.35	.35	.40	
40	.01	.05	.10	.10	.15	.15	.20	.20	.25	.25	.30	.30	.30	.30	.35	
50	.01	.05	.05	.10	.10	.15	.20	.20	.20	.20	.25	.25	.30	.30	.30	
60	.01	.05	.05	.10	.10	.15	.15	.20	.20	.20	.20	.25	.25	.25	.30	
70	.01	.05	.05	.10	.10	.10	.15	.15	.20	.20	.20	.20	.25	.25	.25	
80	.01	.05	.05	.10	.10	.10	.15	.15	.15	.20	.20	.20	.20	.20	.25	
90	.01	.05	.05	.05	.10	.10	.15	.15	.15	.20	.20	.20	.20	.20	.20	
100	.01	.05	.05	.05	.10	.10	.10	.15	.15	.15	.20	.20	.20	.20	.20	

Unguided Ordnance Attack Tables

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Target Size Class	Base Chance to Hit			
	Glide	Level	Lob-	Strafing
	Bombing	Bombing	Toss	
	Base Ph	Base Ph	Base Ph ²	
A	35%	8%	12%	35%
B	24%	6%	10%	30%
C	12%	4%	6%	30%
D	10%	2%	4%	20%
E	6%	1%	2%	14%
F-G	2%	1%	1%	14%

Note : On larger ships, the chance of a hit on the strafing table is not the chance of hitting the ship, but hitting something on the ship worth knocking out.

General-purpose (GP) explosive bombs of 1000 kg/2000 lb or less can be fuzed for either impact or airburst. See section 14.1.4

VLow attacks with retarded bombs do not change the chance to hit. The armor penetration rating of all retarded ordnance is halved.

Attack Altitude Modifier (Level Bombing)

<1,500 m	Base Ph x 3.0
1,500 - 2,999 m	Base Ph x 2.0
3,000 - 3,999 m	Base Ph
4,000 - 4,999 m	Base Ph x 0.5
5,000- 7,500 m	Base Ph x 0.25

Target Speed Modifiers

5 knots or less	Up 2 rows
6 - 10 knots	Up 1 row
25 - 34 knots or more	Down 1 row
35+ knots	Down 2 rows

Final Ph Modifiers

Rudder Casualty	Up 2 rows
Land Targets	Up 2 rows
Ballistic Bombsight:	Up 1 row
Computing Bombsight:	Up 3 rows
Advanced Bombsight:	Up 5 rows
No AA Fire:	Up 1 row
Heavy AA Fire ¹ :	Down 1 row

¹Antiaircraft rating of 3.0 or more firing at the attacking aircraft or SAM launched at the plane.

Attack Altitude Modifier (Glide Bombing)

Medium alt. release	Down 2 rows
---------------------	-------------

²Inertially-guided ordnance that is lob-tossed uses the Glide Bombing column.

Air Attack Table

Base Ph	Salvo = 1	Salvo = 2		Salvo = 3			Salvo = 4			
	1	1	2	1	2	3	1	2	3	4
0.85	0.85	0.90	0.72	0.90	0.89	0.61	0.90	0.89	0.88	0.52
0.80	0.80	0.90	0.64	0.90	0.88	0.51	0.90	0.89	0.82	0.41
0.75	0.75	0.90	0.56	0.90	0.84	0.42	0.90	0.89	0.74	0.32
0.70	0.70	0.90	0.49	0.90	0.78	0.34	0.90	0.89	0.65	0.24
0.65	0.65	0.88	0.42	0.90	0.72	0.27	0.90	0.87	0.56	0.18
0.60	0.60	0.84	0.36	0.90	0.65	0.22	0.90	0.82	0.48	0.13
0.55	0.55	0.80	0.30	0.90	0.57	0.17	0.90	0.76	0.39	0.09
0.50	0.50	0.75	0.25	0.88	0.50	0.13	0.90	0.69	0.31	0.06
0.45	0.45	0.70	0.20	0.83	0.43	0.09	0.90	0.61	0.24	0.04
0.40	0.40	0.64	0.16	0.78	0.35	0.06	0.87	0.52	0.18	0.03
0.35	0.35	0.58	0.12	0.73	0.28	0.04	0.82	0.44	0.13	0.02
0.30	0.30	0.51	0.09	0.66	0.22	0.03	0.76	0.35	0.08	0.01
0.28	0.28	0.48	0.08	0.63	0.19	0.02	0.73	0.31	0.07	0.01
0.26	0.26	0.45	0.07	0.59	0.17	0.02	0.70	0.28	0.06	--
0.24	0.24	0.42	0.06	0.56	0.15	0.01	0.67	0.24	0.04	--
0.22	0.22	0.39	0.05	0.53	0.12	0.01	0.63	0.21	0.03	--
0.20	0.20	0.36	0.04	0.49	0.10	0.01	0.59	0.18	0.03	--
0.18	0.18	0.33	0.03	0.45	0.08	0.01	0.55	0.15	0.02	--
0.16	0.16	0.29	0.03	0.41	0.06	--	0.50	0.12	0.01	--
0.14	0.14	0.26	0.02	0.36	0.05	--	0.45	0.10	0.01	--
0.12	0.12	0.23	0.01	0.32	0.04	--	0.40	0.07	0.01	--
0.10	0.10	0.19	0.01	0.27	0.03	--	0.34	0.05	--	--
0.08	0.08	0.15	0.01	0.22	0.02	--	0.28	0.03	--	--
0.06	0.06	0.12	--	0.17	0.01	--	0.22	0.02	--	--
0.04	0.04	0.08	--	0.12	--	--	0.15	0.01	--	--
0.02	0.02	0.04	--	0.06	--	--	0.08	--	--	--
0.01	0.01	0.02	--	0.03	--	--	0.04	--	--	--
<0.01	--	--	--	0.01	--	--	0.02	--	--	--

Precision-Guided Munitions Attack Table

Guidance Type	Countermeasures Generation and Target Size									
	Base Lg-Sm	Base VSmall	1st Gen Lg-Sm	1st Gen VSmall	2nd Gen Lg-Sm	2nd Gen VSmall	3rd Gen Lg-Sm	3rd Gen VSmall	4th Gen Lg-Sm	4th Gen VSmall
1st Gen Cmd/SARH	0.40	0.30	0.24	0.18	0.18	0.14	0.12	0.09	0.06	0.05
2nd Gen Cmd/SARH	0.50	0.40	0.40	0.32	0.30	0.24	0.23	0.18	0.15	0.12
3rd Gen Cmd/SARH	0.70	0.60	0.63	0.54	0.56	0.48	0.42	0.36	0.32	0.27
4th Gen TARH	0.85	0.75	0.85	0.75	0.85	0.75	0.77	0.68	0.51	0.45
1st Gen SALH	0.60	0.50	0.48	0.40	0.36	0.30	0.27	0.23	0.18	0.15
2nd Gen SALH	0.70	0.60	0.67	0.57	0.56	0.48	0.42	0.36	0.32	0.27
3rd Gen SALH	0.80	0.70	0.80	0.70	0.80	0.70	0.64	0.56	0.48	0.42
1st Gen EO/IR	0.75	0.65	0.60	0.52	0.45	0.39	0.34	0.29	0.23	0.20
2nd Gen EO/IR	0.80	0.70	0.76	0.67	0.64	0.56	0.48	0.42	0.36	0.32
3rd Gen EO/IIR	0.85	0.75	0.85	0.75	0.85	0.75	0.68	0.60	0.51	0.45
1st Gen SATNAV	0.70	0.60	0.42	0.36	0.35	0.30	0.28	0.24	0.21	0.18
2nd Gen SATNAV	0.75	0.65	0.64	0.55	0.56	0.49	0.53	0.46	0.45	0.39
3rd Gen SATNAV	0.80	0.70	0.80	0.70	0.72	0.63	0.68	0.60	0.60	0.53

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Unguided Rocket Attack Table

# of Rkts	2D6 Roll											
	2	3	4	5	6	7	8	9	10	11	12	
2	1	1	1	1	1	1	1	1	1	1	2	
4	1	1	1	1	1	2	2	2	2	2	3	
6	1	1	1	1	2	2	2	2	2	2	3	
8	1	1	1	2	2	3	3	3	3	3	4	
10	1	1	2	2	3	3	3	3	3	4	4	
12	1	2	2	3	3	3	3	3	4	4	4	
16	2	2	3	3	3	3	3	4	4	4	5	
24	2	3	3	3	3	3	4	4	4	5	5	
32	3	3	3	3	3	4	4	4	5	5	5	

Tgt Size	A	B	C	D	E	F	G	H
Die Modifier	+2	1	0	0	-1	-2	-3	-4

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Runway Use

Number of Cuts	Runway Length (m)					
	500	1000	2000	3000	4000	5000
1	Small	Med	Large	Large	Large	Large
2	Small	Med	Med	Med	Med	Large
3	STOL	Small	Med	Med	Med	Med
4	STOL	Small	Small	Med	Med	Med
5	X	STOL	Small	Small	Small	Small
6	X	STOL	STOL	Small	Small	Small
7	X	X	STOL	STOL	STOL	STOL
8	X	X	X	STOL	STOL	STOL
9	X	X	X	X	STOL	STOL
10	X	X	X	X	X	STOL

The table assumes fully loaded aircraft. Lightly loaded aircraft are treated as one class smaller.

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Breakdown Repair Chance

Time Since Breakdown (hours)	6	12	24	48
First rank navies:	30%	35%	40%	45%
Second rank navies:	20%	25%	25%	25%

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Non-Homing Torpedo Attack Tables

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Effective Target Size: Large

Salvo Size = 1			Salvo Size = 2			Salvo Size = 3				Salvo Size = 4				
Torp Run	1		Torp Run	1	2	Torp Run	1	2	3	Torp Run	1	2	3	4
(nmi)	Ph		(nmi)	Ph	Ph	(nmi)	Ph	Ph	Ph	(nmi)	Ph	Ph	Ph	Ph
0.25	0.85		0.25	0.85	0.80	0.25	0.85	0.85	0.73	0.25	0.85	0.85	0.79	0.66
0.5	0.72		0.5	0.85	0.52	0.5	0.85	0.67	0.37	0.5	0.85	0.75	0.51	0.27
1.0	0.38		1.0	0.62	0.15	1.0	0.76	0.27	0.06	1.0	0.85	0.33	0.14	0.02
2.0	0.20		2.0	0.37	0.04	2.0	0.49	0.10	0.01	2.0	0.60	0.16	0.03	-
4.0	0.11		4.0	0.20	0.01	4.0	0.29	0.03	-	4.0	0.33	0.06	-	-
6.0	0.07		6.0	0.14	-	6.0	0.18	0.02	-	6.0	0.21	0.03	-	-
8.0	0.06		8.0	0.09	-	8.0	0.11	-	-	8.0	0.12	0.01	-	-
10.0	0.04		10.0	0.05	-	10.0	0.06	-	-	10.0	0.07	-	-	-

Effective Target Size: Medium

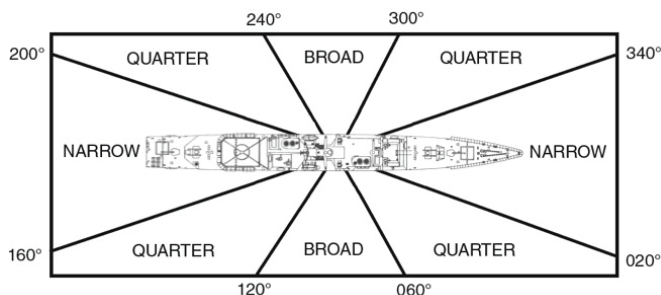
Salvo Size = 1			Salvo Size = 2			Salvo Size = 3				Salvo Size = 4				
Torp Run	1		Torp Run	1	2	Torp Run	1	2	3	Torp Run	1	2	3	4
(nmi)	Ph		(nmi)	Ph	Ph	(nmi)	Ph	Ph	Ph	(nmi)	Ph	Ph	Ph	Ph
0.25	0.73		0.25	0.85	0.50	0.25	0.85	0.62	0.39	0.25	0.85	0.67	0.42	0.28
0.5	0.39		0.5	0.63	0.15	0.5	0.77	0.28	0.06	0.5	0.85	0.34	0.14	0.02
1.0	0.20		1.0	0.36	0.04	1.0	0.49	0.10	0.01	1.0	0.59	0.15	0.03	-
2.0	0.09		2.0	0.17	0.01	2.0	0.25	0.02	-	2.0	0.31	0.04	-	-
4.0	0.05		4.0	0.11	-	4.0	0.15	0.01	-	4.0	0.16	0.02	-	-
6.0	0.03		6.0	0.07	-	6.0	0.09	-	-	6.0	0.10	-	-	-
8.0	0.02		8.0	0.04	-	8.0	0.05	-	-	8.0	0.06	-	-	-
10.0	0.01		10.0	0.03	-	10.0	0.03	-	-	10.0	0.03	-	-	-

Effective Target Size: Small

Salvo Size = 1			Salvo Size = 2			Salvo Size = 3				Salvo Size = 4				
Torp Run	1		Torp Run	1	2	Torp Run	1	2	3	Torp Run	1	2	3	4
(nmi)	Ph		(nmi)	Ph	Ph	(nmi)	Ph	Ph	Ph	(nmi)	Ph	Ph	Ph	Ph
0.25	0.44		0.25	0.68	0.19	0.25	0.82	0.32	0.08	0.25	0.85	0.36	0.19	0.06
0.5	0.21		0.5	0.37	0.04	0.5	0.50	0.10	0.01	0.5	0.61	0.16	0.03	0.01
1.0	0.10		1.0	0.19	0.01	1.0	0.27	0.03	-	1.0	0.34	0.05	-	-
2.0	0.05		2.0	0.09	-	2.0	0.14	0.01	-	2.0	0.18	0.01	-	-
4.0	0.03		4.0	0.04	-	4.0	0.07	-	-	4.0	0.08	-	-	-
6.0	0.02		6.0	0.03	-	6.0	0.04	-	-	6.0	0.04	-	-	-
8.0	-		8.0	0.02	-	8.0	0.02	-	-	8.0	0.03	-	-	-
10.0	-		10.0	-	-	10.0	0.01	-	-	10.0	0.01	-	-	-

Effective Target Size: VSmall

Salvo Size = 1			Salvo Size = 2			Salvo Size = 3				Salvo Size = 4				
Torp Run	1		Torp Run	1	2	Torp Run	1	2	3	Torp Run	1	2	3	4
(nmi)	Ph		(nmi)	Ph	Ph	(nmi)	Ph	Ph	Ph	(nmi)	Ph	Ph	Ph	Ph
0.25	0.24		0.25	0.42	0.06	0.25	0.56	0.13	0.03	0.25	0.66	0.20	0.06	0.03
0.5	0.12		0.5	0.23	0.02	0.5	0.33	0.04	0.01	0.5	0.41	0.07	0.02	0.01
1.0	0.07		1.0	0.13	-	1.0	0.18	0.01	-	1.0	0.24	0.02	-	-
2.0	0.03		2.0	0.07	-	2.0	0.10	-	-	2.0	0.13	0.01	-	-
4.0	0.02		4.0	0.04	-	4.0	0.05	-	-	4.0	0.06	-	-	-
6.0	0.01		6.0	0.02	-	6.0	0.03	-	-	6.0	0.04	-	-	-
8.0	-		8.0	0.01	-	8.0	0.01	-	-	8.0	0.02	-	-	-
10.0	-		10.0	-	-	10.0	-	-	-	10.0	0.01	-	-	-



Target Aspects

Size Class

Target Aspect Large Medium Small VSmall

Medium Small VSmall VSmall

Non-Homing Torpedo Attack Tables

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Effective Target Size: Large

Salvo Size = 5

Torp Run (nmi)	1 <i>Ph</i>	2 <i>Ph</i>	3 <i>Ph</i>	4 <i>Ph</i>	5 <i>Ph</i>
0.25	0.85	0.85	0.85	0.72	0.59
0.5	0.85	0.78	0.58	0.38	0.19
1.0	0.85	0.50	0.21	0.07	0.01
2.0	0.68	0.21	0.05	0.01	-
4.0	0.37	0.08	0.01	-	-
6.0	0.24	0.04	-	-	-
8.0	0.13	0.03	-	-	-
10.0	0.09	0.01	-	-	-

Salvo Size = 6

Torp Run (nmi)	1 <i>Ph</i>	2 <i>Ph</i>	3 <i>Ph</i>	4 <i>Ph</i>	5 <i>Ph</i>	6 <i>Ph</i>
0.25	0.85	0.85	0.85	0.77	0.68	0.53
0.5	0.85	0.82	0.65	0.46	0.32	0.14
1.0	0.85	0.60	0.26	0.12	0.03	0.01
2.0	0.74	0.25	0.09	0.02	-	-
4.0	0.44	0.11	0.02	-	-	-
6.0	0.30	0.06	-	-	-	-
8.0	0.17	0.04	-	-	-	-
10.0	0.10	0.02	-	-	-	-

Effective Target Size: Medium

Salvo Size = 5

Torp Run (nmi)	1 <i>Ph</i>	2 <i>Ph</i>	3 <i>Ph</i>	4 <i>Ph</i>	5 <i>Ph</i>
0.25	0.85	0.74	0.56	0.38	0.21
0.5	0.85	0.35	0.22	0.07	0.01
1.0	0.67	0.20	0.05	0.01	-
2.0	0.38	0.06	0.01	-	-
4.0	0.20	0.02	-	-	-
6.0	0.11	0.01	-	-	-
8.0	0.07	-	-	-	-
10.0	0.04	-	-	-	-

Salvo Size = 6

Torp Run (nmi)	1 <i>Ph</i>	2 <i>Ph</i>	3 <i>Ph</i>	4 <i>Ph</i>	5 <i>Ph</i>	6 <i>Ph</i>
0.25	0.85	0.81	0.70	0.53	0.34	0.10
0.5	0.85	0.37	0.27	0.13	0.03	0.01
1.0	0.74	0.25	0.08	0.02	-	-
2.0	0.43	0.08	0.01	-	-	-
4.0	0.23	0.03	-	-	-	-
6.0	0.13	0.01	-	-	-	-
8.0	0.08	-	-	-	-	-
10.0	0.04	-	-	-	-	-

Effective Target Size: Small

Salvo Size = 5

Torp Run (nmi)	1 <i>Ph</i>	2 <i>Ph</i>	3 <i>Ph</i>	4 <i>Ph</i>	5 <i>Ph</i>
0.25	0.85	0.43	0.26	0.19	0.07
0.5	0.69	0.22	0.06	0.02	0.01
1.0	0.41	0.07	0.01	-	-
2.0	0.22	0.02	-	-	-
4.0	0.11	-	-	-	-
6.0	0.05	-	-	-	-
8.0	0.03	-	-	-	-
10.0	0.01	-	-	-	-

Salvo Size = 6

Torp Run (nmi)	1 <i>Ph</i>	2 <i>Ph</i>	3 <i>Ph</i>	4 <i>Ph</i>	5 <i>Ph</i>	6 <i>Ph</i>
0.25	0.85	0.51	0.30	0.27	0.24	0.02
0.5	0.75	0.26	0.09	0.05	0.02	0.01
1.0	0.47	0.10	0.02	0.01	-	-
2.0	0.25	0.03	-	-	-	-
4.0	0.14	0.01	-	-	-	-
6.0	0.06	-	-	-	-	-
8.0	0.03	-	-	-	-	-
10.0	0.02	-	-	-	-	-

Effective Target Size: VSmall

Salvo Size = 5

Torp Run (nmi)	1 <i>Ph</i>	2 <i>Ph</i>	3 <i>Ph</i>	4 <i>Ph</i>	5 <i>Ph</i>
0.25	0.74	0.25	0.12	0.09	0.02
0.5	0.49	0.10	0.04	0.02	0.01
1.0	0.29	0.03	0.01	-	-
2.0	0.16	0.01	-	-	-
4.0	0.08	-	-	-	-
6.0	0.05	-	-	-	-
8.0	0.03	-	-	-	-
10.0	0.01	-	-	-	-

Salvo Size = 6

Torp Run (nmi)	1 <i>Ph</i>	2 <i>Ph</i>	3 <i>Ph</i>	4 <i>Ph</i>	5 <i>Ph</i>	6 <i>Ph</i>
0.25	0.80	0.29	0.15	0.11	0.04	0.01
0.5	0.55	0.14	0.06	0.03	0.02	-
1.0	0.33	0.05	0.02	0.01	-	-
2.0	0.19	0.02	-	-	-	-
4.0	0.10	-	-	-	-	-
6.0	0.05	-	-	-	-	-
8.0	0.03	-	-	-	-	-
10.0	0.01	-	-	-	-	-

Submarine Fire Control Systems

<u>Gen- eration</u>	<u>Technology</u>	<u># of Target Trackers</u>	<u># of Wire-Guided Torpedoes</u>
1	Analog	1	0
2	Analog/Digital	2	1
3	Federated Digital	4	2
4	Microprocessor MSI	8	2
5	Microprocessor LSI	32	4*
6	Microprocessor VLSI	64	4*

*All US subs except the *Seawolf* class are limited to controlling 2 wire-guided torpedoes at once.

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Homing Torpedo Attack Table

<u>ACM Gen</u>	<u>Torpedo Gen</u>	<u>Torpedo Base Ph</u>	<u>ACMs Only</u>	<u>Evasion Only</u>	<u>Evasion & ACMS</u>
1	1	0.40	0.22	0.32	0.18
	2	0.60	0.42	0.48	0.34
	3	0.70	0.63	0.56	0.50
	4	0.80	0.78	0.64	0.63
2	1	0.40	0.16	0.32	0.13
	2	0.60	0.33	0.48	0.26
	3	0.70	0.56	0.56	0.45
	4	0.80	0.72	0.64	0.58
3	1	0.40	0.10	0.32	0.08
	2	0.60	0.24	0.48	0.19
	3	0.70	0.39	0.56	0.31
	4	0.80	0.64	0.64	0.51
4	1	0.40	0.08	0.32	0.06
	2	0.60	0.15	0.48	0.12
	3	0.70	0.28	0.56	0.22
	4	0.80	0.44	0.64	0.35

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Submarine Torpedo Angle Offsets

<u>Guidance Type</u>	<u>Offset</u>
Gyro/1	0°
Gyro/2	45°
Pass Homing, Act/pass Homing	90°
Wire-Guided, Dual-wire Guided	120°
VA-111 Shkval	10°

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Torpedo Danger Zones (yards)

<u>Range (nmi)</u>	<u>Torpedoes in Spread</u>					
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
≤1.0	250	250	250	250	250	500
1.1-2.0	250	250	250	500	500	750
2.1-3.0	250	250	500	750	750	1000
3.1-4.0	250	250	500	750	1000	1250
4.1-5.0	250	500	750	1250	1500	1750
5.1-6.0	250	750	1000	1500	1750	2250
6.1-7.0	250	750	1250	1750	2250	2500
7.1-8.0	500	1000	1500	2000	2500	3000
8.1-9.0	500	1000	1750	2250	2750	3500
9.1-10.0	500	1250	1750	2500	3250	3750
10.1-11.0	500	1250	2000	2750	3500	4250
11.1-12.0	750	1500	2250	3000	4000	4750
12.1-13.0	750	1750	2500	3250	4250	5250
13.1-14.0	750	1750	2750	3750	4500	5500
14.1-15.0	1000	2000	3000	4000	5000	6000
15.1+	1000	2250	3500	4750	6000	7000

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Torpedo Wire Break Chance

<u>Platform Speed</u>	<u>Speed Only</u>	<u>Speed & Turn or Depth Change</u>
≤ 10 kts	0%	15%
11 - 15 knots	25%	60%
16 - 20 knots	50%	80%
21+ knots	100%	100%

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Submarine Mobile Decoys

<u>Simulator Generation</u>	<u>Endurance (hours)</u>	<u>MAD Capability</u>	<u>Max Speed</u>	<u>Active Capability</u>
1	1	No	7 kts	No
2	1.5	No	10 kts	No
3	2	Yes	12 kts	Yes
4	2	Yes	15 kts	Yes

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Torpedo Seeker Generations

<u>Torpedo Generation</u>	<u>Description</u>	<u>Chance of a hit</u>	<u>Active Acq. Range</u>	<u>Passive Acq. Range</u>	All torpedo acquisition cone arcs are ±60° wide
1	Act/Pass Homing	40%	500 yds	300 yds	
2	Imp Act/Pass Homing	60%	1,000 yds	500 yds	
3	Digital seeker	70%	2,000 yds	1,000 yds	
4	Adv digital seeker	80%	4,000 yds	2,000 yds	

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Ballistic & Land-Attack Cruise Missile Attack Table

<i>Ballistic</i>		<i>Target Size Class</i>							
<i>Missile INS</i>	<i>CEP (m)</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>H</i>
Mechanical 1	500 - 1,000	0.01	--	--	--	--	--	--	--
Mechanical 2	250 - 499	0.02	0.01	0.01	--	--	--	--	--
Digital 1	125 - 249	0.10	0.05	0.02	0.01	--	--	--	--
Digital 2	60 - 124	0.15	0.10	0.05	0.02	0.01	--	--	--
Digital 2+	40 - 59	0.40	0.30	0.20	0.10	0.02	0.01	--	--
Terminal 1	25 - 39	0.75	0.75	0.60	0.45	0.30	0.10	0.01	--
Terminal 1+	15 - 24	0.75	0.75	0.75	0.75	0.60	0.35	0.10	0.01
Terminal 2	10 - 14	0.80	0.80	0.80	0.80	0.70	0.45	0.20	0.01

<i>LACM</i>		<i>Target Size Class</i>							
<i>Missile INS</i>	<i>CEP (m)</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>H</i>
Mechanical 1	500 - 2,000	0.01	--	--	--	--	--	--	--
Mechanical 2	150 - 499	0.07	0.05	0.02	0.01	--	--	--	--
Digital 1	60 - 149	0.40	0.25	0.15	0.07	0.02	--	--	--
Digital 2	30 - 59	0.75	0.75	0.65	0.25	0.07	0.02	--	--
Digital 2+	25 - 29	0.75	0.75	0.70	0.50	0.30	0.15	0.01	--
Terminal 1	20 - 24	0.80	0.80	0.70	0.65	0.45	0.20	0.02	--
Terminal 1+	15 - 19	0.80	0.80	0.75	0.75	0.60	0.35	0.10	0.01
Terminal 2	10 - 14	0.85	0.85	0.80	0.85	0.70	0.45	0.20	0.01

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- Satellite navigation can be added to any missile guidance. This shifts the CEP down one row.
- Digital 2+, Terminal 1+, and Terminal 2 assumes the use of satellite navigation.
- Terminal 1 is a Gen 2 seeker and Terminal 2 is a Gen 3 seeker.
- The hit chances are for a conventional HE warhead; a nuclear warhead always hits.

Generic Land Targets

<i>Target Type</i>	<i>Size Class</i>	<i>Damage Points</i>	<i>Armor</i>	<i>Results</i>
Aircraft in open, tight parking	G	--	0	D6 aircraft lost
Aircraft in open, dispersed	G	--	0	D6/3 aircraft lost
Aircraft Revetment	F	40	6	Aircraft lost
Hardened Aircraft Shelters (HAS)				
NATO Standard	D	100	5	Structure & aircraft inside destroyed
Reinforced HAS	C	120	10	Structure & aircraft inside destroyed
Large Hangar	C	150	0	D6/2 aircraft inside lost
Medium Hangar	D	100	0	D6/2 aircraft inside lost
Small Hangar	E	80	0	D6/3 aircraft inside lost
Airfield Control Tower	F	45	3	Landing/takeoff rate halved
Radar Tower and Building	E	88	3	Landing rate halved, in visibility $\leq 20\%$
Magazine Bunker	E	60	16	Gun ammo only for D10 turns
Large Maint Building	D	90	0	Reduced repair rates
Medium Maint Building	E	75	0	Reduced repair rates
Small Maint Building	F	50	0	Reduced repair rates
Taxiways	C	--	0	Cut isolates aircraft from runways
AA Gun Emplacement	F	45	3/0	Gun lost
Ship Berth	B	400	0	Ship cannot be resupplied alongside
Dry dock pumping station	F	84	3	Cannot pump out flood dry dock
Dry dock gate	E	245	9	Dry dock floods and is unuseable
SAM or SSM launcher	G	2	0	Launcher destroyed
Search or MFC radar	G	20	0	Radar destroyed
Command Bunker	E	225	13	No GCI control possible
Soft vehicle (jeep)	G	--	0	Vehicle destroyed
APC or SP Artillery	G	20	2	Vehicle destroyed
Main Battle Tank (1955-80s)	G	45	20/5	Vehicle destroyed
Main Battle Tank (1980s on)	G	50	80/10	Vehicle destroyed

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Shipboard Firing Arcs

