SUB COMMAND HQ

MULTIPLAYER TACTICAL EMPLOYMENT MANUAL

Second Revision

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INTRODUCTION

Scope

This document is intended for the online Sub Command player. The tactics described herein are exclusively geared toward multiplayer matches. There are no land strike or ASUW tactics discussed.

This manual is not intended to replace the official SC manual; I will not "reinvent the wheel", so to speak. Therefore, there will not be detailed descriptions of controls and indicators. You should already be familiar with the controls of the ship and know how to drive and perform basic operations on board your sub. There will, however, be detailed descriptions on how best to employ the tactical systems you have at your disposal.

This manual covers four main topics, with included sub-topics:

- Sonar Employment
- TMA
- Weapons Employment
- Torpedo Evasion

I had planned to include a section on ship control, and still may in the future. Where applicable, in each section I have included tips on how to drive your ship in order to properly employ sensors, weapons, et cetera. You should already have sufficient knowledge of basic ship control functions from reading the official SC Manual, and single-player experience.

Online Play

Many players find that the "learning curve" for Sub Command is very steep. This is true, and before venturing into the world of online play, it's a good idea to play SC in single-player mode for a month or two before beginning online play. This will, at the very least, acquaint you with the controls of the subs, and give you an idea of their capabilities.

Once you've mastered the basics, you can then jump right into online play. The best way to learn how to battle in multiplayer is to get involved as soon as you've gotten familiar with your sub. Don't be discouraged by taking a few losses for the first few weeks of your online experience; multiplayer is nothing like playing against the AI (computer). Human opponents have the experience and intuition that the AI units simply don't have.

There are many online groups dedicated to playing Sub Command online. Some of them imitate a military hierarchical structure, some don't. Some players enjoy running their virtual sub as if it were a real one, employing real-world tactics and procedures, while some tend to "push the envelope" of the sim with unorthodox and unrealistic methods and saturation weapons-fire. You will have to find the group that is right for you; this manual is geared toward players who prefer realism to extreme tactics. Methods such as launching a half-dozen or more weapons for sinking a single opponent will not be discussed; if this is what you're looking for, close this manual now.

Acknowledgements

The information in this manual was compiled from several years of online Sub Command combat, coupled with the experiences of some real-world submariners. However, it could not have been completed without the help of several other sources:

- Members of the Subsim Radio Room - Sub Command forum, discussions with whom have enlightened the author and provided much information and food-for-thought;
- Members of Sub Command HQ, whose online play and camaraderie have provided experience and inspiration
- TopTorp92, of the Subsim Radio Room - Sub Command forum, who created a TMA primer from which I have taken information for the TMA section of this manual;
- David “Mystic” Sandberg, who created the Cavitation chart in Appendix A;
- The SCX Mod team, whose research into the mechanics of the game have provided invaluable insight;
- Neal Stevens, without whom my online gameplay experience would not have been possible;
- I've also used some information from several websites, such as FAS.org; where applicable, I have included links to the relevant information.

The SCX Mod

Sub Command HQ utilizes the latest version of the SCX Mod during online gameplay. Where applicable, you will see an acknowledgement of information used that reflects the use of the SCX Mod. In general, most of this manual will also be applicable to any player running the stock version of SC.

Additional Helpful Items and Tips for playing Sub Command

You may find that you want to use items in addition to your PC when playing Sub Command that will help you keep a good view of the tactical picture.

- Pencil and paper, for writing down notes, bearings, speeds, frequencies, etc;
- a calculator, for performing conversions and larger computations;
- dim or reduced lighting in the area of your PC monitor, so that you can see faint frequency lines on your Narrowband display;
- A printed copy of this manual;
- Anything else that helps you enjoy and survive your online experience.

SONAR EMPLOYMENT

Passive Sonar Employment

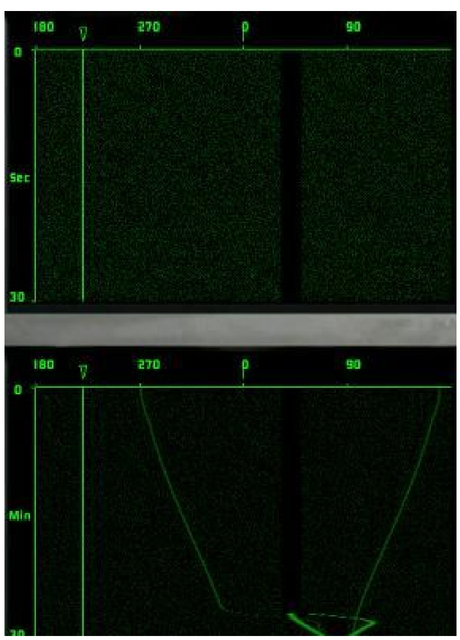
MISCONCEPTION: The passive broadband display is the best way to detect a submerged contact.

TRUTH: The NARROWBAND display is the best way to detect a submerged contact.

This misconception is a holdover from 688(I), in which the broadband display *was* the best way to detect a submerged contact. This is not true of Sub Command.

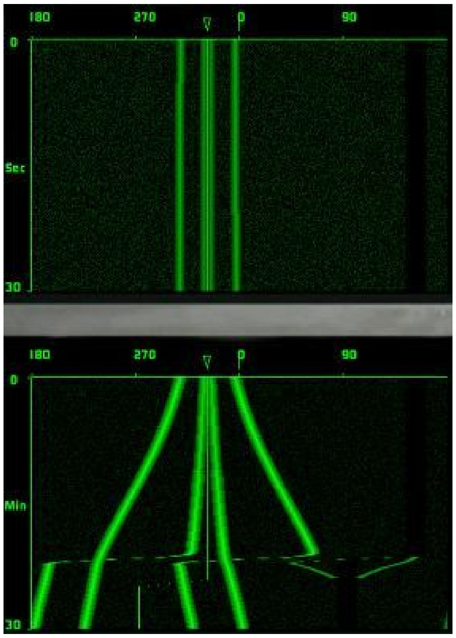
For ASW operations, your most effective employment of the Narrowband station for initial detection is achieved by viewing it at the second lowest frequency scale while viewing the Towed Array output. The reason for this is that lower frequencies travel farther through the water than do higher frequencies; therefore, the lower frequencies will be detected first.

This is not to say that the broadband display cannot be used for ASW operations; at long time averages (U.S. only), the display can show faint traces that are not visible at a short time average. Additionally, sliding the cursor over the broadband display can reveal the faint sound of a submarine, if you have your audio volume set high enough. However, you should still rely mostly on the Narrowband display in conjunction with the Towed Array.



Broadband Sonar display of the 688(I). Notice the trace on the bottom screen, set at ITA; it is a faint contact that is not visible on the top screen, which is set at STA.

In multiplayer matches, the U.S. broadband display is useful for tracking the history of surface shipping by watching the bearing drift of the traces of surface contacts. It's also useful for tracking the progress of torpedoes in the water to determine if they are threats. The Russian broadband display does not display a history of any traces. Everything you see on the broadband SSAZ is real-time. It can still be useful in tracking surface contacts, high-speed contacts, and torpedoes. Both U.S. and Russian displays can be used to get a quick look at the overall tactical picture. Using the Tracker Review (U.S.) and Cycle Contacts (Russian) buttons, you can get an instant bearing indication on any contact that has a tracker assigned.



Broadband display showing signal traces from surface ships. Note the bearing drift on the bottom display, set at ITA.

MISCONCEPTION: The spherical array is the best array to use to detect a submerged contact.

TRUTH: The TOWED ARRAY is the best array to use to detect a submerged contact.

This misconception is another holdover from 688(I), and is dispelled by the same reason you'll use the lower frequency settings at the Narrowband station, as described above.

From the Sub Command manual:

Spherical/Cylindrical Bow Array
The spherical/cylindrical array in the bow can track broadband as well as narrowband contacts. Passive detection ranges from approximately 750 Hz to 2.0 kHz. In active mode, the array transmits and detects at a higher frequency range of approximately 1.5 kHz to 5.0 kHz. The spherical/cylindrical array can process broadband signals. At higher speeds, there is some degradation of performance because of flow noise caused by the water moving across the surface of the array. The bow array is not as sensitive to low frequencies, so it's not the array of choice for narrowband contacts emitting only low frequencies.

Hull/Conformal Array
The hull/conformal array, also near the bow of the ship is a linear array that provides low speed capability to detect low frequency narrowband contacts (50 Hz -to-1.0 kHz). As such, its primary use is for classifying targets.

AN/BQG-5 Wide Aperture Array (WAA): the WAA consists of three flank arrays on each side of the SSN21 class submarines. The WAA can provide rapid passive localization (RAPLOC) for sonar contacts within a 15 kyd range.

Towed Array
The towed linear array—pulled behind the submarine on a long tow cable so it won't pick up the submarine's own machinery noise—is used for both broadband and narrowband detection and tracking (10 Hz–1.0 kHz). It is used at low to medium speeds, and is optimized for lower frequencies. All controllable submarines in *Sub Command* have at least one towed array. The capabilities of the towed arrays vary from class to class. The SSN21 carries these two different towed arrays, the AN/TB-16 and the AN/TB-29. The TB-16 is a 3.5-inch diameter array, which is thicker than the thin line TB-29 array. The TB-16 will suffer less self-noise than the TB-29 at a given speed, but the TB-29 will be more effective at the lower frequencies.

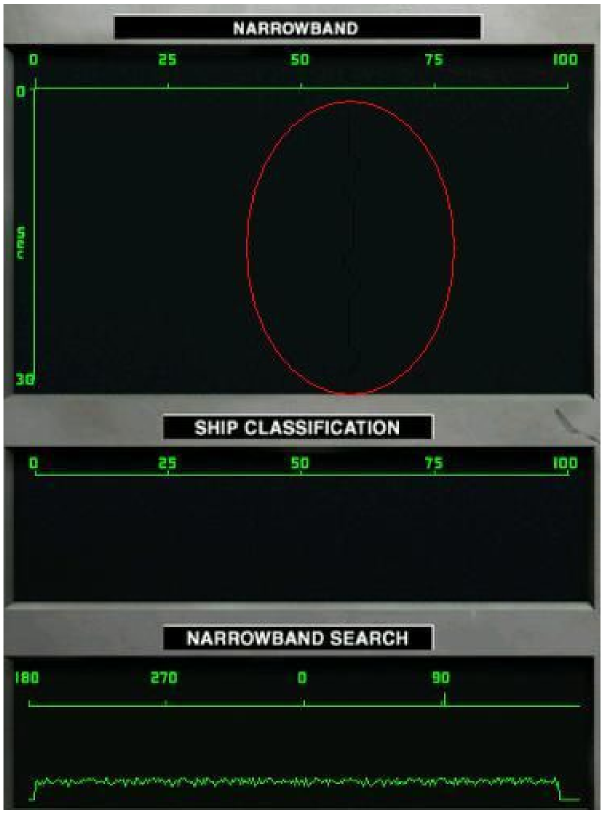
The TOWED ARRAY is much more sensitive to the lower frequency ranges (0-1000Hz) than is the spherical array. The spherical array does not detect frequencies below about 750Hz. Therefore, for ASW operations, you must deploy the towed array.

Drivers of U.S. subs have two TAs to choose from. The starboard TA on each sub is the TB-16. It is the least sensitive of the three U.S. TAs, except at higher speeds (see the “Sonar Array Washout Speeds table in the “Reducing Noise Sources” section). The port TA on the 688(I) is the TB-23 (SCX), which is more sensitive than the TB-16; the port TA on the Seawolf is the TB-29, which is more sensitive than both the TB-16 and the TB-23.

Akula drivers have only one towed array to use, the Pelamida. Its sensitivity is comparable to the TB-23 (SCX). Drivers of the Akula must be very careful not to use a backing bell (also, SCX users must not exceed TA failure speed, see Appendix D); this will destroy the ship's only TA and leave you deaf and blind.

Detecting and Classifying an Enemy Player Sub

The first frequency you will most likely detect from a submerged contact will be 50 or 60Hz. These are the motor-generator (MG) frequencies produced by the on-board power generation equipment. Since these are low frequencies, they travel much farther than any higher frequencies generated by a sub's other equipment, and will be your first indication that there is an enemy submarine present.



First Contact, 60Hz, 688(I)

First Contact, 60Hz, Akula

As the enemy sub closes range, you will begin to notice other frequencies appearing on your NB display. You will use these to determine the classification of the enemy submarine.

The Narrowband Classification Filter

The Narrowband Classification Filter (hereafter called the “class filter” for short) is a simulated part of each sub's sonar suite that provides computer-aided classification assistance to the player. It contains a library of frequency signatures of every platform included in the game. When the filter is turned ON and the cursor on the Narrowband display is placed over a contact, it provides a list of possible platform matches for the frequency lines displayed in the Narrowband waterfall.

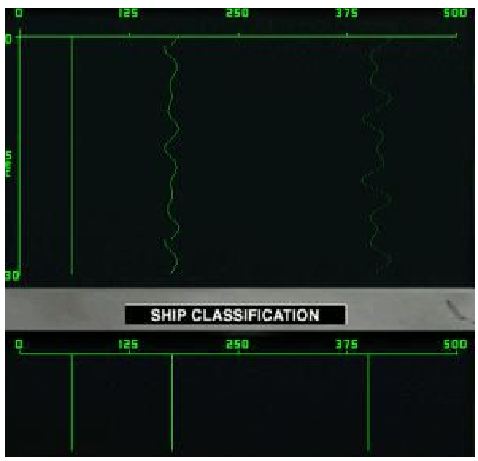
The class filter's output is determined by several things:

- The number of frequency lines displayed on the Narrowband waterfall. The more frequency lines shown, the fewer possible platform profiles will be displayed on the class filter.
- The signal strength of the highest-frequency line displayed. A faint line may not be recognized by the class filter, even though you can see it. In this case, you will have to scroll through the matches to judge which line is the closest match for the faint line that is unrecognized by the class filter.
- “Wavering” or distorted frequency lines. Some frequency lines “waver” or shift frequency slightly, and some faint frequency lines may be distorted by ocean conditions. The class filter will present a list of matches that have frequencies “close” to the wavering or distorted line.

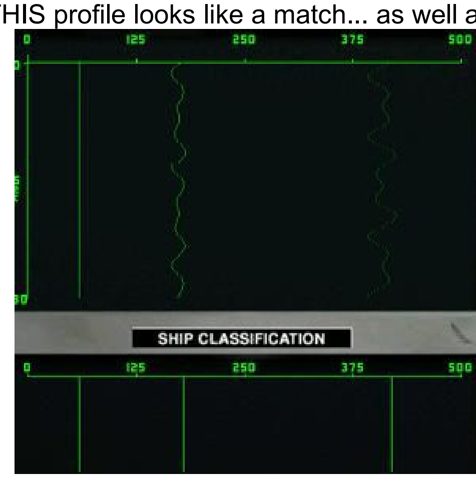
- The class filter's tolerance. The filter sometimes considers a frequency line within 20 or 30Hz of what is displayed on the Narrowband waterfall as a match for the displayed line.

Here's an example of something you might encounter while using the class filter:

The class filter thinks this looks like a match.



But it also thinks THIS profile looks like a match... as well as the image below...



Which image did YOU choose as the closest match for the contact? If you selected the first image, you'd be correct. Notice that the first image's third frequency line was perfectly aligned with the third line in the class profile; in the second image, the class profile presented a line of slightly lower frequency at the third line, and a line of slightly higher frequency in the final image. For the record, the contact is a cargo ship, and two of the other profiles that the class filter came up with for its signature were the Charles DeGaulle and a Cruise Ship.

When you have two or more contacts that overlap on the Narrowband waterfall, the class filter has a much harder time of selecting a match. It may not select a matching profile at all. In such a case, it is best to turn the class filter OFF, and scroll through the matching frequency profiles yourself. This is a time-consuming process; but the only alternative is to try to drive your boat into a position which places some bearing separation between the overlapping contacts.

Other Classification Methods for Multiplayer

The class filter's usefulness in multiplayer ASW matches depends on several factors:

- ocean acoustic conditions; if the conditions are poor, you may not receive enough lines for a solid classification until the range to your contact is down to “knife-fight” distance, which puts ownship and the target in equal danger;
- whether you use Stock SC or a mod like SCX; detection ranges are shorter when using a mod like SCX, and waiting for that second or third line on the Narrowband waterfall will put ownship in very close proximity to the target;
- The experience level of the players. An experienced player knows that he can look at other information besides the class filter's output in order to determine whether the contact he is tracking is his opponent.

In most multiplayer matches, you will not want to get close enough to your target to determine a solid classification, unless you have received specific tasking that there is a submarine in your scenario that you must NOT attack; in this case, you will have to obtain a classification from at least 2 or 3 frequency lines.

If you are playing against an experienced player, and you have detected one frequency line from his sub, chances are that he will probably have already detected you and know that you are an enemy submarine. This player is using other methods in addition to frequency classification to determine if the contact he is tracking is an enemy submarine.

Signal Strength

The first and most obvious sign that your contact is the enemy is signal strength. The submarine's greatest advantage is its stealth; therefore, they are designed to be as quiet as possible. If you can only detect a faint 50 or 60Hz line on Narrowband, and your Broadband is quiet at that bearing (no visible trace), this is a sign that you have a POSSUB (possible submerged contact). However, it is also possible that you are tracking a very distant surface vessel.

Watch the DEMON

Another way you can determine the nature of your contact is by DEMON. Many scenario designers do not typically vary the speeds of their non-submarine objects on the map, and if they do, they do not include frequent speed changes. If you have a contact that changes speed fairly often, this is another sign that you have a POSSUB. Also, the lines on the DEMON display for a submarine (if indeed you have more than one line... initial contact for a POSSUB usually shows only one or two blade lines) are typically closer together than they are for most surface ships, and also fainter in strength.

Akula DEMON display; first contact on a submerged contact, one blade line shown

Akula DEMON, surface ship contact showing bright blade lines

No single aspect of the methods described above will guarantee that you will successfully be able to classify a contact as a POSSUB without using the Narrowband Classification filter; however, taken together, you can have a high degree of confidence that you are tracking your enemy.

Special Objects

There are a couple of in-game objects that you must be aware of that could fool you into thinking you've got a POSSUB. The first is the Sailboat. It will have a faint 50Hz line that might make you think you have a Russian or European submarine, but when you look on the DEMON, you will not see any blade lines. This makes sense, because a sailboat under sail is not using its propeller. The other object is actually a group of objects implemented under the SCX mod, the False Contact Anomaly. These objects will also not show any blade lines on DEMON. These objects can display either 50Hz or 60Hz lines.

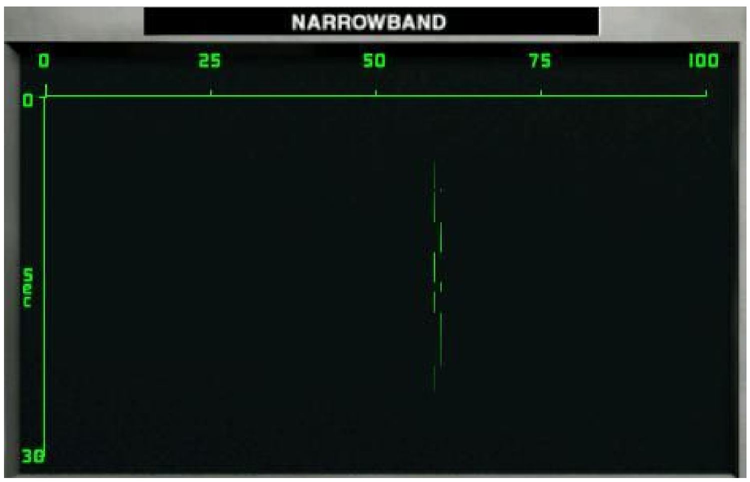
Other objects to be aware of are the biologics, the Shrimp and the Whale. These objects have no narrowband signature - which makes sense, because they do not contain any onboard machinery capable of producing discrete frequencies - and will only be visible on the broadband display. You might think that, at the very least, the whale's “song” would produce a set of discrete frequencies, but this is not modeled in Sub Command.

Ambiguous or “Mirror” Towed Array Contact Resolution

Due to the construction of the Towed Array and the method by which its information is processed, every contact detected by the TA is displayed twice by the sonar system.

The only way to resolve which trace is the true contact is to turn your sub. When you do this, the true contact will remain stationary on the display (or very close to the original observed bearing), while the “mirror” contact will move in the direction of the turn, by the same amount as the turn.

This can be a lengthy process, especially if you are conducting a slow, silent search, because of the time it takes the TA to stabilize (straighten) after the turn. You can shorten this process; as the TA begins to stabilize, you will notice the baffled area begin to move across the display. When this starts, go to the NB display, and scan your cursor across each contact. The true contact will display a solid frequency line. The mirror contact will display a non-solid, partial line, like the one seen in the picture below:



This process is not necessary when driving the Akula; you will begin to notice the contacts turning along with the array as soon as the array begins to stabilize. High-amplitude contacts (close-aboard or surface) will also be easier to judge, since they are easier to see.

<u>Reducing Noise Sources</u>

Certain noise sources can interfere with effective employment of passive sonar. These sources are ownship noise and ambient noise.

Ownship Noise

Ownship noise in Sub Command is primarily flow noise created by the flow of water over the submarine. You can minimize flow noise by maintaining a patrol speed well below your sonar array washout speed as listed below. Additionally, transiting with your torpedo tube doors open increases flow noise. To keep flow noise to a minimum, you should only open your torpedo tube doors when a weapon launch is imminent.

PLATFORM	***ARRAY***	***WASHOUT SPEED(kt)***
688(I)	*TB-16 STBD*	*16-17*
688(I)	*TB-23 PORT*	*12-13*
688(I)	*SPHERICAL (BOW)*	*11-12*
688(I)	*HULL*	*8-9*
SSN-21	*TB-16 STBD*	*16-17*
SSN-21	*TB-29 PORT*	*12-13*
SSN-21	*SPHERICAL (BOW)*	*12-13*
SSN-21	*FLANK (HULL)*	*8-9*
AKULA	*PELAMIDA TOWED ARRAY*	*12-13*
AKULA	*CYLINDRICAL (BOW)*	*12-13*
AKULA	*CONFORMAL (HULL)*	*8-9*

Sonar Array Washout Speeds under SCXII mod

Another source of self-noise is tube equalization and weapons launches. These effects do not last long enough to be a hindrance to a passive sonar search, but they are noticeable on the broadband display.

Ambient Noise

Ambient noise can be generated via several sources, but the most noticeable in Sub Command is wave action and weather action, and is expectedly worse near the ocean surface than at significant depth. In many cases, ambient noise due to surface action will require you to patrol below 400ft (122m) in order to escape its effects. A careful watch on the broadband display while transiting from deep depths to shallow depths will show you any effects created by surface action; as the ambient noise floor increases, so will the brightness of the background noise on the broadband display.

Ambient noise is also increased temporarily by underwater explosions such as those created by a torpedo impacting a target. There is a very noticeable and short-term "washout" of the broadband display immediately following an explosion that can hinder your passive search ability until the noise subsides.

There is another source of noise that can interfere with passive sonar searching. If you are using the TA and are close to the ocean floor, the TA can drag across the bottom. This will cause a washout of the TA on both broadband and narrowband. In order to correct this, you must reel in the TA, or increase speed, until the washout ceases.

Cavitation

The phenomenon of *cavitation* in submarining is caused by the submarine's propeller moving through the water rapidly, thus causing a separation in the flow of the water. This separation is manifested in the form of vacuum bubbles, which collapse rapidly. The collapsing bubbles generate significant broadband noise above 10kHz, which can lead to the detection of the cavitating platform by other platforms, including *passive homing torpedoes*. This makes it an undesirable phenomenon.

In order to avoid cavitation, it is important not to transit at high speed in shallow water. The higher pressure of deep water will prevent cavitation. Refer to Appendix C for a cavitation chart. This chart plots the speeds at which each playable submarine will cavitate at a given depth.

PC Equipment Considerations for Passive Sonar Searching

This is the least obvious factor in conducting a passive sonar search in Sub Command. Experience has show that certain PC monitor settings can be adjusted to provide the best display of very faint Narrowband contacts; these contacts can be missed if your settings are not optimized. Check the Advanced settings for your monitor (Gamma, Brightness, and Contrast) against the image file provided with this manual. If you cannot see the faint Narrowband contact in the image, perform adjustments to your monitor until you can see it.

Environmental Conditions: The Sound-Speed Profile

MISCONCEPTION: Thermal layers will always hide you from an enemy that is on the other side of the layer.

TRUTH: The thermal layer is not the "glass ceiling" or "magic shield" that many players believe it to be.

This misconception springs primarily from the behavior of early PC submarine simulation games, in which the acoustic environment was not as accurately modeled as it is in Sub Command. Thermal layers in early sims seemed to behave as a "glass ceiling"; signal strengths would drop significantly as the thermal layer was crossed. This caused many players to believe that this behavior is normal.

For all that, there are no guarantees when it comes to the acoustic ocean environment, just like there are no guarantees when it comes to the weather. How often is the weatherman on TV correct? How many times does he guess? How many times have you heard them predict a foot of snow overnight, and wake up to a mere dusting?

This uncertainty is due to the complex nature of the earth's atmosphere, which is simply a large body of fluid with numerous external and internal forces working to affect it. The same is true of the ocean; you can “predict” the possible acoustic conditions based on the environmental conditions that you measure, but that doesn't guarantee that sound waves will behave in the exact way that you predict. There are just too many variables to be allow for perfect predictions; thus, a layer might exist, but may not be an effective “shield”.

Another reason that the thermal layer is less of a “shield” than many people would like is technology. Current surface and airborne ASW technology allows sonar arrays to shift frequencies and allows some sonar arrays to be deployed at variable depths, destroying the advantage of hiding on the other side of a thermal layer. Additionally, a prudent submarine CO can and will search both sides of the acoustic boundary, if he decides that the layer could be helping to “hide” his enemy.

Even though there are “no guarantees”, the Sound-Speed Profile (or SSP, also known as the Sound-Velocity Profile or SVP) cannot be ignored. It is still the submarine skipper's best estimate of how sound will behave, and is an invaluable tactical planning tool.

The following information has been “borrowed” from the Federation of American Scientists website, from a page entitled “Sonar Propagation”; the entire page can be seen at http://www.fas.org/man/dod-101/navy/docs/es310/SNR_PROP/snr_prop.htm .

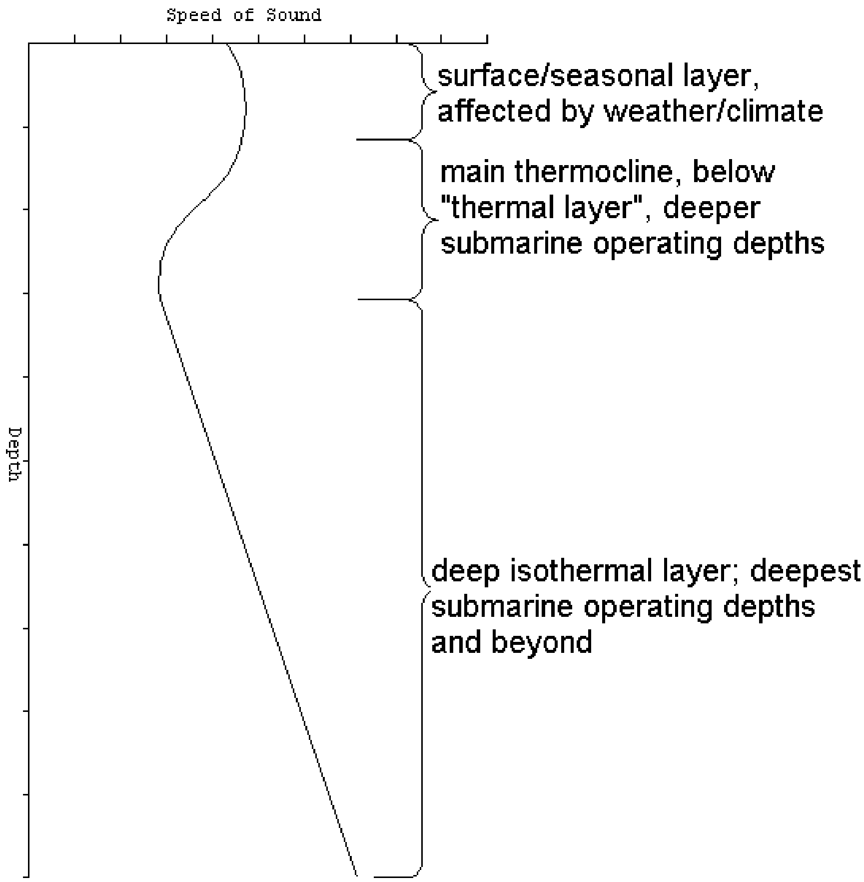
The information presented here is very much condensed from that of the website, and is not meant to provide a detailed tutorial on sound propagation. It is meant as a tactical aid to the virtual submariner.

DEFINITIONS:

- *isothermal:* little or no temperature change with increasing depth; leads to little or no sound-speed change with depth
- *positive gradient:* speed of sound increases with depth
- *negative gradient:* speed of sound decreases with depth
- *boundary:* the depth at which two gradients meet, also known as the *thermal*

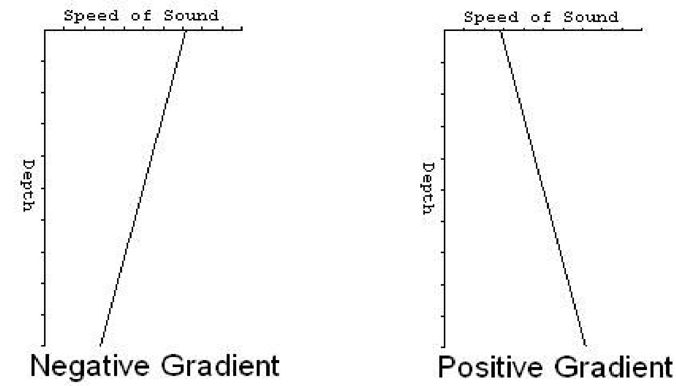
layer, boundary layer, sonic layer

The figure below represents a generic SSP:



According to FAS, beyond 500m (1640ft) depth, water pressure creates a constant positive gradient of 1.7m/s. Of the stock Sub Command playable subs, only the Seawolf and Akula II can safely operate much deeper than 500m; the 688(I) implodes at about 1700ft. Therefore, we will concentrate on the seasonal layer and main thermocline.

The following diagram illustrates both positive and negative sound-speed gradients.

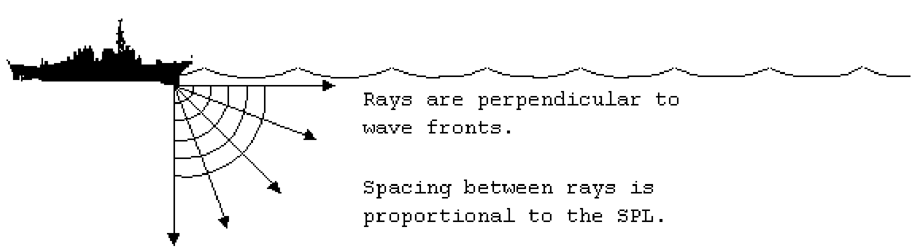


As you can see, a negative gradient is one in which the speed of sound DECREASES with depth, while a positive gradient is one in which the speed of sound INCREASES with depth.

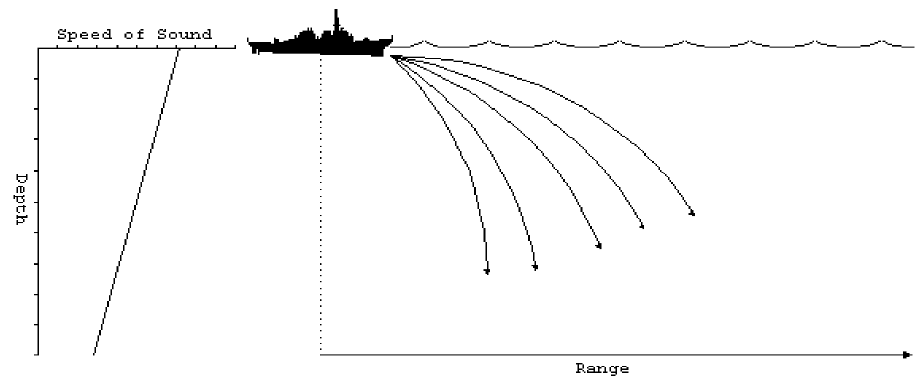
In a Sub Command bottom-limited environment, most often seen in shallow water and littoral (coastal) locations, you will most often see a slight positive gradient. This gradient will be so slight as to be nearly isothermal, or displaying very little change in the speed of sound with increasing depth. Additionally, shallow water locales have notoriously bad acoustic conditions. Ambient noise levels are higher due to wave action, and muddy or sandy sea floors will absorb sound waves, reducing detection ranges to less than 10kyds for submerged targets.

In deeper water and other environments, the gradients on either side of a thermal layer are sharper, leading to more refraction of sound waves, which produce different phenomena.

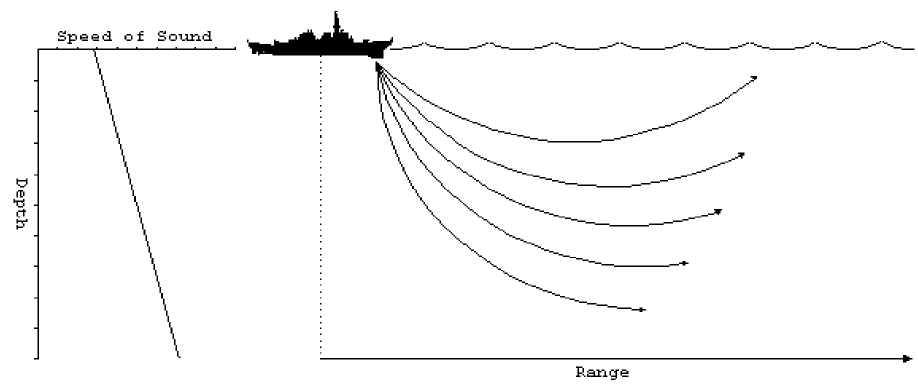
The figure below illustrates how sound waves can be interpreted as “rays” using the “ray trace” technique, which will make it easier to understand the refraction of sound waves caused by gradients.



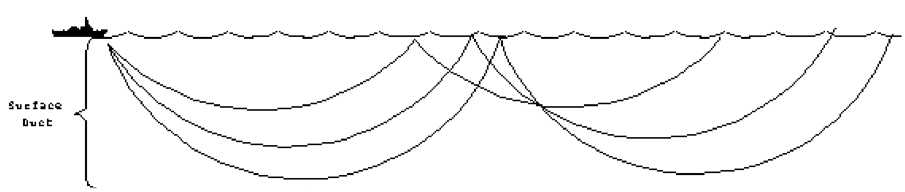
The figure below shows the refraction pattern of a negative gradient.



The figure below shows the refraction pattern of a positive gradient.



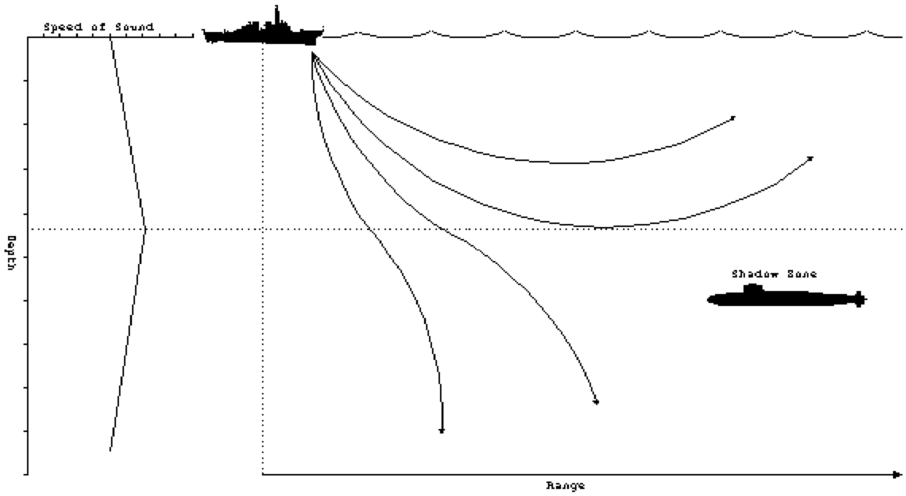
If the water is deep enough, meaning that the sound waves do not strike the sea floor and get absorbed or reflected, the refraction will bend the ray pattern upward, where it will strike the surface and be reflected. Upon reflection from the surface, the refraction will be repeated. This sort of repeated refraction and reflection creates a phenomenon known as a "surface duct", shown below.



Surface Duct Propagation

If a submerged contact exists within the surface duct, and its sound waves do not reach a thermal layer after refraction, it is very unlikely that any of these waves will reach below the layer. A submarine or sensor below the layer will have a difficult time detecting a submarine in the surface duct that is not sufficiently close to the layer.

In the case of a submarine that is close enough to the layer that its sound waves can strike the layer before being refracted upwards, the waves will then be refracted in the by the new gradient in the opposite direction, as seen in the figure below:



Positive Gradient over Negative Gradient, split refraction pattern creates a "shadow zone".

According to FAS:

Above the layer, the positive gradient will produce a surface duct as previously described. When rays penetrate below the layer, they are deflected downward. Therefore, the rays diverge above and below the layer. Beyond a certain minimum range, the rays from the source will never reach locations just below the layer. This is called *the shadow zone.* It is a favored depth for submarines to operate at for just this very reason. The optimum depth to operate at, called best depth (BD), is a function of the layer depth. The best depth can be calculated from

$$BD = 17\sqrt{LD}. \quad if \quad LD < 60m$$

and

$$BD = LD + 60m, \quad if \quad LD > 60m$$

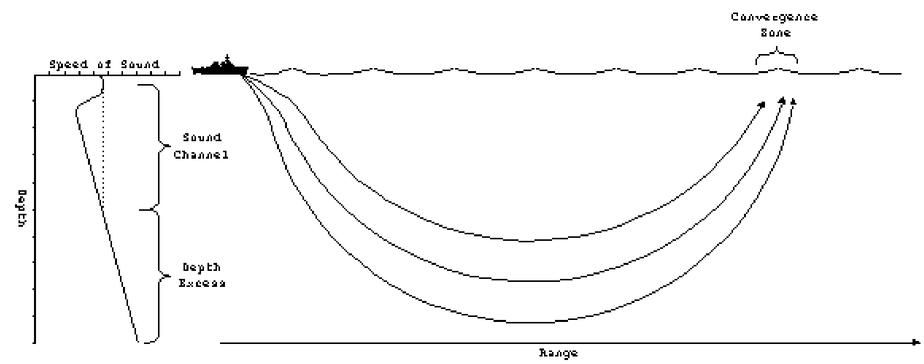
NOTE: 60m = 197ft

From this, it can be seen that, if the layer depth is roughly 200 feet or greater, a submarine could "hide" in the shadow zone, roughly 200ft *below* the layer. This shadow zone is a double-edged sword, in that, in addition to "hiding" a submarine from its enemy, it also could *prevent* the hiding submarine from detecting other contacts.

Experience from playing Sub Command has shown that the shadow zone at LD+200ft is not the only potential shadow zone. Therefore, it is prudent for players to conduct their searches at a variety of depths in order to eliminate the possibility of a missed detection.

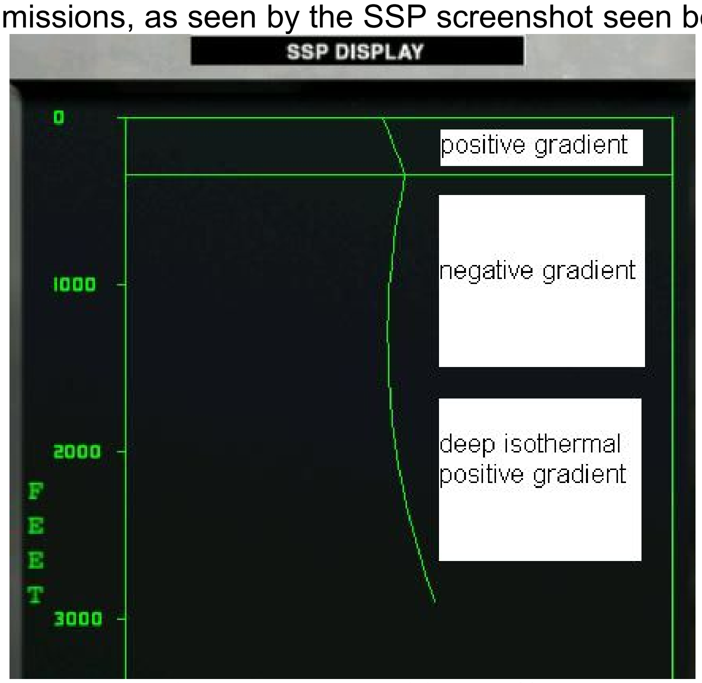
Another significant propagation pattern is the *convergence zone.* This pattern can only occur when the ocean floor is at least 200m (656ft) below the thermal layer, and is caused when the sound waves reach the deep isothermal layer. The positive gradient in this area refracts sound waves upward toward the surface at a long distance from the signal source, which *converge* in a small area at the surface. According to FAS:

> The convergence zone tends to be at large distances, typically 20-30 nm from the source. It is possible to have multiple convergence zones, which will occur at regular intervals. For example, if the first CZ is at 30 nm, the second CZ would be at 60 nm. The CZ is only a few miles wide, and therefore, contacts which are acquired through convergence zones tend to appear and disappear quickly.



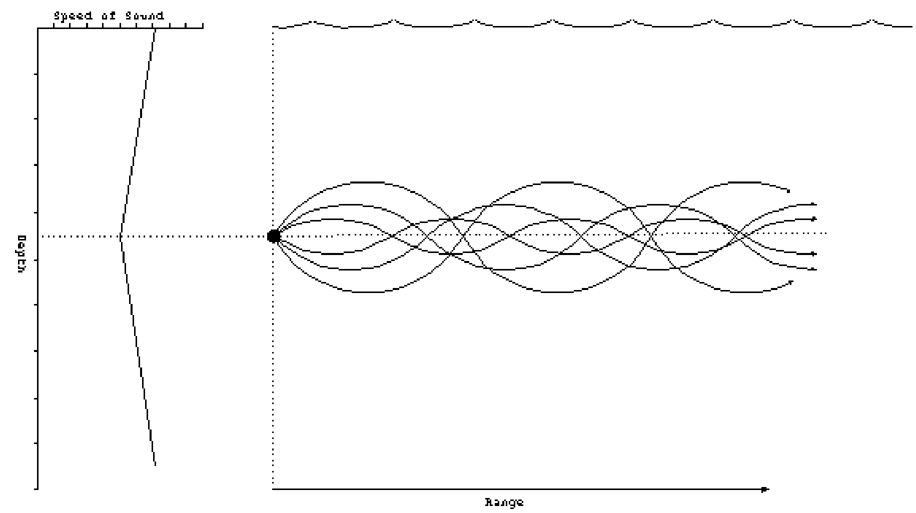
Convergence Zone Propagation

This type of propagation can be set by the mission creator and does appear in Sub Command missions, as seen by the SSP screenshot seen below.



Convergence Zone SSP, 688(I)

A rare case in Sub Command is the formation of a *sound channel,* by the combination of a negative gradient over a positive one. According to FAS, a sound source (submarine), and the sensor detecting it, must be at the axis (or layer depth) of the sound channel in order for one platform to detect another. In any case, this phenomenon occurs most often much deeper than submarines operate, in the area where a negative gradient meets the permanent positive gradient well below 500m (1640ft).



Sound Channel formed by negative gradient over positive gradient

Active Sonar Employment

Active sonar *should* be one of the least-frequently used systems on your virtual submarine, just as in real life. However, there will be times when it is necessary to use active sonar.

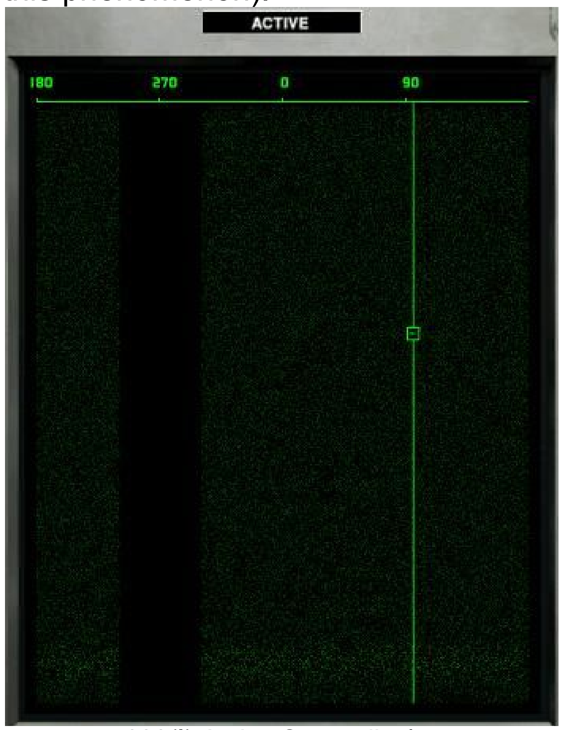
As opposed to passive sonar, which is simply the detection of sound waves emitted by other sources, active sonar *generates* a strong sound signal which reflects, or bounces off of solid objects in the water. The sonar system then listens for this echo, measures the round-trip time of the signal, and displays a graphical representation of range and bearing to all echo returns.

To another platform that is using passive sonar, the use of active sonar is an immediate notification that there is a submarine nearby. The listening platform will know the active platform's bearing, giving it a tactical advantage in that, even if the listener has not yet detected tonals (machinery frequencies) from the active platform, he will still know where to concentrate his search.

Sound waves from an active sonar set are subject to the same patterns of propagation as any other sound waves emitted by a submarine. A positive gradient will refract sound waves up, creating a surface duct if there is a thermal layer present. Active returns from below the layer may not be sufficiently strong enough to be detected by the sonar set. Shallow water has a similarly negative effect on active sonar employment, not only due to the higher ambient noise levels in a shallow water environment, but also due to the reverberation of the active signal from the surface and the ocean floor and the possibility of absorption by the ocean floor composed of mud or sand.

In a multiplayer match, the best time to use your active sonar is immediately after launching wire-guided torpedoes. This will help you to confirm the range to your target, and since you have already revealed your bearing by launching a weapon, the risk involved in using active sonar is now minimal. Be careful in how many “pings” you use to range your target, because your enemy could use multiple pings to get a rough TMA range from multiple pings. Optimal employment of your active sonar is gained by changing your heading to the target's bearing, and slowing to below 4 kts, perhaps 2 or 3 kts. When trying to discern faint returns from the background noise, it's best to reduce your the light level near your PC monitor to a minimum. Also, follow the guidelines in the Passive Sonar section of this manual for optimizing your PC monitor settings.

The image on the next page shows the return of a submerged contact using the Continuous-transmit setting of the 688(I) active sonar, with the range scale set to 40kyd. Notice the bright section at the bottom of the scale, which is at a short range from ownship (1kyd-4kyd). This is the result of reverberation from the water surrounding ownship as well as from the surface (see http://www.fas.org/man/dod-101/navy/docs/es310/asw_sys/asw_sys.htm for more information on this phenomenon).



688(I) Active Sonar display

Akula Active Sonar display

Shown above is the Active Sonar display for the Akula II. The image was taken under the same conditions as the image above from the 688(I). Compared to the image above, it can be seen that the Akula's active sonar set is not as sensitive as that of the U.S. boats. The target designation cursor is positioned right on top of the contact.

MISCONCEPTION: You can always determine the range and bearing to a contact when you operate Active sonar.

TRUTH: You will not always get a sufficient return from a contact to see it on the Active sonar display.

As has already been stated, active sonar signals are subject to the same propagation patterns and vagaries of the ocean acoustic environment as other sounds. An active return is not always guaranteed.

In addition to the "uncertainty principle", there is a *very rare and intermittent* bug in Sub Command in which NO DATA is displayed on the active sonar screen – not even the background noise. If you encounter this during the course of a multiplayer match, you should consider it a simulated "equipment failure". Remember – *this is a rare bug!*

<u>HF Active Sonar</u>

The modeling of HF active sonar in Sub Command is such that it is undetectable by other players or AI units, and as such, is perfectly safe to use. Its effective range is no more than 6kyd (3nm), and therefore is not effective for ranging other submarines in most tactical situations (if your enemy is within 6kyd and you have not already detected him with passive sonar, you are in trouble!). In the forward-looking mode, it is used for minefield avoidance and ice-keel detection; in the upward-looking mode, it is used for determining the thickness of surface ice cover.

The screenshots below show ice keels detected by each of the stock playable submarines in Sub Command.

Ice Keel, 688(I) HF Active Sonar

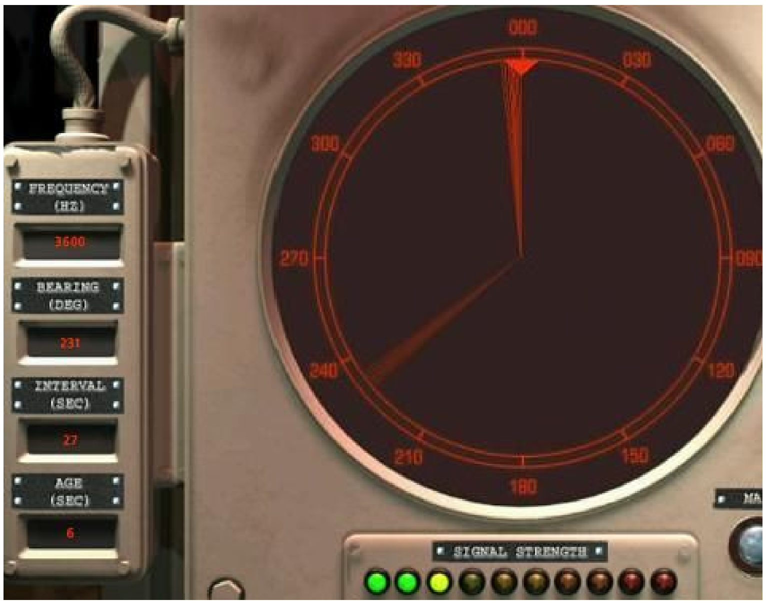
Ice Keel, Seawolf HF Active Sonar

Ice Keel, Akula HF Active Sonar

Active Intercept Receiver

The active intercept receiver detects active sonar emissions from other platforms. In multiplayer matches, you will use it most often to detect the active acoustics from torpedoes, and sometimes from enemy subs. In some cases, if you have been tasked to expect airborne and surface ASW assets, you will also intercept the active sonar from ships and air-dropped sonobuoys. The active intercept receiver's audio can be heard at every station in Sub Command; when heard, this is an indication that you should check the receiver for the bearing to the active emission. Frequencies above 15000Hz (15kHz) are related to sonobuoys and weapon activity. Frequencies below 10000Hz (10kHz) are usually hull-mounted sonars on submarines and surface ships.

The active intercept receiver does not wash out at high speeds, but it does have a baffled area that extends 30 degrees on either side of the stern of your sub. When engaged in a torpedo evasion, you will not hear any active acoustics from inbound torpedoes in the baffled area. This could lead to a nasty surprise if you think you are not being pinged by a torpedo, but instead, it is riding up your receiver baffles.



Akula Active Intercept Receiver.

Given enough data, you can track any platform that emits active sonar, including weapons, using the AI receiver. Using the MARK button sends AI track IDs to TMA, where, using known or estimated speeds, you can obtain a firing solution on an AI track.

<u>UUV Operations in Multiplayer Matches</u>

Current real-world UUV employment is limited to intelligence, surveillance, and reconnaissance; UUVs are not yet intended for active combat operations. However, in Sub Command, the UUV can be a useful tool for multiplayer matches *when properly employed.* Let's start with a list of advantages and disadvantages to UUVs in multiplayer:

Advantages:

- Wider sensor coverage (aperture): Since the UUV can be deployed at a significant distance from ownship, greater sensor separation can be obtained, leading to faster TMA solutions. The point at which ownship's passive sensor bearings and the UUV passive bearings cross is a very close approximation to a contact's range. If you choose to enable the UUV's active sonar, you will get an exact range. *It is important to note that the data from a UUV is presented relative to the UUV and not to ownship.* (See the TMA section for more information on solutions from multiple sensors.)

- Mobility: a UUV can be steered around objects and formations such as shoals and islands, extending your sensor range beyond your line of sight.
- Can be used in torpedo evasion to substitute for washed-out ownship sensors. The UUV's active sonar can be used to pinpoint incoming weapons.
- In addition to being a useful substitute for washed-out sensors, the UUV can be employed as an emergency replacement for failed towed arrays.

Disadvantages:

- The UUV's sensitivity is low compared to the towed array. Combined with its 30-minute battery life and speed of 5 knots, the UUV can only travel 2.5nm (5000yd), which is far enough to increase your sensor "aperture" (as described above), but not far enough to increase ownship's overall sensor range. The UUV would have to be capable of much greater range to make that possible. The towed array is still your best sensor for detecting contacts at long range.
- The UUV's sensor data cannot be viewed on the broadband, narrowband, or DEMON sonar displays. Therefore, accurate classification cannot be obtained with UUV data alone.
- Maneuverability of ownship is limited; an ownship turn greater than 90 degrees cannot be performed while using a UUV without breaking the wire between ownship and UUV.
- Tube-loading a UUV takes up space in a torpedo tube that could be used for a weapon (not as significant when driving the Seawolf or Akula).
- ***A UUV launch creates a torpedo-in-the-water (TIW) report for all platforms within the UUV's line of sight, potentially alerting your opponent(s) to your presence.***

This last point is the most important thing to consider when deciding whether or not to deploy a UUV. If you have not yet been counterdetected, a UUV launch will change the tactical situation drastically, putting you at a tactical disadvantage. In the author's view, this point alone trumps all other considerations for multiplayer UUV employment. However, if you have been counterdetected or even fired upon, you will not significantly increase the danger to ownship by deploying a UUV, with the possible exception of decreasing your maneuverability.

The TIW issue can also decrease your chances of putting yourself in an optimum weapons launch position for contacts you have detected with the UUV by deploying it "around" shoals or islands. If a target that is "behind" an island or shoal detects a UUV, it will receive a TIW report, and may decide to begin torpedo evasion. This may put the target at a greater distance from ownship, requiring you to work harder to put ownship in an optimum firing position. Additionally, although the UUV will report the presence of a contact “behind” an island or shoal, you will have to get “around” the object yourself in order to classify it with ownship's sensors. The contact could be a civilian vessel, and if you launch weapons at it without a proper classification, you may incur non-combatant casualties.

TARGET MOTION ANALYSIS (TMA)

Introduction

TMA is the art-and-science by which incoming sensor data is analyzed in order to determine a contact's range, bearing, and course (and, in some cases, speed). It is simultaneously one of the most challenging and rewarding aspects of playing Sub Command. The reward comes from knowing that your skills and efforts have allowed you to put weapons on target and score a kill.

The challenges of TMA are several; first and foremost is learning to perform TMA. The skills are intuitive for some people, but most people require a lot of practice before they can get their first accurate firing solution. Even experienced players sometimes have difficulty “nailing” a reasonable solution. Another significant challenge lies in the nature of submarine TMA itself; the process often entails determining a target's range and course from only passive bearing and speed information, which is different from other forms of warfare that are based on active sensor data. Finally, the motions of the target itself contribute to the complexity of TMA. If a target changes course or speed during your analysis, you basically have to re-start your analysis from scratch.

MISCONCEPTION: The TMA Auto-crew is more efficient and accurate at determining a firing solution than I am when I am performing TMA manually.

TRUTH: See Below...

The truth is actually a little more complex than simply praising or scorning the use of the Auto-crew. One thing that the TMA Auto-crew (or Otto, for short) excels at is handling many contacts at once in a high-contact-density environment. This is useful both for players new to the sim and to those with experience; players new to the sim will allow Otto to obtain solutions on all contacts, while experienced players will perform manual TMA on contacts of interest (i.e. The enemy!).

The TMA Auto-crew is about 80% accurate, but it has no intuition or experience. It only acts on the information it has available, and even then, it seems to ignore DEMON information completely. With some experience, a player can combine his detection and classification skills, DEMON information, and knowledge of his tactics and his enemy to do things that Otto cannot.

Like most of the aspects of submarining covered by Sub Command, TMA in the real world is much more involved than you see in the sim. Even real-world submariners do not depend completely on their computerized, hi-tech combat systems to provide them with all the answers. They still use low-tech methods like pencil and paper, along with their training, experience and judgement, to obtain firing solutions for their targets. You may not need to use a pencil and paper, but you will need to practice in order to become proficient at TMA.

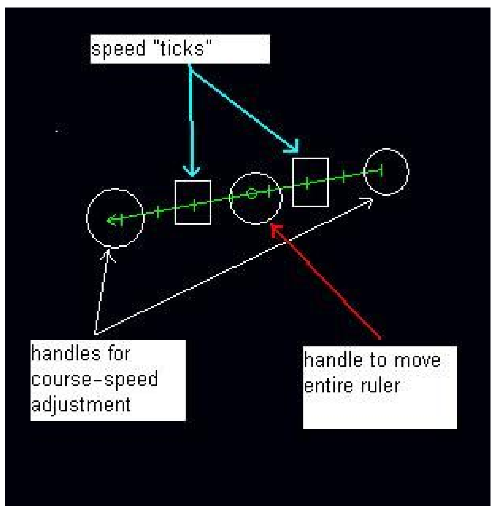
Scope and Credits

The intent of this section of the TACMAN is to introduce some basic TMA concepts, and also how to effectively employ the TMA station in Manual mode. No advanced or paper plotting techniques will be discussed. Some amplifying and advanced information can be found in a file called “target_motion_analysis.pdf”, written by TopTorp92 of the Subsim Radio Room Forums, included in this manual's ZIP package. Elements of this file were referenced in the creation of this section of the TACMAN.

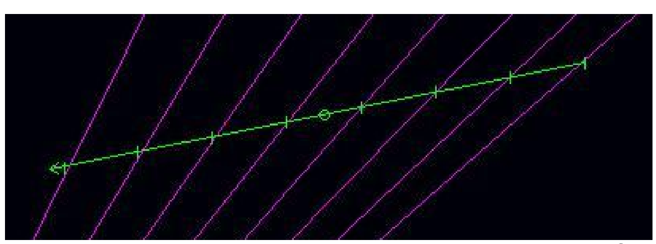
TMA Operations in Sub Command

Manipulating the Ruler

The “ruler” is the green (688(I) and Seawolf) or red (Akula) line on the TMA screen that you will align with the bearing lines you receive from your trackers.



As can be seen in the image above, there is a “handle” on each end of the ruler that allows you to change the direction (target course) and speed of the ruler, a handle in the center of the ruler that allows you to move the entire ruler across the TMA screen, and speed “ticks”, whose spacing along the ruler correspond to the target's speed as set in the SPEED control/indicator at the bottom of the TMA station.



This ruler's speed ticks are aligned with the bearing fan.

Speed adjustment is a critical consideration when manipulating the ruler. If you do not have the SPEED button "locked", as shown below, the ruler will stretch as you adjust the ruler's course, which will throw off your target's speed solution if you are not careful. To prevent this, it is extremely helpful to LOCK the SPEED button at the TMA station if you know, or have a high confidence in, your target's speed.

TMA station "SPEED" control/indicator. The button next to the display "locks" the target's speed when pressed. Speed can be manually entered by clicking on the digits.

If you do not know the target's speed, it can be helpful to leave the speed unlocked so that you can manipulate the ruler to "fit" the ticks to the bearing lines.

You may be asking yourself, "But how can I know the speed, if i don't know the target's classification?" This is an excellent question, but there is a rule-of-thumb for estimating the speed of an enemy submarine.

RULE-OF-THUMB: many submarines in Sub Command have TPK (turns-per-knot) values of 7. If you suspect that you are tracking an enemy submarine and do not have a complete classification, set the TPK at your DEMON station to 7.

As with any rule-of-thumb, this is not always the case; it is just a generalization that can help you when you lack complete information.

The Dot Stack

The whole purpose of being able to manipulate the ruler at the TMA station is to line up the dots on the dot stack, which is in the upper-left-hand corner of the TMA screen. When these dots are lined up on the center line of this display, you have obtained one of the possible solutions for your target.

If your contact is maneuvering or changing speed frequently, it will not be possible to maintain a perfectly aligned dot stack. However, if some of the dots are near (within 1 degree), but not on, the centerline, you can still obtain a reasonable solution.

Initial Estimated Solution

Prior to refining your solution, you will want to at least send an initial solution to the fire control system. This estimate will place the contact "in context" on the NAV map, giving you a rough idea of the contact's range, speed, and course. It will also free you to perform other tasks between tracker updates, such as sonar searching, navigation, and weapons presets. Your estimate can be based on experience, intuition, and an estimate of the current acoustic conditions of the match.

Refining your Firing Solution

The Sub Command manual included on the game CD actually has some good advice for refining your target solution:

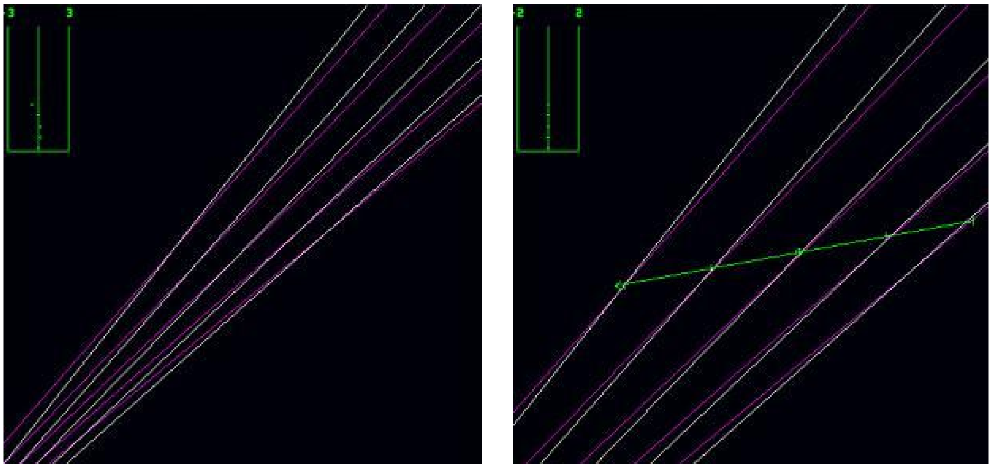
> By changing your ship's contribution to the bearing rate you can mathematically reduce the number of possible solutions for the available data. You do this by changing the course and/or speed of your submarine. The more you change your ship's contribution to the bearing rate, the more dramatic the change in the data. In most cases the leg with the larger bearing rate indicates a lag course. For a broadband contact, this may be easier to see on the sonar waterfall display. If the contact maintains its course and speed and the sonar bearings are very accurate (they may not be for weak contacts), two or three Ownship maneuvers, or legs, will result in a single possible solution if the maneuver produces a moderate change in bearing rate.

You need at least two TMA legs to obtain a workable firing solution. Ownship's heading for each new leg should be a minimum of 30 degrees different from the previous heading; if this is not practical (due to sonar baffles, or heading changes not making significant contribution to bearing rate), you could instead order an increase in speed.

When not operating with Auto-crews, passive sonar trackers send updates to the TMA station every two minutes; excluding the first bearing line from the solution, you will need at least 3 lines, or 8 full minutes of data after assigning the tracker. Subsequent legs can be as short as 6 minutes, which is the time required for three new bearing lines. ***Trackers from active sonar, active intercept, ESM, periscope stadimeter, and radar must be updated manually by pressing the MARK button at each of these stations.***

Merging Contacts from Different Sensors

If you have detected a single contact using two or more sensors, you can more easily obtain an accurate firing solution. The bearing lines from two or more sensors will intersect, and you can place the speed ticks of the ruler right on top of these intersection points. This will refine your firing solution much more without performing additional TMA legs. The reason for this is that TMA legs compensate for the fact that you are usually only tracking a submerged contact with one sensor; when you use two sensors (such as the TA and the spherical array, for example), you obtain sufficient bearing separation between the two sensors to provide you with, at the very least, a well-estimated target range.

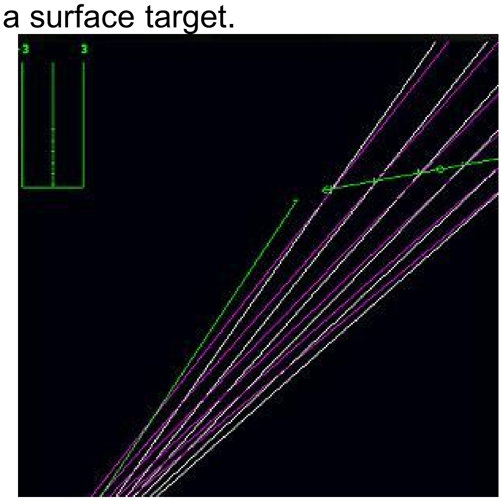


Intersection of bearing lines from the TA and spherical array; placement of the ruler speed ticks at these intersections. Notice the alignment of the dot stack in the image on the right.

In multiplayer matches, you will not likely get close enough to your enemy to detect him on two sensors before he has detected you and obtained his own firing solution on your sub. Therefore, this technique is mostly useful for getting a good solution on surface contacts. This is important if you are conducting anti-shipping ops, or if you are trying to avoid the sinking of non-combatant shipping.

TMA Data from Active Sensors and the Periscope

Using active sensors is a sure-fire way to get yourself counterdetected in a multiplayer match. Active sonar will give away your bearing immediately; radiating your radar is less likely to give you away to an enemy sub, but the possibility exists that your enemy is at PD, listening on ESM. However, if you should decide to risk using active sensors, or your periscope (to obtain a visual range on a surface ship), you can immediately obtain a range with which to refine your solution. This data can be merged with the passive sensor data to form a Master contact. The image below shows the result on the TMA screen of an active ping against a surface target.

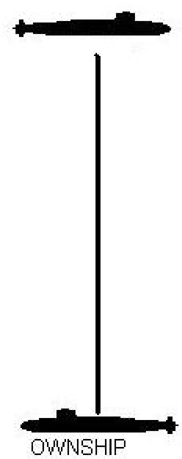


Data from an active sonar ping on the TMA display. The green line stops at the range to the contact; data from radar and the periscope stadimeter will look the same, except for the color of the bearing line.

In order for a NTDS icon of the new contact, gained from an active sensor, to be placed on the Nav map, you must select the new contact in the TMA screen, and press ENTER SOLUTION. If you already know, or have an estimate, of the new contact's course and speed, you should enter these values into their respective digital displays on the TMA station before pressing ENTER SOLUTION.

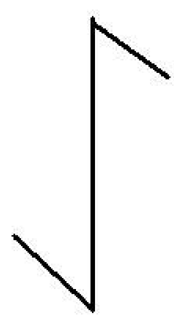
The Line of Sight (LOS)

Also known by some as the “Line of Sound”, the LOS is simply a straight line drawn along the bearing between ownship and the target.



Basic Line-of-Sight (LOS)

The LOS is so important is because it's the basic tool for understanding the relative motion between ownship and the target. However, the diagram above is not complete; each end of the LOS must have a shorter line attached to it indicating the direction across the LOS, as in the figure below:



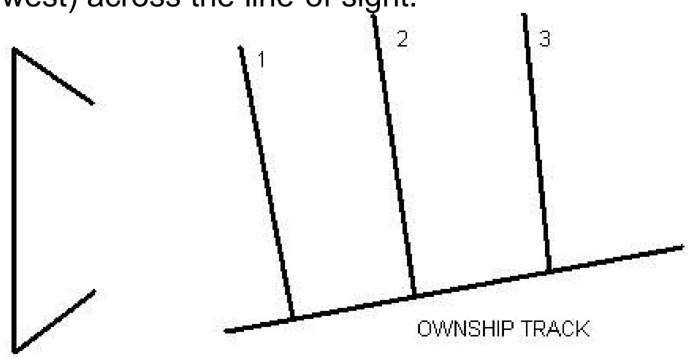
Example of a complete LOS diagram

The orientation of the lines at the ends of the LOS describes the type of LOS situation (ownship is always at the bottom). In the next section, we will discuss several LOS diagrams and how you might see them at the Sub Command TMA station.

<u>Recognizing LOS Situations</u>

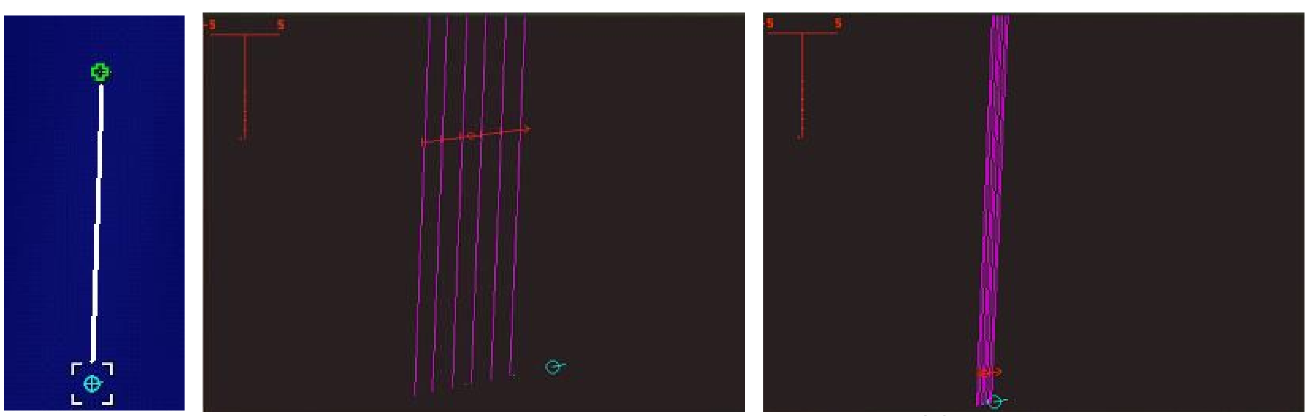
Lead(ing) LOS

A Lead LOS is one in which ownship and the target are both traveling in the same direction across the line-of-sight, at close to the same speed. For example, if the line-of-sight were oriented north-south, both ships would be traveling generally east (or west) across the line-of sight.



Lead LOS, and a geo-plot of a Lead LOS with bearing lines superimposed on ownship's track.

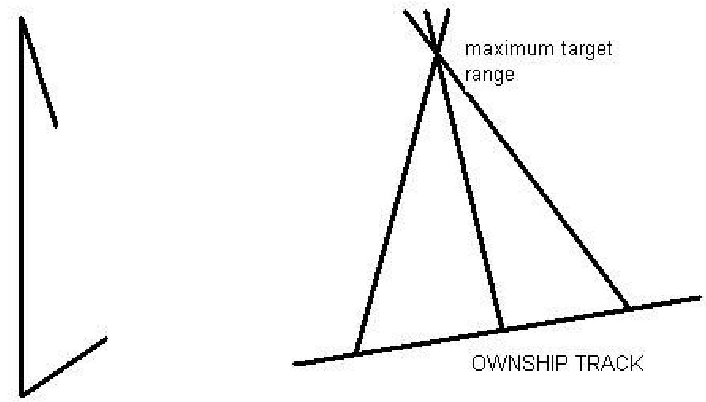
A Lead LOS is not an optimum LOS for determining the target's range; the bearing lines maintain a relatively constant spacing between them. If speed is known and set on the ruler, the ruler “ticks” could line up almost anywhere along the bearing “fan”. The diagram below shows how a Lead LOS looks in the Sub Command TMA display:



Notice that ownship and target are traveling east, same direction across the LOS. Bearing lines are equidistant on the TMA display, even when the display is “zoomed out” very far' the lines never intersect.

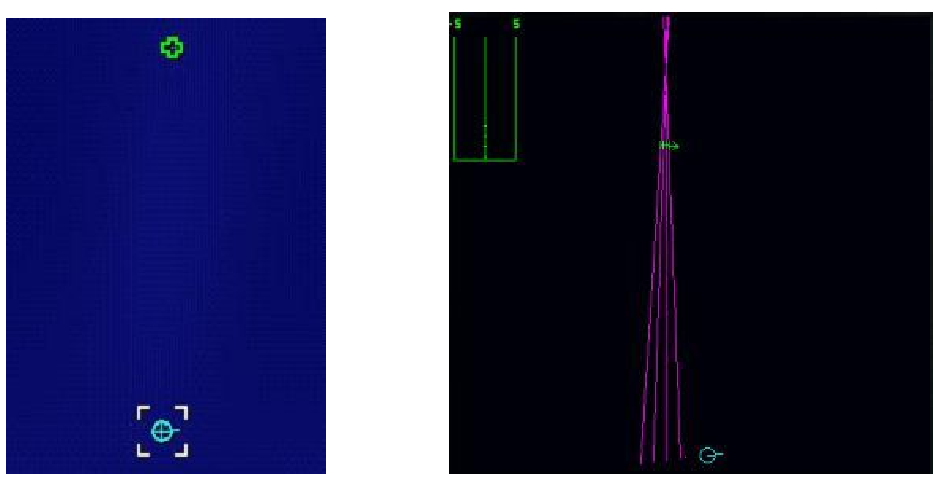
Overlead(ing) LOS

An Overlead LOS is one in which ownship and the target are both traveling in the same direction across the line-of-sight, with the target traveling at a much lower speed. For example, if the line-of-sight were oriented north-south, both ships would be traveling generally east (or west) across the line-of sight at a much slower speed.



Overlead LOS and its geo-plot.

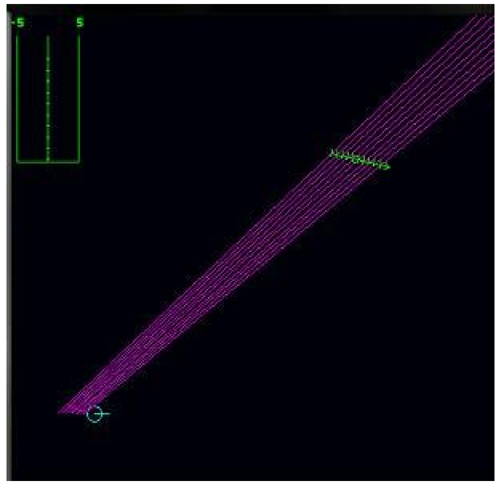
Under an Overlead LOS, the point at which the bearing lines intersect is the maximum possible range to the target. This can allow the operator to estimate speed if it is unknown. Here's how it looks in Sub Command:



Ownship and target both heading east; notice that the target is much slower.

Overlead by Target

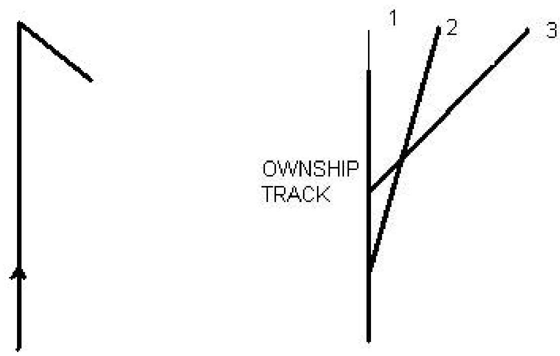
There is a second type of Overlead LOS in which the target is traveling in the same direction but **faster** across the LOS than ownship. In this situation, the bearing lines do not intersect; instead, they spread out as the range from ownship increases. It can be very difficult to get a good solution from this type of LOS. Like the Lead LOS, there are many places along the bearing fan where the ruler's alignment will produce an aligned dot stack. See the image below.



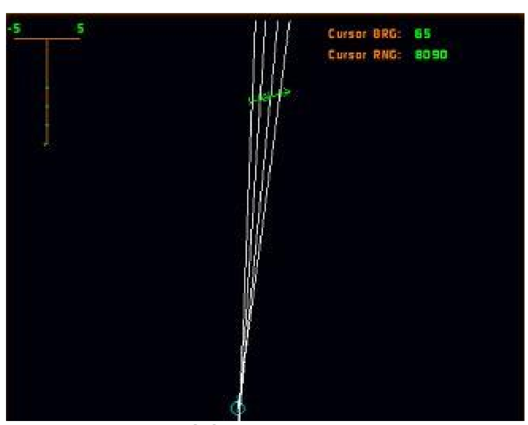
Overlead in which the target is traveling faster across the LOS than ownship.

Pointing LOS

A Pointing LOS is one in which ownship's heading is “pointing” at the target's track, close to perpendicular.

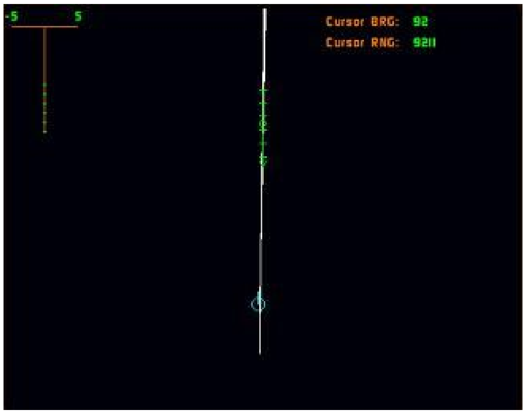


A pointing LOS can be used for determining range, but can lead to an ambiguous course solution. If this LOS is maintained, it presents a risk of collision.



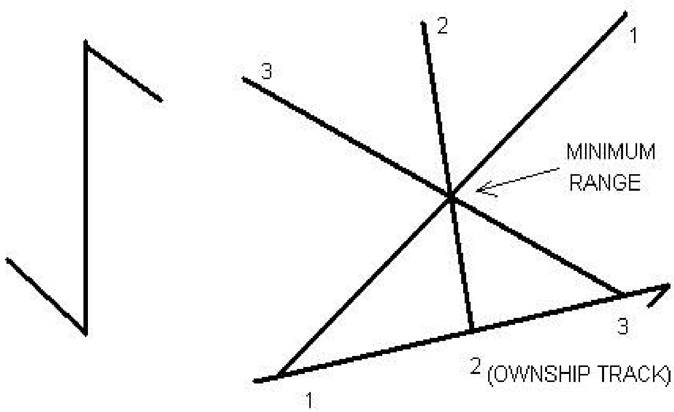
Pointing LOS on the TMA display.

If your TMA display looks like the image below, or one with many lines close together that are difficult to distinguish, both ownship and the target are pointing into the LOS, which indicates a potential collision.

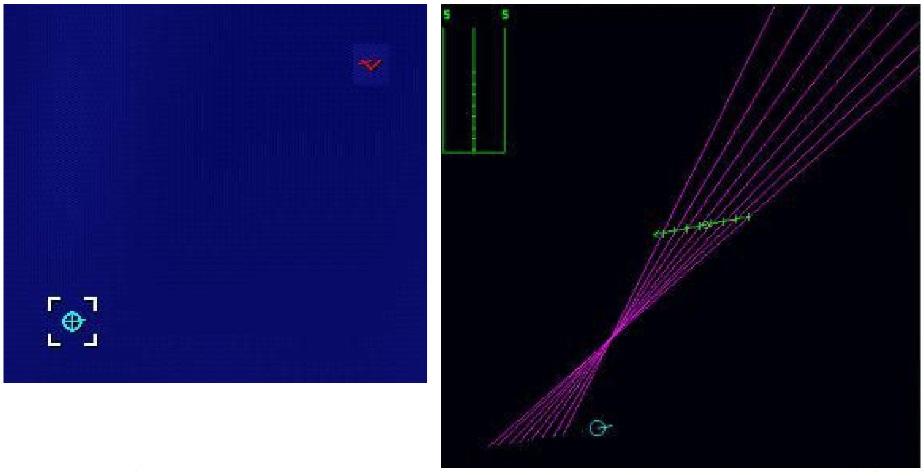


Lag LOS

The Lag LOS is the most optimum for obtaining a solid TMA solution. The Lag LOS is a situation in which ownship and target are traveling in opposite directions across the line-of-sight.



If speed is known, an accurate range can easily be obtained from a Lag LOS. Here is what a Lag LOS looks like in Sub Command (next page):



Ownship and target traveling opposite directions across the LOS.

The Lag LOS is the optimum situation for launching torpedoes; ownship heading in this situation already puts you in a good position to “clear the datum”, or begin to transit away from the position at which you launched your weapons. With any other LOS situation, you will have to change course to clear datum.

The Lines-of-Sight described above do not represent all possible situations you may encounter; they are, rather, “perfect” examples of what you may see in any given match. Changes in the target's course and speed can change the LOS as you are tracking it, which will require you to adjust your TMA accordingly in order to obtain an optimal firing solution.

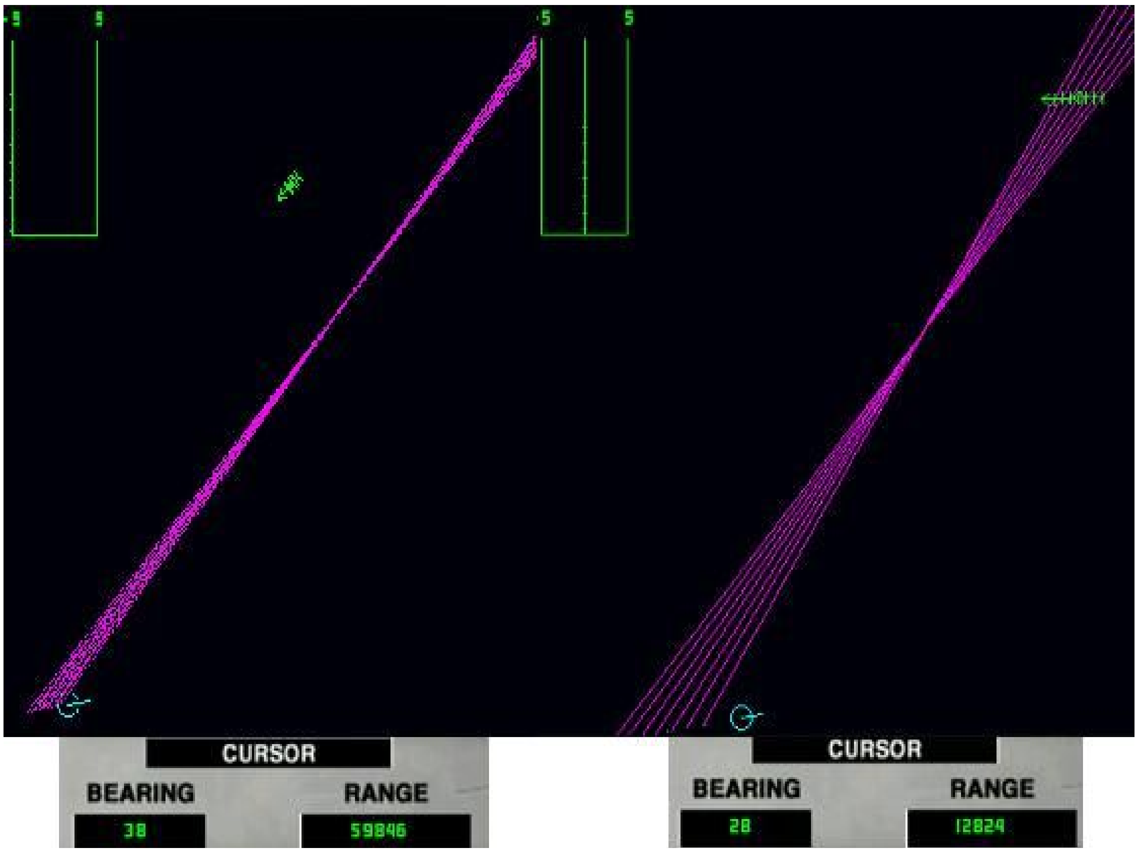
<u>Distinguishing between an Overlead and Lag LOS</u>

The Overlead and Lag lines-of-sight both have X-shaped bearing fans; that is, their bearing lines intersect at a “single” point or small area. As a result, these lines-of-sight can look quite similar on the Sub Command TMA display. To obtain a reasonably accurate solution, you must try to distinguish between the Overlead LOS and Lag LOS.

Intersection Point

As discussed previously, the Overlead LOS intersection point is the maximum possible target range, while the Lag LOS intersection point is the target's minimum possible range. Combined with other information, you can determine if the intersection point for the LOS you are seeing is either a minimum or maximum possible range, and from this, the LOS type.

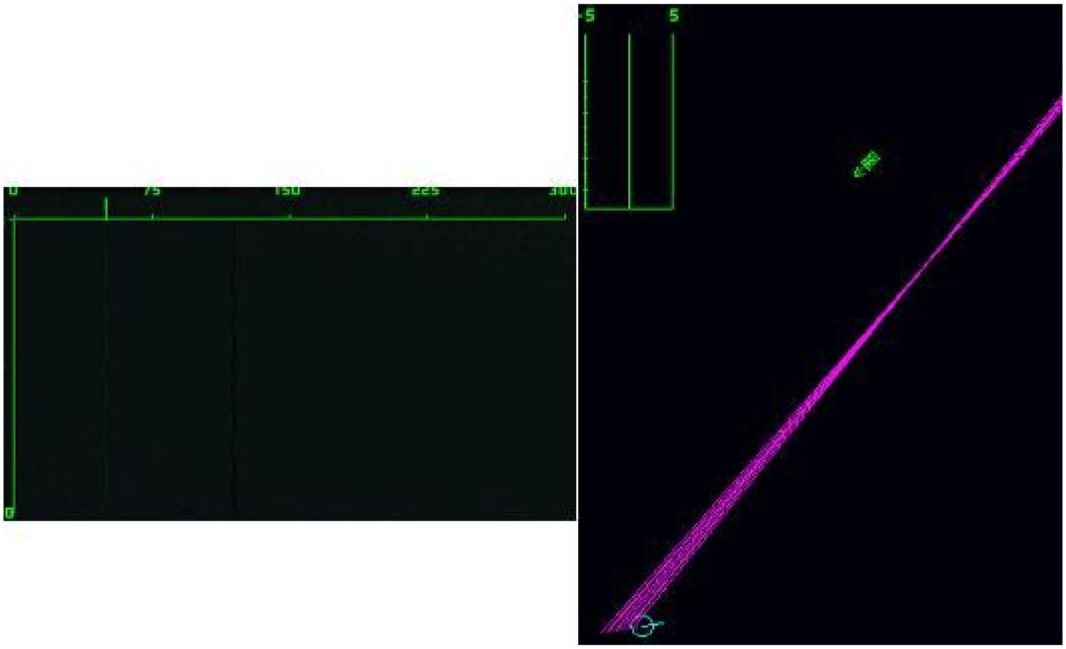
The images below were taken from two separate lines-of-sight. In each case, the subs started off at the same bearing and range from each other and were traveling at the same speed, ownship at 8 knots and target at 4 knots. Notice that the cursor range in the left-hand image (an Overlead LOS), which is the range to the intersection point, is at approximately 60kyd. On the right-hand image, a Lag LOS, the cursor range is close to 13kyd. This serves to illustrate the potential difference in the intersection point between these two different lines-of-sight.



Using Sonar Data to Estimate the LOS

Once you have classified your contact as a POSSUB, you can use that information, combined with the number of frequency lines displayed on your narrowband sonar display, knowledge of the acoustic environment, and the bearing fan on the TMA screen, to determine the type of LOS you are seeing.

It will be necessary to compare the range of the intersection point with the contact's sonar information and acoustic environmental information. If you have a contact classified as a POSSUB with a single weak line on the Narrowband display, and the range of the intersection point is short (< 25kyd, for example), you could reasonably assume that you are in a Lag LOS (25kyd or less being the minimum possible range). Conversely, if you have 2 or 3 frequency lines on the Narrowband display, and the range of the intersection point is long (> 40kyd), you could similarly assume that you are in an Overlead LOS (40kyd or more being the maximum possible range).



This contact displayed 2 frequency lines, and the range to the point of intersection was approximately 60kyd. This LOS could be assumed to be an Overlead.

It can be dangerous to take such assumptions as a “firm” solution. These assumptions **can** be useful in obtaining a rough initial solution. However, it is essential that you refine your solution if you are to obtain an accurate target datum, as described in the “TMA Operations” section above, and in the following paragraphs.

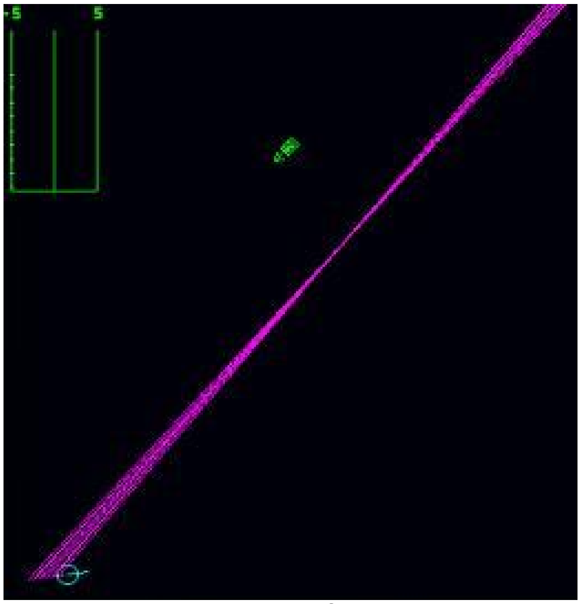
“Nailing” the LOS

Once you have obtained a rough solution estimate and determined a possible LOS, it is time to refine your solution and confirm the LOS. If you are certain that you are in a Lag LOS (which is, as discussed previously, the optimum TMA and weapons-launch LOS), you can make a course change (of at least 30 degrees) or a speed change to obtain a second TMA leg.

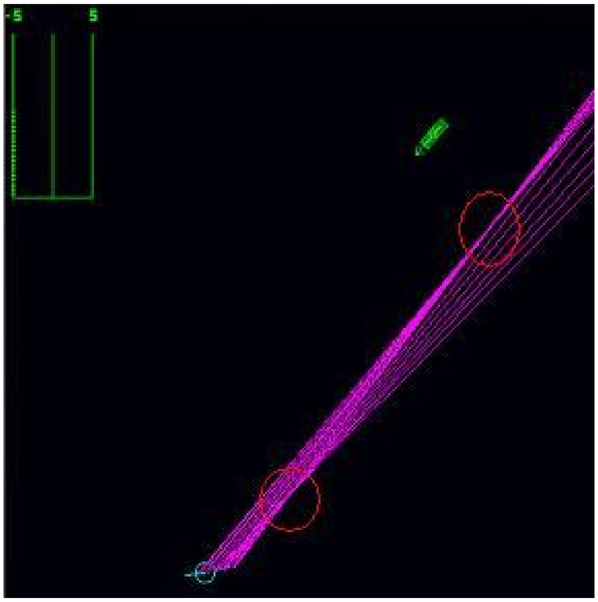
If you are uncertain of the LOS, a course change of 180 degrees will reverse the LOS, turning an Overlead LOS into a Lag LOS and vice-versa. Shortly after your course change, you will begin to see a new intersection point forming.

If the new intersection point is at a **greater** range than the first, you have determined that the original intersection point was the minimum possible range, and that you WERE in a Lag LOS, but are now in an Overlead situation. You should then maneuver to place yourself back into a Lag LOS, but not on the previous heading; your new heading should be at least 30 degrees away from the previous one, and, if possible, in a direction that does not place the contact into endfire (see “Special Situations” section below).

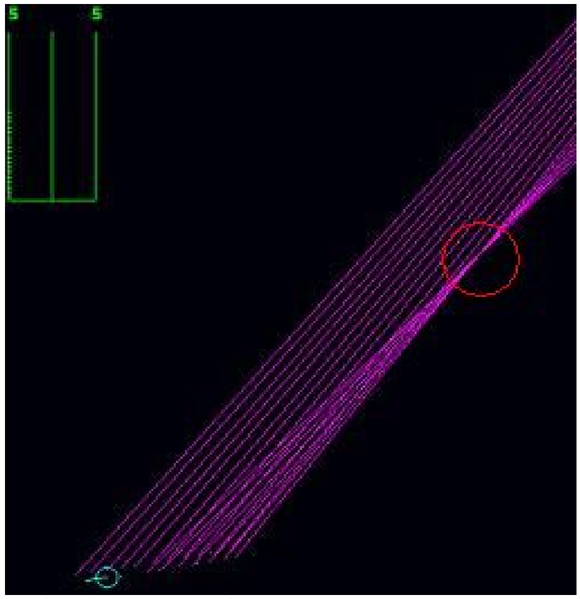
If the new intersection point is at a **shorter** range than the second, you have determined that the original intersection point was a maximum range, and that you WERE in an Overlead LOS, but are now in a Lag LOS. Since this is an optimal LOS from which to determine a target solution and launch weapons, you should stay on or near the new course.



TMA screen prior to refining maneuver.



TMA screen after the maneuver. Notice ownship's course is reversed, and there is a new intersection point at a much shorter range than the original point. This indicates that the original LOS was an Overlead LOS, and that the new LOS is a Lag LOS. The target's range falls somewhere in between the two intersection points.



Close-up view of the new intersection point.

In either case, your target's range has been narrowed down to being somewhere between the intersection points, which places you at an advantage, especially if you know the speed of your contact. The target solution will be much easier to determine with accuracy.

Special Situations

TMA on Close-aboard, Endfire, and High-speed contacts

Close-aboard and high-speed contacts present a target with a very high bearing rate; in this situation, it is difficult to make the dot stack line up perfectly. “Endfire” contacts are those contacts that are close in *relative bearing* to 000 or 180, or off the bow or stern of ownship. The bearing of an endfire contact is parallel, or nearly so, to the axis of each sonar array on board (except for spherical arrays), which makes these bearings somewhat less accurate than they would be if they were close to perpendicular to ownship's heading. A contact can be taken out of endfire by simply maneuvering ownship, when tactically prudent.

In all three of these situations, your TMA will be more of an art than a science, and you will have to make a “best guess”. This includes TMA on incoming torpedoes; if you think you have enough time to perform TMA on a torpedo, you probably don't need to. If you are unsure, your best bet is evasion, not TMA.

Less accurate TMA “methods”

There are some players who prefer to play “fast and loose” with the sim, that do not follow real-world tactical doctrines or TMA employment (of course, it is not possible, within the limits of the sim, to reproduce real-world conditions or tactics 100% faithfully). These players will use high-speed (greater-than-normal patrol speed) legs to generate a TMA solution. While this can be useful, it does present a higher risk of counterdetection. Also, some players will tell you that the intersection of two bearing lines, *the one obtained immediately following an ownship turn with the one immediately preceding the turn,* will immediately give you a good range for your firing solution. This may be true in some cases, but in many cases, it is not. These methods can help if you think you have been fired upon and need a quick solution for a snapshot.

Other Tools

The NAV map can be helpful in trying to determine a firing solution. You can right-click on a contact's icon and select “show history”, which will show the history (in the form of a dot trail) of the contact's movement according to your TMA solution. This can help you decide if your solution “makes sense” according to the tactical situation you see on the map.

WEAPONS EMPLOYMENT

Introduction

The final stage of a multiplayer match is launching weapons at your enemy and ensuring a kill. It is the culmination of all the work you've done at the Sonar and TMA stations.

Although current technology has made submarine weapons very lethal, with advanced homing logic, sensor, propulsion and delivery systems, the arsenal at your disposal is not full of “magic bullets”. Along with your efforts at Sonar and TMA, your employment of proper weapon presets, ship control, and post-launch operator intervention are crucial in placing “ordnance on target” - and avoiding non-combatant casualties.

This section of the TACMAN is devoted to the proper employment of ASW weapons.

The Fire-Control Crew

Sub Command's Fire-Control crew is notoriously inept, whether the Auto-crew is used or not. The Auto-crew invariably enters incorrect presets that will make you wish you had entered the presets yourself. Even if you should decide to enter the presets yourself, if you assign a specific track ID (S01, M02, for example) to the tube, its weapon may go off in a completely different direction than it should. For this reason, unless you are launching wire-guided torpedoes, you should launch the weapons on a Snapshot bearing. If your Mk 48 ADCAP goes astray, you can still steer it back onto a proper course; if a Stallion flies off in the wrong direction, there's nothing you can do about it, and you've just wasted a valuable weapon.

Realism

There are some realism “quirks” in Sub Command that may annoy the hardcore submarine simulator buff.

The first is the torpedo tube operation. On board a real submarine, the tubes are flooded and equalized to sea pressure before launch. Sub Command allows you to equalize your tubes at one depth and travel to another depth without re-equalizing your tubes prior to launch.

Another quirk is that in Sub Command, the torpedo's speed setting has inconsistent effects on its operating range. A torpedo has a limited amount of fuel, so it would be reasonable to assume that the slower it travels, the less fuel it would consume, leading to an increase in operating range. In the game, this is not always the case. Generally, you can expect each torpedo to run out to its maximum range listed in the USNI Reference.

Yet another potentially annoying aspect of the sim pertains to weapon launches. In Sub Command, the launch transient generated by a weapons launch can be detected on sonar (if you know where to look), but it is not announced by the Sonar Crew. The “torpedo in the water” (TIW) report you'll hear is generated by the torpedo's entrance into the water. This is a problem when your opponent has torpedo-tipped missiles like the Stallion; you will not hear a TIW report until the torpedo from a Stallion has landed, which gives you much less time to react than if he had launched a UGST, for example.

Weapons Loadout

The main consideration in selecting your weapons load is mission type. For a pure ASW mission, you should maximize your load of ASW torpedoes and missiles. If your tasking tells you to conduct a land strike, you'll need land-attack missiles like the Tomahawk, SS-N-21, or SS-N-27. Similarly, if you are ordered to attack surface shipping, you might load up on Harpoons, Tomahawk (ASM variant) or SS-N-27 (ASM variant) missiles, although these are more effective against ships that have little or no missile defense capabilities in the game.

Standard Torpedoes

We can define a “standard torpedo” as any torpedo that travels the entire distance to its target underwater. There are two types of standard torpedoes in Sub Command: wire-guided and non-wire-guided.

Non-wire-guided torpedoes are fire-and-forget weapons that travel in a straight line until their onboard sensors begin the homing phase. They cannot be recalled or controlled by the launching platform. The only stock playable sub that carries non-wire-guided torpedoes is the Akula, which carries the 53-65M, 53-65K, 65-76, and Shkval torpedoes. When the guidance wire of a wire-guided torpedo is cut, it becomes a non-wire-guided torpedo.

Wire-guided torpedoes are torpedoes that can be controlled by an operator on board the launching platform after launch by means of a thin cable connected between the torpedo and the submarine. Of the torpedoes carried by the stock playable boats in Sub Command *with the SCXII mod applied*, only two can be wire-guided: the U.S. Mk 48 ADCAP and the Russian UGST.

The obvious advantage to using a wire-guided weapon is the ability of the operator to control it, if new targeting information should become available, or if the need should arise for the weapon to be shut down. One disadvantage to ANY standard torpedo, wire-guided or not, is that the target sub has immediate knowledge of its launch, giving the target the opportunity to begin immediate evasion. In this situation, the capability of wire-guidance becomes extremely useful.

Torpedo Presets

The following images show the preset screen for each stock playable submarine.

Torpedo preset Screens for the Akula, Seawolf, and Los Angeles classes, shown with default settings.

Run To Enable (RTE) Setting

The RTE setting tells the torpedo how far to travel before activating its onboard acoustic sensors (active, passive, or wakehoming). If the RTE is set too long, it will pass the target before the acoustics activate, and it will not acquire the target. If the RTE is set too short, the homing pattern of the torpedo – often a series of S-turns (except for the ADCAP under SCX) – may allow the target more time to escape, since the turns cause the torpedo to travel for a longer period of time before reaching the target datum.

It may seem obvious, then, that you'll want to set your RTE to a range just short of where you think the target is. The question then becomes, “how short?”. One thing to consider when setting RTE is the confidence level you have in your firing solution. If your confidence is high, you might set RTE for as little as 2000 yards short of your TMA range; if it is low, you might set it for as much as 6000 yards short.

One rule of thumb is to set your RTE at 75% of your firing solution range. Below are some examples:

Firing Solution Range:	RTE
10000yd	7500yd
15000yd	11250yd
20000yd	15000yd
25000yd	18750yd
30000yd	22500yd
35000yd	26250yd
40000yd	30000yd

As you can see, at firing solution ranges over 20kyd, the difference between your TMA range and the 75% RTE rule can be greater than 6000 yards, which may be less than optimal. Therefore, a second rule-of-thumb can be employed; whenever your firing solution range is greater than 20kyd, set your RTE to 5000 yards shorter than solution range.

RTE setting is, in reality, a judgement call made by each individual skipper depending on the tactical situation. If your confidence in your firing solution is low, you might want to stick to the 75% rule. You might even come up with your own “rule”, or use a compromise between the 75% rule and the 5000 yard rule. In any case, it's better to err on the side of a shorter RTE, rather than one that is too long.

Setting the Floor

The FLOOR setting is the maximum depth to which your torpedo will travel after it has enabled. The torpedo may still detonate if it acquires a target below the floor setting, but this is rarely a consideration in multiplayer matches.

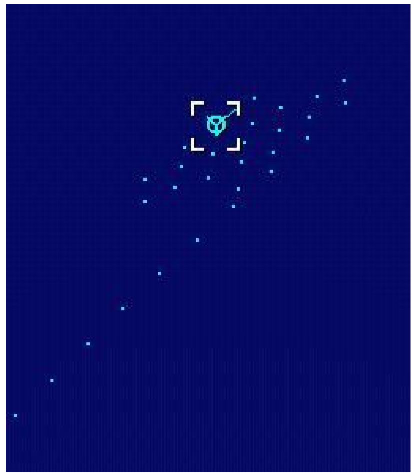
There are two very important considerations involved in setting the floor. The first is hydrographic; if the sea bottom in your combat area contains many depth variations, it is prudent to set the floor at about 50 feet (16m) above the shallowest sea-bottom depth. This can help to avoid sending your weapon “into the mud”, or into the sea bottom, in which case, it is lost.

The second consideration comes into play when the sea floor level is not important (when it's deeper than 3000 feet or 935m, or relatively flat). The default settings for the torpedo's floor are far too shallow to allow the weapons to reach the deepest operating depth of the playable submarines. Therefore, it is important to set the floor to its maximum depth, to give your weapons a better chance of destroying your target.

Setting the Ceiling

The CEILING setting is the minimum depth to which your torpedo will travel after is has enabled. The torpedo may still detonate if it acquires a target above the ceiling setting.

The above statement is critical. The ceiling is extremely useful in avoiding non-combatant casualties, and you might think that you could set it to 100 feet (31m, above which few submarines operate in multiplayer) and be safe from sinking a supertanker in the vicinity of your target. However, testing with the Mk 48 ADCAP against a deep-draft ship has shown that, to avoid sinking surface traffic, ***the ceiling must be set to no shallower than 170 feet (53m) in order to avoid an inadvertent sinking of non-combatant surface vessels.*** When set to 170 feet, an enabled torpedo will pass under a surface ship without detonating. It will then try to reacquire the surface ship. If you see your torpedo performing sharp zig-zags in a certain area, you can assume that it has acquired a contact that it cannot attack because of its ceiling (or even floor) setting.



A torpedo zig-zagging to reacquire a target above its ceiling, shown on the NAV map with "Show History" enabled for the torpedo.

There is a disadvantage to using this tactic. If your opponent is aware of your propensity to set your ceiling so as to avoid sinking non-com traffic, he may "hide" above 170 feet (53m). That's why it is important to drive your boat into a position from which you can fire at your opponent without high risk of civilian casualties, and also to practice your TMA so that you can obtain accurate firing solutions. However, no matter how good you are at these two things, there will be situations in which you *must* set the ceiling to a surface-friendly depth.

Setting the Depth

The DEPTH preset is the depth at which the torpedo will search *after* it has enabled, therefore it is often called *search depth*.

The statement above is critical. *Prior to enabling, the torpedo will travel at the depth from which it was launched!* This is very important to consider when you are operating in shallow water or in the vicinity of a sea floor with widely varied depths.

The search depth preset can be useful in an acoustic environment in which the thermal layer is very strong or pronounced. In such an environment, the torpedo's active homing may not penetrate the layer, or active returns from the target may not get back to the torpedo's receiver. In this case, it would be prudent to launch a pair of torpedoes, one with a search depth above the layer and one with a search depth below the layer.

Setting the Speed

There is rarely a reason to set a torpedo's speed below its maximum capable speed, unless you plan to set its acoustic mode to PASSIVE, in which case, you should set it to 40kt or less. As you would expect, the torpedo's maximum speed gives your target less time to evade.

Setting the Acoustics

There are two main acoustic modes for Sub Command torpedoes: Active and Passive. Some torpedoes also have a wakehoming mode, but this is for use against surface targets, and is ineffective against submarines.

In active mode, the torpedo emits a “ping” signal, and listens for a return, which gives the torpedo the target's bearing and range. After several such pings, the torpedo knows the target's relative motion and will compensate by changing its intercept course. This is THE most useful torpedo acoustics mode against other submarines. Since submarines are quiet under most conditions, an active search is the best way for the weapon to locate and intercept the target.

In passive mode, the torpedo homes in on a target's radiated noise. For this to be an effective method against a submarine, the target sub must emit much more noise than it does under normal conditions. In Sub Command, this means that *the target must be cavitating*. Testing has shown that unless a stock playable sub is cavitating, a passive torpedo will not acquire it.

A potentially successful tactic employing passive torpedoes against a submarine is to launch an active torpedo below the thermal layer, and a passive torpedo above. If the target sub goes shallow enough, its evasion speed may cause it to cavitate, allowing the passive torp to home in on it. Shallow water operations can also lend themselves to successful passive torpedo employment; since the target sub cannot go deep, he is forced to cavitate during evasion.

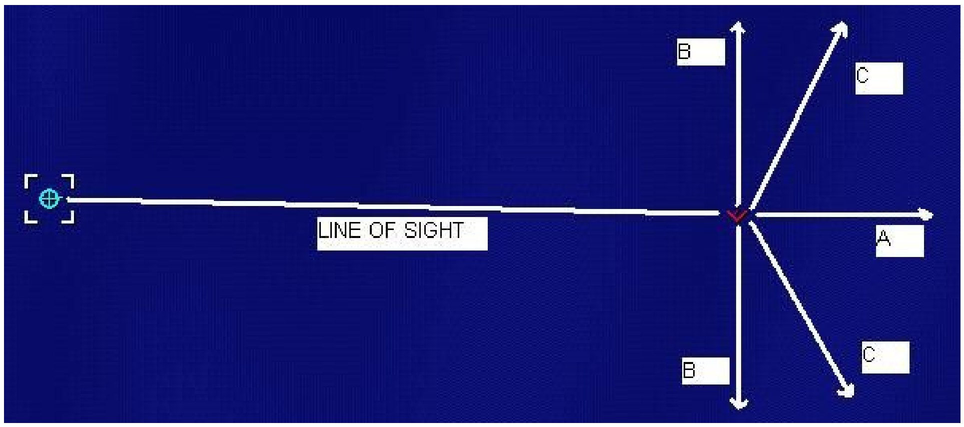
<u>Torpedo Salvos</u>

An experienced – or lucky - skipper can sink an enemy sub with a single torpedo. Even so, it is not unreasonable to launch a spread of two or even three torpedoes at a submerged target, especially given the uncertain nature of submarine combat. You can't see what your target is doing, the environment may have an effect on your weapon's acoustics, the target may have successfully “spoofed” a torpedo with countermeasure decoys – all of these are valid reasons for launching more than one weapon.

The question then becomes: “How many is too many?” or “How much is enough?” Some less experienced players, or players less interested in realism and more interested in the instant gratification of a loud, booming kill, have no compunctions about firing 5, 6, even 8 torpedoes in rapid succession at a *single* target! There is very little challenge to such a tactic, and very little realism.

Discussions with real-world submariners have revealed that a two or even three-torpedo salvo is an acceptable tactic in submarine warfare. Employment of a salvo instead of a single torpedo is especially valuable when using non-wire-guided torpedoes, but users of wire-guided torps can also benefit from salvos. The combined benefits of the ability to control one's weapons after launch and having multiple weapons in the water increase your chances of a kill.

It is not enough to fire multiple weapons in order to have a successful salvo. Because your target, if he wants to remain alive, will attempt to evade your weapons, three torpedoes launched along a single bearing will not have much more probability of a kill than a single torpedo. Therefore, it is necessary to have a brief discussion of torpedo evasion. The picture below presents several possible basic evasion courses for your target.



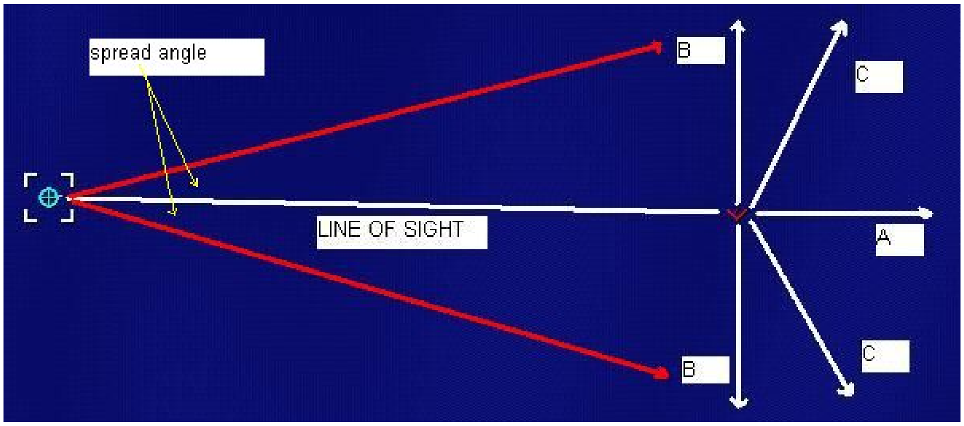
Course A is a straight-line evasion directly away from the incoming weapons. Only a very foolish skipper would use this tactic, because he has very little hope of outrunning a modern torpedo in a straight-line chase.

Course B, a 90-degree evasion from the line-of-sight (LOS), is a good tactic, because it will take the target out of the acquisition cone of a torpedo traveling along the LOS, if performed at sufficient speed. The downside to this course is that it does not open the range along the LOS between the shooter and the target. If the shooter is using wire-guided torps, and is able to track his target's movements (i.e. not running from the target's snapshot), he can easily turn the torpedo to intercept the target, possibly even putting the target into the undesirable position of being in a Course-A tailchase.

Course C is better than Course B. It puts the incoming torpedo at about 120 degrees from the target's bow. It has the advantage of taking the target out of the acquisition cone of a torpedo traveling along the line-of-sight (LOS), along with the added benefit of opening the range along the LOS between the shooter and the target. There is still the possibility that the shooter is tracking the target's movements and will re-steer a wire-guided torpedo to intercept, but the shooter's job is more difficult now due to less bearing change and a longer range to the target.

Salvo with Two Torpedoes

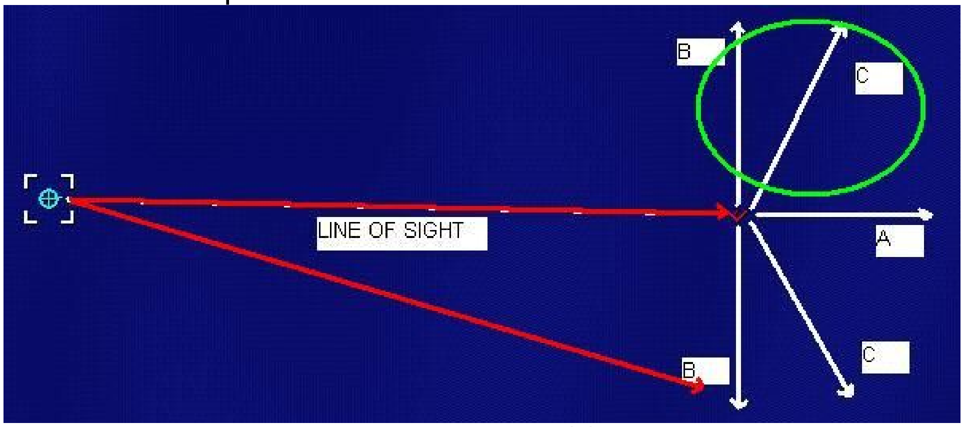
Next we will examine a two-torpedo spread, aimed to cover the target's possible evasion courses.



Two torpedoes, launched at an angle to the LOS.

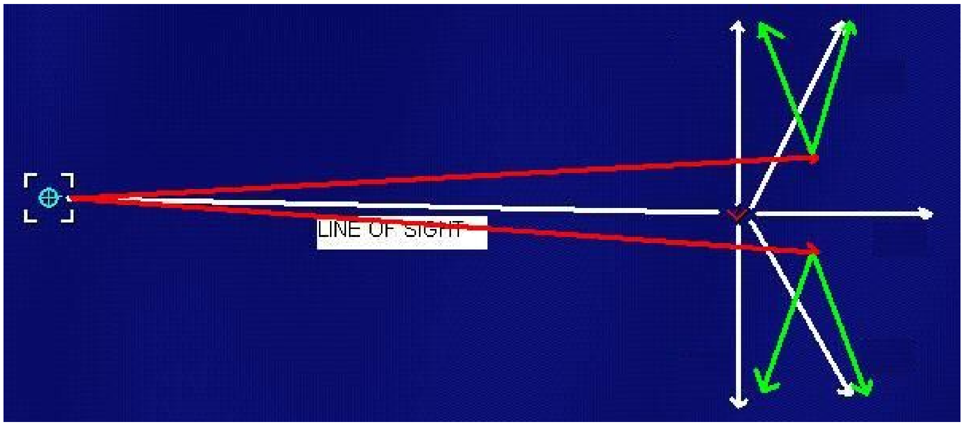
This tactic works if the target does not examine the bearing drift of the incoming weapons and discover that he can just evade directly down the LOS. Many skippers will not take the time – or will not think they have the time – to check on the bearing drift. In many cases, they'd be correct. However, a quick check of the broadband sonar display might reveal the drift, and allow the target to escape.

Other two-torp spreads are possible. The skipper might launch one down the LOS and the other to cover an evasion course, but this would leave one evasion course wide open.



Two-torpedo spread with one torp launched on the LOS. The target can easily evade north.

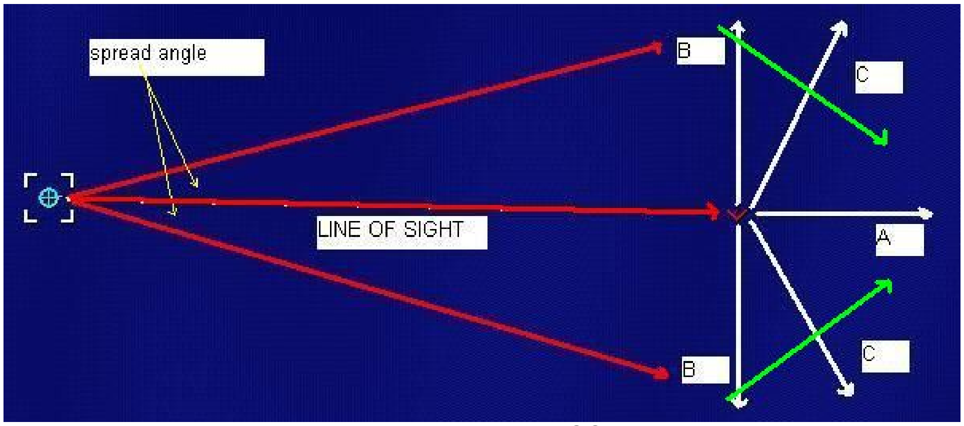
A better method would be to launch the two torps with a small angle to the LOS rather than larger angles. This way, each torp can cover the areas *between* the LOS and the evasion courses. Additionally, if they are wire-guided, it will be much easier for the shooter to steer them to intercept the target; they will have less distance to travel to intercept than if they had been launched at larger angles to the LOS.



Two-torp spread at small angles to the LOS. The torpedoes can easily be steered to either intercept course with less distance to cover than if they had been launched at larger angles to the LOS and had to be steered back towards it.

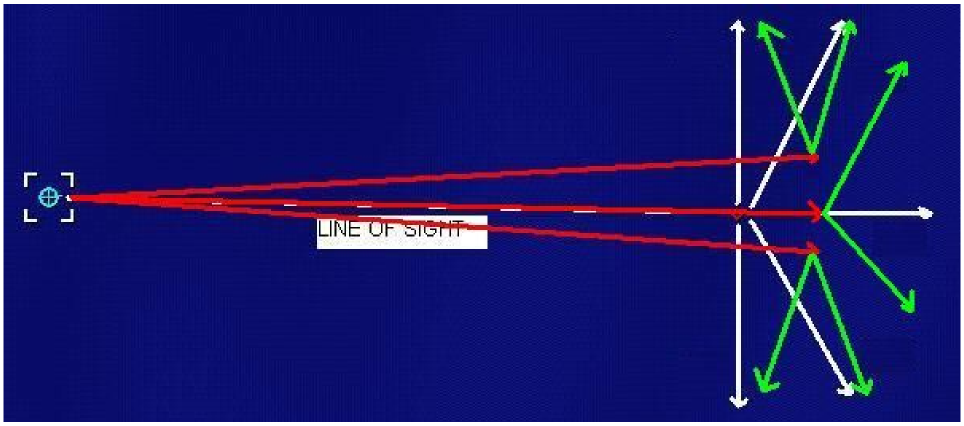
Salvo with Three Torpedoes

Here is a basic three-torpedo spread. Notice that it covers the LOS as well as the evasion courses. The possible re-steering legs are once again represented in green.



Three-torpedo spread, with one launched along the LOS and two at large angles to the LOS.

Next is the small-angle three-torp salvo. Again, we see the benefit of a shorter distance for re-steering to intercept, as well as the possibility of re-steering a second torp in the same direction as one of the others, improving the chances of intercept.



Spread Angle to the LOS

So far, we have talked in general about the torpedo's angle to the LOS, but we have not specified any angles to use. Let us consider the case of a three-torp spread using non-wire-guided weapons. If you were to launch your weapons assuming that the target will evade at a flank bell at Course A (90 degrees to LOS), you would want a spread angle that would allow your weapons to intercept the target along that course.

A set of calculations, not to be described here, will show that for an evasion by the target at a 90 degree angle to the LOS, the spread angle depends mostly on the weapon's speed, and not the target's (unless the target moves much slower than a flank bell). The table below lists the spread angles you would use to cover the evasion courses.

Torpedo Speed (kt)	***Salvo Spread Angle***
200 (Shkval)	8
70	24
65	26
60	27
55	29
50	31
45	34
40	37
35	41
30	45

These angles from the LOS are the *maximum* spread angles you will want to use in any situation. Larger angles will greatly reduce your probability of intercept.

The use of smaller angles will probably be more effective, and the angle you'll use is a matter of judgement. If you decide to launch at a smaller angle, take the angle corresponding to your weapon's speed and cut it in half, or perhaps one-third.

Salvo Summary

The type of salvo you'll use depends somewhat on what type of weapon you will be using against the target. When using wire-guided torpedoes, a two-torpedo salvo can be as versatile and effective as a three-torpedo salvo, simply because you have the option to steer your weapons when you obtain additional target data; even one torpedo, under the control of a skilled operator, can be enough for a kill. However, when launching non-wire-guided weapons, the three-torpedo salvo has a better chance of intercepting the target than the two-torp spread.

Which salvo you'll use also depends on what kind of boat you're up against. If you are battling a Seawolf, you'll want more chances to intercept him with your weapons, because one or more of them may be spoofed by the Seawolf's generous loadout of countermeasure decoys. Even skilled drivers of the 688(I) and Akula, with smaller countermeasures loadouts, can perform evasions more complex than the basic evasions shown above, laying decoy “screens” and zig-zagging to stay behind them. This argues for the use of a multi-torpedo salvo.

Clearing the Datum

This phrase sounds like technical jargon, and it is. What it means in plain English is “getting away from where you are”. The datum is the position, course, speed and depth from which you launched your torpedoes. It is very important to clear datum once you have launched standard torpedoes, because your enemy, at the very least, now has your bearing, which is all he needs to get off a snapshot at you.

Clearing the datum begins during the final TMA phase, when you attempt to put your target on a Lag LOS (see the chapter on TMA). A Lag LOS puts you in the position to open the range between you and your target. At this stage, you can begin planning a course, speed, and depth that you will take to clear datum once you have launched your weapons. It will be much easier for you to put a possible enemy snapshot at 120 degrees from your bow (see Torpedo Evasion section) when you have put your target on a Lag LOS and planned in advance the general direction in which you will clear datum.

Wire Guidance

The benefits of wire guidance (WG) over fire-and-forget (FAF) torpedoes have already been discussed. Guiding a torpedo is very basic, from a control point of view. Figuring out which way to steer your torpedo is more involved, and will take you back to the Sonar and TMA stations.

The Wire Guidance systems for each playable sub have the same controls.

WG Controls

ENABLE: Activates the torpedo's acoustics.

PRE-ENABLE: deactivates the torpedo's acoustics and returns the torpedo to its speed and depth at the time of launch.**

SHUTDOWN: Shuts the torpedo down entirely.

HEADING: actually steers the torpedo. Left arrow turns the torpedo left by 5 degrees, right arrow turns it right by 5 degrees, *as measured from the torpedo's heading.* This is important; a target that bears 090 from ownship might bear 045 from the torpedo, therefore, you would steer the torp to 045, not 090.

That was the easy part. Now consider this scenario: You've just launched a two-torp spread at your target, and your confidence in your TMA is moderate. Your target returns fire. Now you have to clear datum, and probably evade. Right around the time and place that your torps were supposed to intercept the enemy, there's nothing... no explosion reported. Well, you think, that's no big deal, let's give the fish a few minutes to snake and see if they snap up the target.

Well, they don't. Your options are to evade at maximum speed, or slow to reacquire the target and steer your torpedoes. Today, you're sufficiently confident that you can slow to re-steer and still escape with your skin intact.

Slowing to less-than-evasion speed can be a dangerous proposition, and if you had to reel in your towed array to evade, you'll spend even more time at such a speed while your re-deploy it, increasing your risk of getting killed by the enemy's torps. You will want to slow down to a speed that allows you to detect your target, but doesn't keep you near the enemy's searching weapons, perhaps 12 to 15 knots. As soon as your TA is redeployed, you must attempt to reacquire the target on sonar. A quick look at the DEMON can tell you if your sonar has regained contact; you can then go to Broadband or Narrowband sonar and use the “Tracker Review” button to quickly get the target's new bearing. Now you can begin steering your weapons.

If you feel confident enough, you can stay at your reacquisition speed for several minutes and try to get a rough TMA estimate of where your enemy has evaded. This will help your wire-guidance process, but it's very risky. Even more risky, but more helpful, would be to slow down enough to use your active sonar to pinpoint the enemy's exact position. Slowing down is not the only risk involved in this proposition; your enemy can use the bearing of your active ping to re-steer his own weapons toward you.

This point bears repeating: the heading of the torpedo *is measured from the torpedo, not from ownship!* You must remember this when re-steering, because if you don't, you may just be re-steering your weapon away from the target.

One of the most helpful tools you can use when steering weapons, or even when tracking contacts, is the “Show History” feature on the NAV map. This feature can only be enabled on a track-by-track basis by right-clicking on the contact's track ID icon and selecting “Show History”. You will see a series of dots describing the contact's - or weapon's - movement since the start of the match (or since weapon launch). If a torpedo is enabled and seeking, you may see a “snake” pattern, or a series of S-turns; if it has acquired a target, it will travel in a straight line.

Steering Under Different Modes

The best mode under which to steer a torpedo is when it's pre-enabled. The torpedo will always go where you order it. If you steer a torpedo while it is enabled, it will not always do this, especially if it has acquired a target. This can be useful in determining if you have indeed acquired *your* target. You must be careful with this; the torpedo may have acquired an unintended target. If you just let it go, thinking you've “nailed” your enemy, you might find yourself sinking a non-combatant.

Malfunctions and Mistakes

Sometimes, the guidance wire on your torpedo will break, and sometimes it won't. It would be reasonable to assume that high speed and sharp turns by ownship would break the wire, but this is not always the case. Most of the time, you can run at a flank bell and change course radically and not break your wire. Sometimes the wire just breaks for no apparent reason. You should just interpret this as simulated equipment failure.

You *WILL* lose the guidance wire if you shut the torpedo tube muzzle doors while you have a torpedo in the water. The disadvantage to this is obvious if your torpedo has not acquired the target and you still need to steer it. Less obvious is the situation in which you have already killed your enemy, and need to shut down the torpedo before it kills an innocent cargo ship. *ALWAYS* go to the wire-guidance screen and *SHUT DOWN* your torpedo before shutting the tube muzzle door!

The Shkval Supercavitating Torpedo

The Akula and Akula II submarines are equipped with the Shkval supercavitating torpedo. This weapon can travel at 200kt for 6nm (approximately 12000yd or 12km). It is not wire-guided and has no acoustical homing sensors, but it does have a proximity MAD (magnetic anomaly detection) sensor that will sense its target's magnetic field and explode nearby.

This weapon is excellent for short-range and/or snapshot situations. Its high speed allows the target less time to evade, and its proximity sensor allows the weapon to inflict damage from indirect hits. However, its short range limits its tactical usefulness.

If you plan to launch a Shkval, it is prudent to launch 2 or 3 with varying depths. The proximity of the weapon to the target determines how much damage it will do, and a Shkval launched at the default depth of 60m (192ft) will not be effective against a deep-diving submarine. You should be familiar with the ocean environment of your combat area, and plan your “depth spread” accordingly. For example, in an environment in which the sea floor is greater than 2000 feet (625m), you could launch 3 Shkvals at depths of 500, 1000, and 1500 feet (156, 312 and 469m).

ASW Missiles: The Stallion (SS-N-16) and SS-N-27

The Akula and Akula II submarines are capable of carrying the SS-N-16 Stallion and SS-N-27 ASW missiles. Each missile carries a lightweight torpedo (Stallion carries the E45-75A, SS-N-27 carries the Type 40) that is dropped into the water at the end of the missile's flight.

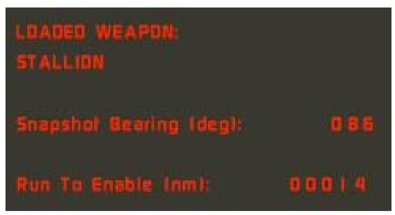
These missiles offer distinct tactical advantages. The most obvious is their speed. The Stallion travels at 1010kt, and the -27 travels at 1675kt, allowing them to drop their torpedoes in the immediate vicinity of the target in seconds rather than minutes. A less obvious advantage is their stealth against submerged targets, which is a realism issue in the game. Due to the lack of launch-transient announcement by the Sub Command Sonar crew (as discussed in the Realism section at the beginning of this chapter), these missiles allow the shooter to launch his weapons without immediate detection. Additionally, if the weapons are placed properly in the vicinity of the target, the target will have bearings from several TIW reports to contend with; if he has not already detected the shooter, he cannot effectively fire a snapshot.

These advantages come with a price. The first price comes from ship control; these weapons can only be launched from depths of 50m or shallower, at speeds of 5kt or less. If you are conducting your search and TMA at deep depths, it will take time for you to transit to launch depth; it's also possible that your enemy is tracking you and will detect your decrease in speed while you prepare to launch. The second price is TMA. Your TMA often must be 90% accurate in order to get a hit with an ASW missile. This is because the E45-75A and Type 40 torpedoes' homing systems do not always acquire the target like they should. (You could think of this as a simulation of “inferior workmanship” by the manufacturers of the weapon). This is not to say that at longer ranges from the target, these torpedoes will *never* acquire their targets, but with the Stallion and -27, a kill from longer ranges is not always a guarantee.

A specific disadvantage of any ASW missile is that they cannot be launched through ice cover. Even if you manage to launch an ASW missile through partial ice cover, the torpedo may land on an ice floe and be destroyed.

ASW Missile Presets

The presets for an ASW missile are simple.

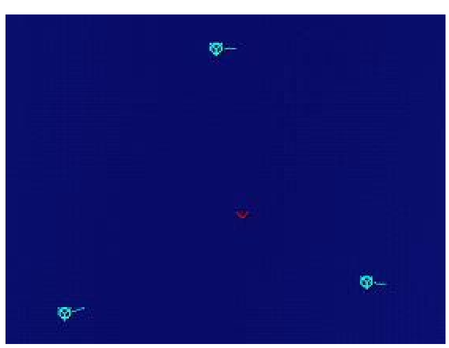


As discussed at the beginning of this chapter, you will want to launch these weapons on a Snapshot bearing, rather than assign a track ID to the tube. The Run-to-Enable setting, in nautical miles, tells the missile where to drop its torpedo.

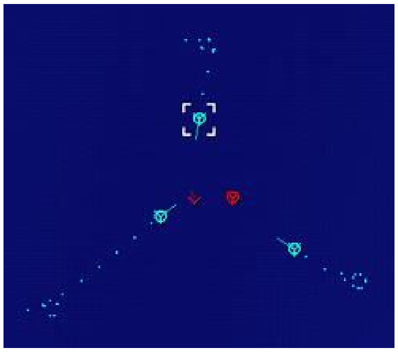
ASW Missile Salvos

As with standard torpedoes, these missiles can be launched in salvos to increase the probability of a kill. Unlike standard torpedoes, you cannot simply utilize a bearing spread, because these torpedoes do not travel in a straight line when they enter that water; they conduct a circular pattern search. This makes it easier for a target to escape if several torpedoes land on one side of him.

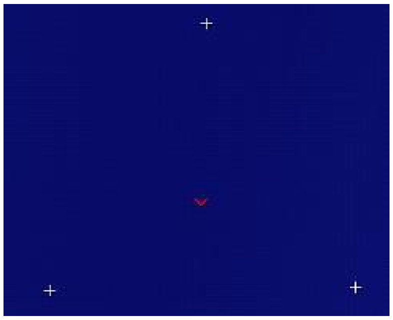
The most effective method of employing ASW missiles is the *bracket*. This method involved dropping the missiles in a pattern such that the target is “surrounded” by torpedoes. The images below show a bracket pattern.



ASW Missile bracket pattern.


Target acquired.

To form a this kind of bracket, it is helpful to use the drawing tools on the NAV map. First, you should place position markers (by pressing the ENTER key) at about 1 to 1.5nm from the target, with approximately 120 degrees of separation from each other, as shown below:



You will then use the RANGE tool. Position your cursor over ownship, press the R key, and then move the cursor to each position marker in the bracket. Record each bearing and range. You will enter these into the presets for your missiles.

You will want to compensate for the target's course and speed when entering your presets. You can use the same drawing tools to project a position on the NAV map of where your target will be when the torpedoes enter the water, instead of where the target is at the time of launch. Depending on your target's speed, there could be a significant enough difference in these two positions that your bracket will not quite surround the target. Use the flight speeds given above for each missile to determine their flight time, and use that to calculate where the target will be when the torpedoes drop.

TORPEDO EVASION

Introduction

It is a rare occasion when playing a multiplayer match in which you will not be forced to take action due to incoming weapons. Whether you are taken by surprise or are the target of return fire, you will need to learn how to effectively evade weapons.

Even experienced players get sunk, no matter how good their evasion techniques are. When you're running at a flank bell, you're deaf and blind to everything except the loud pings of your enemy's weapons hunting you down; often that's the only indication you have of what's happening in the combat environment, and sometimes, you don't even have that!

Torpedo in the Water!

This paragraph from the Realism section at the beginning of the chapter bears repeating:

"Yet another potentially annoying aspect of the sim pertains to weapon launches. In Sub Command, the launch transient generated by a weapons launch can be detected on sonar (if you know where to look), but it is not announced by the Sonar Crew. The "torpedo in the water" (TIW) report you'll hear is generated by the torpedo's entrance into the water. This is a problem when your opponent has torpedo-tipped missiles like the Stallion; you will not hear a TIW report until the torpedo from a Stallion has landed, which gives you much less time to react than if he had launched a UGST, for example."

In other words, with a standard torpedo, you'll get the TIW warning exactly when you should; with ASW missiles, you won't get it until it's almost too late.

Other objects in the game generate TIW reports as well. The UUV and the SLMM both generate a TIW when they enter the water. If you go to the broadband station and do not hear the telltale sound of a torpedo motor, your opponent has probably launched one of these objects, and you are in no danger. You may also be able to classify such objects at the narrowband station.

Once you hear the TIW report, whether expected or not, you have a choice to make – run immediately, or stay put and figure out your "danger level". Players with less experience will often evade immediately at a flank bell, and there's no shame in that, whether experienced or not.

Before you even begin the match, you should evaluate the potential enemies you will face in-game. Your most obvious and most frequent enemy by far will be your player-opponent. The first thing you should do when a match begins is to take note of what boats your opponent(s) are driving. This will give you advance knowledge of the type of weapons that might come your way. Next, read your tasking. If there is any mention of "other ASW assets", you can expect some air-dropped torpedoes, which are extremely difficult to evade.

Now that you know what could be out there, based on your tactical picture, you can make the decision whether to evade or evaluate.

Known Enemy Contact, Single Bearing

If you get a TIW from a single bearing upon which you already have an enemy contact, you could:

- Evaluate the broadband sonar display; if you see and/or hear a signal corresponding to a torpedo, continue to the steps below; if not, your enemy may have launched a UUV or SLMM;
- linger at the datum for a few minutes more to refine your TMA, then return fire and clear datum;
- begin to clear datum immediately by ordering a standard bell and changing course, continuing to track your enemy;
- return fire immediately and begin evasion;
- begin evasion with no other actions.

The actions described above will depend on the range to the shooter.
If the range is short, or unknown, an *immediate snapshot and evasion, or evasion alone*, will be the best course of action. You will have no time to fix your enemy's position, even with a rough estimate.
If the range is long, you may have time to clear datum at less than evasion speed, which may allow you to continue to refine your TMA solution for a snapshot.

Unknown Enemy Contact, Single Bearing

If you receive a TIW from a single bearing upon which you have no known enemy contacts:

- Evaluate the broadband sonar display; if you see and/or hear a signal corresponding to a torpedo, continue to the step below; if not, your enemy may have launched a UUV or SLMM (you can also use the narrowband station to attempt to classify the TIW);
- An *immediate snapshot and evasion, or evasion alone*, will be the best course of action. You will probably not have time to detect your enemy on sonar, and his bearing will be cluttered with the narrowband lines from the torpedoes anyway. It's not impossible to find the NB line, but you will not want to take the time. It could cost you dearly!

TIW from Multiple Bearings

TIWs from multiple bearings can come from several sources:

- Multiple players launching weapons,
- an Akula that has launched Stallions or SS-N-27s,
- air-dropped torpedoes.

Weapons from Multiple Players

In this case, you will have to quickly plot an evasion route, if you have not done so already during the TMA phase. You may not be able to plot an optimum evasion course; you'll just have to choose the bearing with the most separation between shooter bearings. It's also worth a quick look at the broadband sonar, to see if the shooters are shooting at each other and not you. A trace with a high bearing rate can indicate a torpedo aimed at someone else; however, it could also indicate a weapon that is close-aboard.

ASW Missiles

If you are playing against an Akula driver, he may try to sink you with torpedoes from ASW missiles. Pay close attention to the TIW reports and take note of the bearings. If the bearings are all on one side, you can still plot an evasion course that will take you away from the torpedoes; for example, if all TIW reports are between 045 and 150, you can take a north- or south-westerly course for evasion.

If, however, these bearings are somewhat evenly spaced around you, you may be surrounded, or bracketed, and are going to have a difficult time of it. Pick a “hole” – a space between two of the bearings – and “run the gauntlet”; you have few options at this point. If one of the “holes” is larger than the others, choose that one.

Air-dropped Torpedoes

On the rare occasions when you play a multiplayer match in which there are AI ASW assets, you may find yourself in the frightening position of having air-dropped torpedoes used against you.

The first thing you'll want to do is stay as deep as you can *prior* to such a thing happening. This will give you a bit of space cushion from the torp's acquisition cone.

The next thing to do is to take a quick note of the bearings of the TIWs and RUN. Evade directly away from these evil beasts! There's little else you can do.

Tracking Torpedoes on Sonar

The sonar station available to you that will often be your only indication of the torpedo's movements is the Active Intercept station. At this station, you can check on the torpedo's bearing by listening to its active acoustics (assuming it's an active-acoustic torpedo).

Sonar Active Intercept display, showing intercepted torpedo acoustics, superimposed with a possible evasion course (not visible in the game).

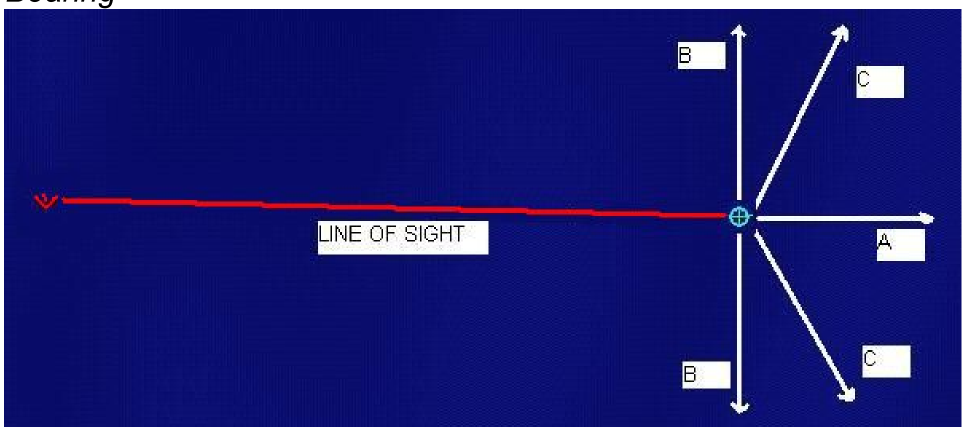
It is also possible to use the broadband and narrowband sonar displays to track torpedoes. If you have a visible trace on the broadband display or frequency lines from the torpedo on the narrowband display, you can assign a tracker and watch the tracker's bearing line on the NAV map. If it is fairly steady (remains close to the original bearing), you've got a problem; the weapon has a small or zero bearing rate, it may be headed toward you. If it shows a fairly bearing change, it may not have been launched at you.

You can also watch the broadband waterfall on the U.S. subs and check the torpedo's trace; if it has a steep slant, this indicates a high bearing rate, indicating that the weapon was not launched at you – or that it is extremely close to you. You'll need to consider a number of factors in a very short amount of time to make that determination; range (if known) to the shooting platform, signal strength of the torpedo signature, and the time of launch. The torpedo's signal strength may not be a valid consideration if the sonar conditions are marginal. Torpedoes launched from a relatively short range could appear distant. As with any submerged contact, you should consult the narrowband display for a better idea of the signal strength of the weapon and its possible threat to you.

Evasion Courses

As was discussed in the Torpedo Salvos section, there are 3 basic torpedo evasion courses you could take. Let's look first at the evasion possibilities for a TIW from a single bearing.

Single Bearing



Course A is a straight-line evasion directly away from the incoming weapons. Only a very foolish skipper would use this tactic, because he has very little hope of outrunning a modern torpedo in a straight-line chase. Additionally, you would not be able to hear the torpedoes' active sonar if you put the incoming weapons directly astern of you; the active sonar receiver has a baffled area that extends 30 degrees on either side of the stern.

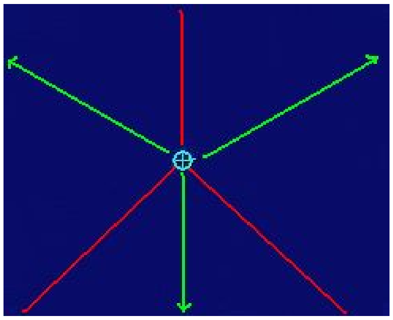
Course B, a 90-degree evasion from the line-of-sight (LOS), is a good tactic, because it will take the you out of the acquisition cone of a torpedo traveling along the LOS, if performed at sufficient speed. The downside to this course is that it does not open the range along the LOS between you and the shooter. If the shooter is using wire-guided torps, and is able to track your movements, he can easily turn the torpedo to intercept you, possibly even putting you into the undesirable position of being in a Course-A tailchase.

Course C is better than Course B. It puts the incoming torpedo at about 120 degrees from your bow. It has the advantage of taking you out of the acquisition cone of a torpedo traveling along the line-of-sight (LOS), along with the added benefit of opening the range along the LOS between you and the shooter. There is still the possibility that the shooter is tracking your movements and will re-steer a wire-guided torpedo to intercept, but the shooter's job is more difficult now due to less bearing change and a longer range along the LOS.

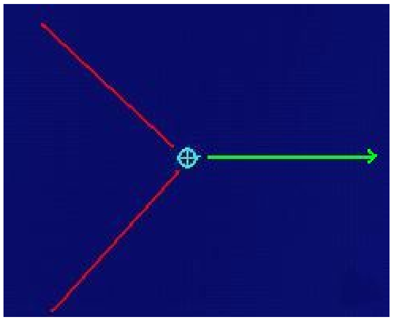
Multiple Bearings

In the image below, an evenly spaced set of TIW bearings is shown in red, perhaps the kind of spacing you might see if you were “bracketed” by

Stallions. Shown in green are the possible evasion courses for this situation.



Shown below is a situation in which you receive TIWs from multiple bearings, possibly from two different players, or ASW missiles. In this situation, it is easier to select an evasion course.



It's important to remember that your ideal evasion course puts incoming weapons 120 degrees from either side of your bow. If this is not possible due to widely spaced TIW bearings, you will have to do your best to maintain as large a spacing between ownship's heading and the bearing(s) of the incoming torpedo (s). Equally important to remember is that you may need to perform course changes to keep tabs on the incoming weapon's active sonar.

<u>Using Countermeasure Decoys</u>

Countermeasure decoys, also called decoys, countermeasures, or CMs, can be used to fool, or “spoof”, an incoming torpedo into thinking that the decoy is the target (which, in this section, is YOU). Properly employed, they can aid you in your evasion, keeping you alive long enough to get another shot at your enemy.

CM types

Active decoys release a “curtain” of bubbles that will cause returns on an active-acoustic torpedo's homing system; the the bubble screen will reflect the pings back to the torpedo.

Passive decoys generate an acoustic signature similar to that of the launching platform. Passive-acoustic torpedoes will see this signature as their target, and will home in on the decoy signature.

Decoy Misconceptions

Decoys are not an infallible shield. They will not hide you if you use them improperly, and they will not “lure” the torpedo away from you if the torpedo's homing logic already has a solid lock on you.

Torpedoes do not always detonate when they have locked onto a decoy. In fact, this is a very rare occurrence.

Players of 688(I) Hunter-Killer used to launch SLMMs and other non-torpedo weapons (Tomahawks, Harpoons) into the water to act as decoys for active-acoustic torpedoes. *THIS WILL NOT WORK IN SUB COMMAND!* For one thing, a failed missile will simply sink to the bottom after it is ejected from the torpedo tube. Also, SLMMs and missiles present too small a target to a torpedo's active acoustics to present a sufficient return.

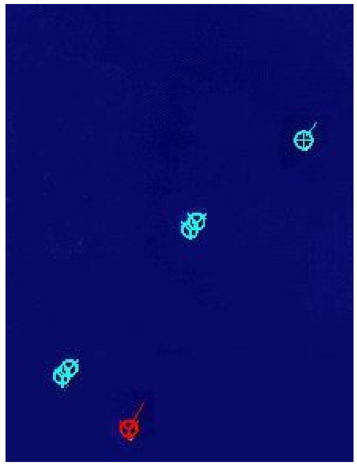
Changes to the Evasion Course when using CMs

The best way to use CMs is to put them between you and the incoming weapons. This causes the torp's homing logic to think it has already acquired you. The torpedo will turn toward the decoys as it tries to confirm its lock and execute an intercept course. This has the effect of either slowing the torpedo enough for you to put more distance between you and the torp, or causes the torpedo turn away from you as it begins to try to reacquire.

One decoy is often not sufficient to cover the possible paths the torpedo might take on its way to ruining your day. If you put one decoy between you and the torp, you then have to stay behind a single decoy and drive directly away from the torpedo, causing you to be unable to detect the torp's active acoustics. Once the torpedo passes the decoy (as they usually do not detonate on decoys), the next thing the torp will home in on is your sub.

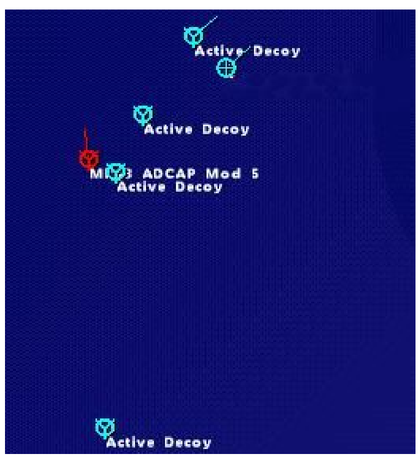
Instead of single decoys, you should try to “dump” your decoys in a pattern that forms a sort of line, or “screen”, between you and the incoming weapon. This is a challenge when driving the 688(I) and the Akula, as each only has 2 CM tubes and the reload time for each tube is 2 to 3 minutes. This only allows you to drop each pair of decoys 2nm apart. The Seawolf, on the other hand, has 18 countermeasure tubes, making the formation of a screen much easier; your screen can be much tighter.

Forming a decoy screen alters the optimal evasion course, which keeps the incoming torpedo 120 degrees from ownship's heading (or 60 degrees off the stern). If you do not alter this course while dropping a string of decoys as you evade, there is a chance that the torpedo will catch up with you and “see” past the decoys, allowing it to to lock on to your sub.



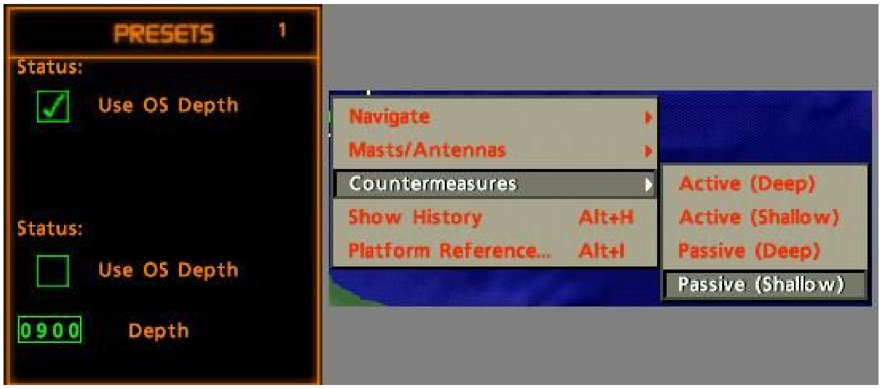
If the skipper of this submarine continues on this heading, the torpedo may ignore the decoys and catch up to him.

Instead of a straight-line evasion, place a line of 3 or 4 decoys on one course, and then change course radically – anywhere between 45 and 90 degrees – and drop another line of decoys. Drop your decoys at a rate of one every thirty seconds, wait for the tubes to reload, and dump the next pair. You can continue this process until you feel that you are out of danger, and then continue on your previous evasion course. You may, however, want to choose a course different from your original evasion course, one that still opens up the range between you and the weapons, but will not be immediately obvious to the shooter.



Taking the time to arrange a screen, or field, of decoys, can save your skin!

The pattern of the screen, or field, of decoys that you create will depend on the hydrographic environment, acoustic environment, and the number of inbound torpedoes. You may choose to vary the frequency at which you will dump each CM, or the spacing between them, depending on the tactical situation and the combat area. Your CM screen can also be created in three dimensions. Right-clicking on ownship at the NAV map allows you to launch CMs deep (800ft) or shallow (100ft) when driving the Akula or 688(I); when driving the Seawolf, you can select a specific depth by unchecking “Use OS Depth” and entering a depth into the preset field.



Using Countermeasures against ASW Missiles

Recent experience has shown that an improper decoy pattern could possibly draw a torpedo *toward* ownship. In most cases, this happens when the decoy is released when a weapon is close, but has not yet acquired a lock on the target. The decoy may create a return that causes the torpedo to turn and acquire, which could then lead the torpedo to receive a stronger return from the target itself.

In a case in which ownship is bracketed by ASW missiles, releasing decoys before escaping the bracket could actually draw the torpedoes toward ownship, which is the exact opposite of the desired effect. You should escape the bracket first, open range between ownship and the weapons, and then release decoys at a safe distance, perhaps 1-2 nm.

APPENDIX A: Playable Sub Characteristics

Includes SCU Subs; Stock Subs indicated in green
(FFL = First Frequency Line)

SUB	TPK	BLADES	FFL	MAXDEPTH	MAXSPEED	TA?
688(I)	7	7	60	1720ft	32	TB-16D/TB-23
Akula	7	7	50	730m	35	Pelamida
Seawolf	7	7	60	2260ft	35	TB-16D/TB-29
688 FLT 1/2	7	7	60	1620ft	32	TB-16D/TB-23
Alfa	9	5	100	470m	43	None
Collins	7	10	60	1080ft	21	Karriwarra
Gal	7	10	50	218m	17	None
Gotland	7	10	60	300m	20	None
Han	7	7	50	333m	25	None
Kilo	6	10	50	330m	17	None
November	5	9	50	327m	31	None
Permit 1970	7	7	60	2066ft	30	AN/BQR-15
Permit 1982	7	7	60	2066ft	30	AN/BQR-15
Sierra-II	7	7	50	875m	35	Pelamida
Sturgeon 1975	7	10	60	1300ft	26	AN/BQR-15
Sturgeon 1985	7	10	60	1300ft	26	TB-16D
Swiftsure	10	10	60	1600ft	30	Type 2026
Trafalgar	10	10	60	2116ft	32	Type 2046
Trenchant	7	10	60	2116ft	32	Type 2076
Tupi	7	10	50	320m	22	None
Type 206	7	10	50	200m	17	None
Type 209/1100*	7	10	50	284m	22	None
Type 209/1200**	7	10	50	284m	22	None
Type 209/1300#	7	10	50	284m	22	None

SUB	TPK	BLADES	FFL	MAXDEPTH	MAXSPEED	TA?
Type 209/1400##	7	10	50	320m	22	None
Typhoon 1985	7	7	50	490m	25	None
Typhoon 2001	7	7	50	490m	25	Pelamida
Upholder	7	10	60	820ft	20	Type 2046
Victoria	7	10	60	820ft	20	Type 2046
Victor-I	7	7	50	560m	32	None
Victor-II	7	7	50	560m	32	None
Victor-III	8	7	50	560m	30	Pithon
Walrus	5	10	50	300m	21	Type 2026

*Type 209/1100: Glavkos
**Type 209/1200: Atilay, Jang Bogo, Pijao, Poseidon
#Type 209/1300: Cakra
##Type 209/1400: Mbeki, Preveze, Thompson

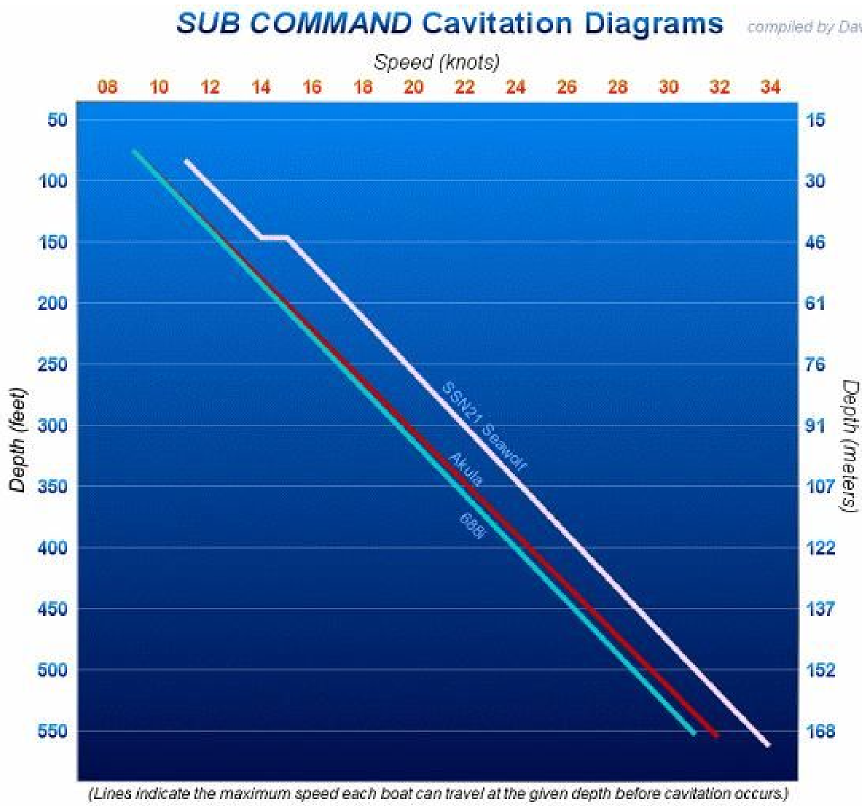
APPENDIX B: ASW Weapons

Weapons from SCU-playable subs are included. Stock weapons are indicated in green.

WEAPON	PLAYABLE	SPD	RNG	DEPTH	WIRE	Comment
53-65M	**YES**	70	24km	300m/984ft	NO	
A 244	NO	30	6000m	650m/2132ft		
APR-2E	NO	63		650m/2132ft		
DM2A-3	**YES**	35	20km	500m/1640ft	YES	
DM2A-4	**YES**	50	40kyd	500m/1640ft	YES	
E45-75A	**YES**	38	8000m	500m/1640ft	NO	Stallion(stock), Silex(SCU)
F 17	NO	40	18km	650m/2132ft		
L 5	NO	35	7000m	600m/1968ft		
L 7	NO	35	16kyd	600m/1968ft		
Mark 37	**YES**	35	18km	330m/1083ft	YES	
Mk 44	NO	30+	5486m	1000m/3280ft		
Mk 46	NO			500m/1640ft		
Mk 48 ADCAP	**YES**	55	50km	833m/2733ft	YES	
Mk 48 Mod 1	**YES**	55	44kyd	700m/2296ft	YES	
Mk 50	NO	40+		1200m/3937ft		
NT-37C	**YES**	35	18km	330m/1083ft	YES	
SAET-40	NO	30	12kyd	500m/1640ft		
SAET-60	**YES**	35	15km	300m/984ft	NO	
SET-65E	**YES**	40	15km	436m/1430ft	NO	
Shkval	**YES**	200	12kyd	436m/1430ft	NO	
Spearfish	**YES**	75	40km	1000m/3280ft	YES	
SST-4	**YES**	35	32kyd	800m/2624ft	YES	
Stingray	NO	45		875m/2870ft		
SUT	**YES**	34	28km	500m/1640ft	YES	
TEST-71ME	**YES**	40	22kyd	600m/1968ft	YES	

WEAPON	PLAYABLE	SPD	RNG	DEPTH	WIRE	Comment
Tigerfish	**YES**	35	22km	650m/2132ft	YES	
Type 40	**YES**	40	13kyd	546m/1791ft	NO	SS-N-27(stock), Starfish(SCU)
Type 613	**YES**	50	32kyd	300m/984ft	YES	
Type 431	**YES**	40	24kyd	300m/984ft	YES	
Type 89	NO	70	32.8kyd	1000m/3280ft		
UGST	**YES**	50	40km	650m/2132ft	YES	
USET-80	**YES**	50	25km	600m/1968ft	NO	
USET-95	NO	50		500m/1640ft		
YU-1	**YES**	55	12kyd	218m/715ft	NO	
YU-3	**YES**	40	22kyd	436m/1430ft	NO	
YU-4	NO	35	16kyd	300m/984ft		

APPENDIX C: CAVITATION CHART



kts	SSN21	688i	Akula
9	-	74	23 (075)
10	-	96	29 (095)
11	82	117	36 (118)
12	104	139	43 (141)
13	126	161	49 (161)
14	147	183	55 (180)
15	147	204	61 (200)
16	169	226	68 (223)
17	191	248	74 (243)
18	213	270	80 (262)
19	235	292	87 (285)
20	256	313	93 (305)
21	278	335	100 (328)
22	300	357	106 (348)
23	322	379	112 (367)
24	344	401	118 (387)
25	365	423	125 (410)
26	387	444	131 (430)
27	409	466	137 (449)
28	431	488	144 (472)
29	453	510	150 (492)
30	475	532	157 (515)
31	496	553	163 (535)
32	518	-	169 (554)
33	540	-	-
34	562	-	-

Values are shallowest depths (given in feet) where the boat can travel at the indicated speed without cavitation. Akula speeds are shown in meters, with feet in parenthesis.

Chart and Table compiled by David “Mystic” Sandberg, of the Subsim Radio Room Forums.

APPENDIX D: TOWED ARRAY FAILURE SPEEDS

688(I)
TB-16 (starboard) towed array: Warning 26 kts, Fail 29 kts

TB-23 (port) towed array: Warning 22 kts, Fail 25 kts

SSN-21
TB-16 (starboard) towed array: Warning 26 kts, Fail 29 kts

TB-29 (port) towed array: Warning 20 kts, Fail 23 kts

Akula
Pelamida towed array: Warning 28 kts, Fail 31 kts

APPENDIX E: Measurement Conversions

1m = 3.28ft = 1.1yd, 1ft = .30m, 1yd=.91m

1nm = 2025yd = 1852m = 1.8km.... HOWEVER...

For simplicity's sake, a nautical mile is often rounded to 2000yd; this is the convention used in Sub Command.

Therefore, 1nm = 2000yd = 1829m = 1.8km . The scale used by the drawing tools on the NAV map is the yards / nautical miles scale, on both U.S. and Russian interfaces.

FEET-TO-METERS TABLE

FEET	METERS		FEET	METERS
60	18.29		1050	320.12
100	30.49		1100	335.37
150	45.73		1150	350.61
200	60.98		1200	365.85
250	76.22		1250	381.1
300	91.46		1300	396.34
350	106.71		1350	411.59
400	121.95		1400	426.83
450	137.2		1450	442.07
500	152.44		1500	457.32
550	167.68		1550	472.56
600	182.93		1600	487.8
650	198.17		1650	503.05
700	213.41		1700	518.29
750	228.66		1750	533.54
800	243.9		1800	548.78
850	259.15		1850	564.02
900	274.39		1900	579.27
950	289.63		1950	594.51
1000	304.88		2000	609.76

METERS-TO-FEET TABLE

METERS	FEET
14	45.92
20	65.6
50	164
75	246
100	328
125	410
150	492
175	574
200	656
225	738
250	820
275	902
300	984
325	1066
350	1148
375	1230
400	1312
425	1394
450	1476
475	1558
500	1640
525	1722
550	1804
575	1886
600	1968

YARDS	NM	METERS	KM
2000	1	1818.18	1.82
3000	1.5	2727.27	2.73
4000	2	3636.36	3.64
5000	2.5	4545.45	4.55
6000	3	5454.55	5.45
7000	3.5	6363.64	6.36
8000	4	7272.73	7.27
9000	4.5	8181.82	8.18
10000	5	9090.91	9.09
11000	5.5	10000	10
12000	6	10909.09	10.91
13000	6.5	11818.18	11.82
14000	7	12727.27	12.73

YARDS	NM	METERS	KM
15000	7.5	13636.36	13.64
16000	8	14545.45	14.55
17000	8.5	15454.55	15.45
18000	9	16363.64	16.36
19000	9.5	17272.73	17.27
20000	10	18181.82	18.18
21000	10.5	19090.91	19.09
22000	11	20000	20
23000	11.5	20909.09	20.91
24000	12	21818.18	21.82
25000	12.5	22727.27	22.73
26000	13	23636.36	23.64
27000	13.5	24545.45	24.55
28000	14	25454.55	25.45
29000	14.5	26363.64	26.36
30000	15	27272.73	27.27
31000	15.5	28181.82	28.18
32000	16	29090.91	29.09
33000	16.5	30000	30
34000	17	30909.09	30.91
35000	17.5	31818.18	31.82
36000	18	32727.27	32.73
37000	18.5	33636.36	33.64
38000	19	34545.45	34.55
39000	19.5	35454.55	35.45
40000	20	36363.64	36.36
41000	20.5	37272.73	37.27
42000	21	38181.82	38.18
43000	21.5	39090.91	39.09
44000	22	40000	40
45000	22.5	40909.09	40.91

YARDS	NM	METERS	KM
46000	23	41818.18	41.82
47000	23.5	42727.27	42.73
48000	24	43636.36	43.64
49000	24.5	44545.45	44.55
50000	25	45454.55	45.45

APPENDIX F: The Three- and Six-Minute Rules

The 3- and 6- minute rules are used by navigators and tracking parties to determine how far ownship, or a contact, is traveling in a given time period.

The 3-minute rule states that if you take the ship's speed in knots and multiply it by 100, you will obtain the distance traveled by the ship in 3 minutes; e.g. If a ship is traveling 10 knots, it will travel 1000 yards in 3 minutes.

The 6-minute rule states that if you take the ship's speed in knots and multiply it by 200, you will obtain the distance traveled by the ship in 6 minutes; e.g. If a ship is traveling 10 knots, it will travel 2000 yards in 6 minutes.

The table below gives 3- and 6-minute rule distances, as well as 1-minute distances, for a list of specific speeds.

SPEED (kts)	3-minute rule (yds)	6-minute rule (yds)	One minute distance (yds)
1	100	200	33.33
2	200	400	66.67
3	300	600	100
4	400	800	133.33
5	500	1000	166.67
6	600	1200	200
7	700	1400	233.33
8	800	1600	266.67
9	900	1800	300
10	1000	2000	333.33
11	1100	2200	366.67
12	1200	2400	400
13	1300	2600	433.33
14	1400	2800	466.67
15	1500	3000	500
16	1600	3200	533.33
17	1700	3400	566.67
18	1800	3600	600
19	1900	3800	633.33

SPEED (kts)	3-minute rule (yds)	6-minute rule (yds)	One minute distance (yds)
20	2000	4000	666.67
21	2100	4200	700
22	2200	4400	733.33
23	2300	4600	766.67
24	2400	4800	800
25	2500	5000	833.33
26	2600	5200	866.67
27	2700	5400	900
28	2800	5600	933.33
29	2900	5800	966.67
30	3000	6000	1000
31	3100	6200	1033.33
32	3200	6400	1066.67
33	3300	6600	1100
34	3400	6800	1133.33
35	3500	7000	1166.67
40	4000	8000	1333.33

Torpedo Speeds	3-minute rule (yds)	6-minute rule (yds)	One minute distance (yds)
45	4500	9000	1500
50	5000	10000	1666.67
55	5500	11000	1833.33
60	6000	12000	2000
65	6500	13000	2166.67
70	7000	14000	2333.33
75	7500	15000	2500

APPENDIX G: Mission Start Checklist

STATION	TASK
Pre-Game	Read your tasking / orders
Pre-Game	Select a sub
Pre-Game	Select Weapon Loadout
NAV	Zoom in to combat area on NAV Map
Ship Control	Stream TA
Ship Control	Charge HP air
Fire Control	Flood all tubes
Fire Control	Equalize all tubes (for more realism, skip this step until immediately prior to launch)
Sonar	Set sonar on NB station
Sonar(NB)	Check Spherical / Cylindrical Array for contacts and assign trackers; attempt initial classification.
Sonar(NB)	Check Towed Array for contacts; write down freq and bearing for each contact. Cross-check with Spherical / Cylindrical Array contacts; assign trackers to any positive matches. Write down track IDs of matched contacts.
Ship Control/Tool bar	Order at least a 30 degree turn; making sure not to baffle any contacts of interest
NAV/Fire Control	While turning, evaluate water depth on NAV Map, set floor presets on WG weapons to deepest practical depth
Sonar (NB/Demon)	When TA is stabilized, re-check NB TA output. Look for the contacts that have stayed mostly stable, and assign trackers; write them down. Attempt initial classification. Attempt to determine contacts' speed from DEMON.
TMA	At TMA station, merge matched Spherical / Cylindrical Array and Towed Array contacts.
Sonar/TMA	Begin TMA and continue passive sonar search.

APPENDIX H: List of Revisions

- Introduction; minor editorial addition, paragraph 4
- Sonar Employment, Passive Sonar Employment; added description of towed arrays for stock playable subs, pg.8
- Sonar Employment, Passive Sonar Employment; added header for Classification section, pg.9
- Sonar Employment, Passive Sonar Employment; added Narrowband Classification Filter section, pp 10-12
- Sonar Employment, Passive Sonar Employment; added information and headers for Other Classification Methods, pg.12
- Sonar Employment, Passive Sonar Employment, Reducing Noise sources; added headers
- Sonar Employment; added section on UUV Operations, pp 29-31
- TMA Employment; section completely reorganized with a new section, "Distinguishing between an Overlead and Lag LOS", added
- Weapons Employment, ASW Missiles; added ice cover launching information, pg. 62
- Torpedo Evasion, Using Countermeasure Decoys; added information for decoy depth settings, pp 71-72
- Reorganized Appendices:

APPENDIX A: Playable Sub Characteristics
APPENDIX B: ASW Weapons
APPENDIX C: Cavitation Chart
APPENDIX D: Towed Array Failure Speeds
APPENDIX E: Measurement Conversions (with added yds/nm/m/km chart)
APPENDIX F: The Three- and Six-minute Rules
APPENDIX G: Mission Start Checklist
APPENDIX H: List of Revisions