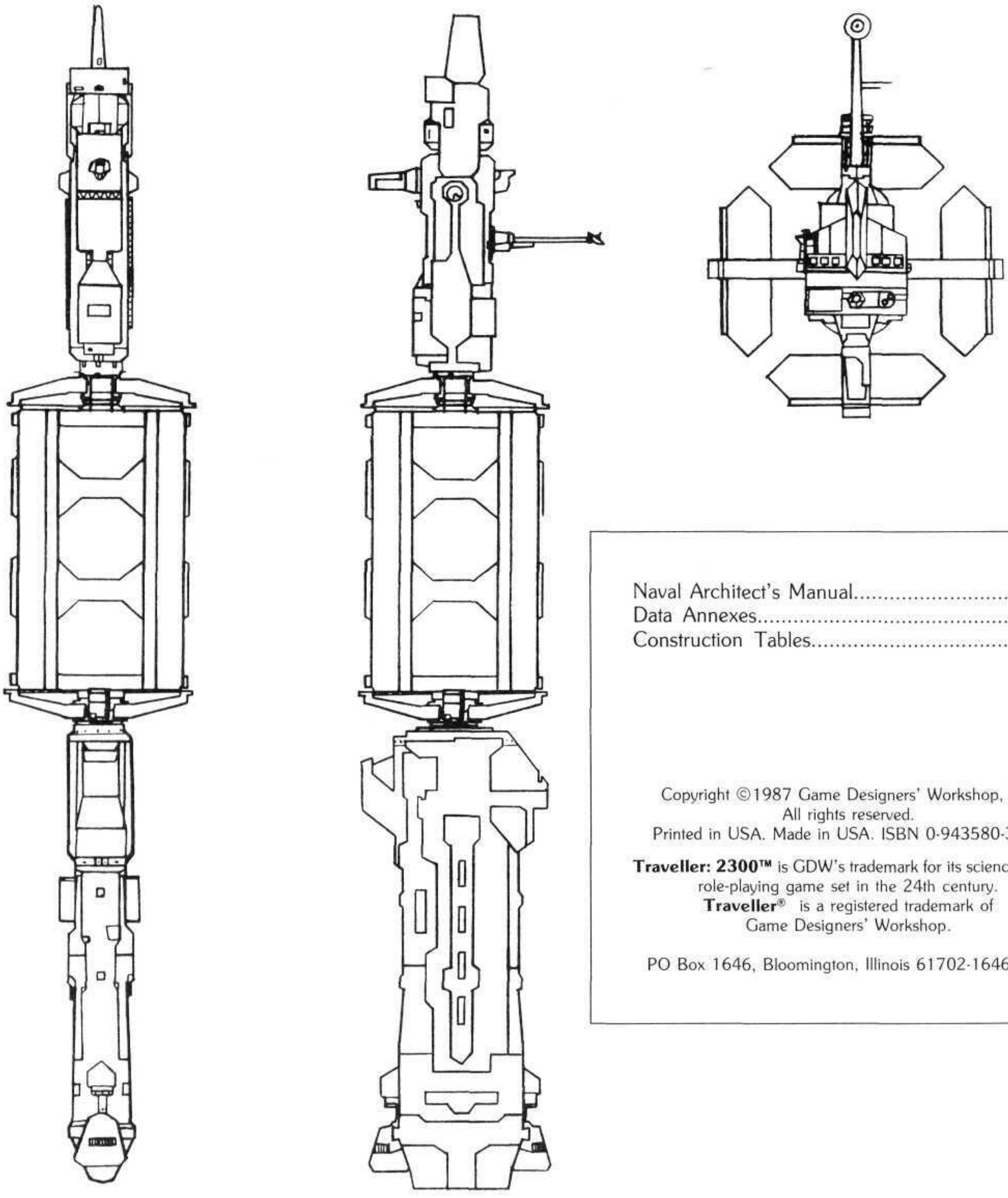
2300™

STAR CRUISER

NAVAL ARCHITECT'S MANUAL



Printed in USA. Made in USA. ISBN 0-943580-35-8.

PO Box 1646, Bloomington, Illinois 61702-1646 USA

GAME DESIGNERS' WORKSHOP

CC-1050/R2

Naval Architect's Manual

INTRODUCTION

Starship construction in the 24th century is a tremendously complex and sophisticated industry. Ships are assembled in large, orbital facilities from subcomponents either built in orbital factories or shipped up from the planet surface. Some shipyards on the frontiers of human space have to transport some of the more complex components all the way from Earth.

Ship construction has been considerably simplified for purposes of the game, and only the most important elements in defining a ship's characteristics are covered. Two general procedures are followed when constructing a ship: design and evaluation. Often a ship will be redesigned several times, based on its evaluation, to fine-tune the design. Thus, these two procedures will, to a certain extent, be ongoing and simultaneous. For ease of explanation, however, we will deal with them separately.

Units: Throughout these construction rules the following units apply: Volume is measured in cubic meters (m^3). Surface area is measured in square meters (m^2). Mass is measured in tons, which are equal to 1,000 kilograms. Money is in livres (Lv) or mega-livres (MLv). A MLv is equal to one million livres. Distances are measured in meters. Time is measured in various standard units — weeks, days, hours, and minutes.

The Examples: Two separate examples are provided throughout these design rules. First is the *Kennedy*-class cruiser, a large ship design. Second is the *Punyuang* fighter, a small ship design. These will be referred to as the Large Ship Example and the Small Ship Example.

Overview: Ships are designed by assembling various components (power plant, drive, quarters, work stations, etc.) and building a hull around them. As the design procedes, two critical quantities will be constantly updated: interior volume used and hull surface area used. Although the size of the hull is up to the builder, each hull configuration has its own interior volume and surface area. You cannot cram more inside a hull than its interior volume will allow, nor can you plaster the outside of the hull with more surface installations (sensor arrays, air locks, docking bays, turrets, etc.) than there is surface area to attach them to.

1. CONCEPTUALIZATION:

Decide what the ship is supposed to do. That will enable you to determine which areas of design you want to emphasize. Although design proceeds in an orderly sequence, if you know that this is a cargo carrier, you will know to leave plenty of room for cargo.

Ship Classification: For purposes of design, each ship must fall within three broad classifications determined by the designer during conceptualization. A ship is considered a *remote object* if it has no crew whatsoever. If the ship has a crew but is intended for missions of 12 hours or less duration (such as fighters or landers), it is considered a *small ship*. If the ship has a crew, and is intended for missions of indefinite duration, the ship is considered a *large ship*.

These classifications will dictate certain procedures to be used throughout the design sequence. After design, when in use, special rules will apply to the use and capabilities of small ships and remote objects.

Large Ship Example: The *Kennedy*-class guided missile cruiser is intended to be a relatively small, but sophisticated, warship with a powerful self-defense capability, which relies primarily on remote ordnance for its offensive punch. Since it will have a crew and be capable of long-lasting missions, it is considered a large ship.

Small Ship Example: The *Punyuang*-class fighter is designed to be a stutterwarp-capable system defense fighter which is cheap to produce but light on defensive capabilities. Since it has a crew, but is only intended for short missions, the *Punyuang* is considered a small ship.

2. POWER PLANT

In general, power plants provide power to run the ship's electrical systems, life support, sensors, weapons, and drives. For simplicity the basic housekeeping functions of a power plant (interior heat, light, etc.) are assumed to be provided by the installation of the plant, and its rated capacity is what is left over for sensors, weapons, screens, and the drive. The main function of the power plant is to power the ship's drives, and, thus, the size of the power plant is the basic limitation on drive size. However, military ships require power for their energy weapons and shields, and ships with active sensors require energy to power them. Players need not make allowances for these separately from the energy needs of the drive; however, if no such provision is made, then the drive cannot function at full efficiency at the same time that the active sensors or energy weapons are being used.

The unit of energy used for power plants in *Star Cruiser* is the megawatt. Active sensors require at least one megawatt in order to function. Many energy weapons will require one or more megawatts to fire. Screens may require up to six megawatts in order to function. Therefore, in order to supply all ship's functions at one time, the power plant must produce megawatts equal to the sum total of the drive's requirement, the screens' requirements, the weapons' requirements, and the active sensor's requirement.

The Power Plants Table lists a variety of standard power plants. The four general types are fuel cells, MHD (Magneto-Hydro-Dynamic) turbines, fission (nuclear) reactors, and fusion (thermonuclear) reactors. Note that three different levels of quality are available. In general, "old commercial" are available anywhere starships are built. "Modern commercial and old military" are available at better shipyards. "Modern military" are not available to the general public, and in most cases their exact internal components and means of construction are classified.

In addition to listing the various power outputs (in megawatts) available, the table has the volume and price of each power plant. Volume is the number of cubic meters of space inside the hull taken up by the plant and will strongly influence the size of the hull of your starship. Price is the normal cost of the drive in livres. MHD turbines also include a listing for rotor diameter. Because turbines of different outputs have different minimum diameter rotor blades, there are certain minimum diameters of hulls into which they can fit. When you choose a hull, it will have to be at least as large as the minimum diameter shown.

Mass is not shown on the table, as all power plants mass one ton per cubic meter.

Multiple Power Plants: If more than one power plant is installed, add 10 percent to total volume of power plants per additional power plant. For example, if two 20 MW MHD turbines were installed, multiply total power plant volume by 110 percent. If three 20 MW MHD turbines were installed, multiply total power plant volume by 120 percent. In combat, power plant hits against vessels with multiple power plants will affect only one of the installed plants, determined at random. Thus, installing multiple drives can help to ensure some power output after battle damage is sustained, but at a cost in additional volume within the ship. If a ship with three 20 MW MHD turbines suffers a total loss of one plant, it will still have 40 MW of output with which to operate.

All ships must have a power plant of at least 0.01 MW output.

Large Ship Example: The *Kennedy*-class cruiser uses a 150-megawatt fusion power plant. It masses 5,000 tons and takes up 5,000 m³ of interior volume. The 150 megawatts of output will be used for a large drive and a variety of weapons. The drive costs MLv50.

Small Ship Example: The *Punyuang* fighter anticipates needing one megawatt for its drive, one for active sensors, and one for a laser. The most space-efficient three-megawatt plant is an Old Military MHD turbine displacing 40 m³ and massing 40 tons. It costs MLv0.5.

3. FUEL

All ships with MHD turbines or fuel cells for power plants will require fuel and fuel tankage. Fission and fusion plants have their fuel built into the drive, and that fuel will last the life of the drive.

Using the Fuel Table, decide upon a desired maximum time duration for the ship's mission. This may be hours or weeks, possibly months or years. Calculate how much fuel it will take to operate the drive for that time, and allow sufficient interior space for the fuel.

Fuel Processing Plants: In order to process raw hydrogen into usable fuel, a ship will require a fuel processing plant. The basic plant masses 2 tons, occupies 5 m³, and costs Lv100,000. It requires 10 standard solar arrays to function and produces one ton of fuel in 10 hours.

Small ships may have durations of less than 12 hours, but additional fuel might be desired for emergency situations.

Large Ship Example: The *Kennedy* has a fusion plant, and therefore needs no fuel.

Small Ship Example: The *Punyuang* has a 3 MW MHD plant. If we provide enough fuel for 12.11 hours of use, we will need 0.60 ton of fuel per hour per megawatt, or 21.8 tons of fuel. This will take up 35.97 m³ of interior space.

4. THRUSTERS

All starships have small utility thrusters which use compressed oxygen jets to maneuver the craft into and out of orbit. These are subsumed in the basic cost of the hull and power plant, and no special allowance need be made for them. However, a few ships are also configured for atmospheric re-entry and landing. These ships require large thrusters if they are to take off again and reach orbit or make interplanetary journeys without benefit of a stutterwarp drive.

Thrusters may only be added to ships which have MHD turbine power plants. The addition actually consists of adding a large reinforced reignition chamber to the power plant and thrust nozzles at the rear of the hull. The MHD turbine is thus modified to function as a thruster. When in thrust mode, large volumes of additional fuel are added to the reignition chamber, burned, and ejected as reaction mass.

This conversion adds 10 percent to the volume and mass of the power plant and adds 20 percent to its cost.

If thrusters are added for the purpose of atmospheric landings, the ship's hull must be streamlined. The decision to streamline the hull is made at this time, but the actual calculations are not made until the hull is designed later in this design sequence. Simply note for now the fact that the ship will be streamlined for reference at that time. Similarly, the fuel requirements for the thrusters will also be calculated at that time.

Only streamlined ships with thrusters may make planetary landings. Only ships with thrusters, regardless of streamlining, may make interplanetary journeys without a stutterwarp. However, most interplanetary travel is accomplished with a stutterwarp.

Large Ship Example: The *Kennedy* is not intended for planetary landings of its own, nor is it intended for interplanetary travel without its stutterwarp. Therefore, no additional thrusters are installed.

Small Ship Example: The *Punyuang* fighter is intended for planetary landings and so must have both thrusters and streamlining. Therefore, the *Punyuang's* power plant will instead mass 44 m³ and mass 44 tons, and it will cost MLv0.6. The hull for the *Punyuang* will also be 10 percent more expensive and will lose 10 percent of its interior volume to waste space—these must be noted for later in the design sequence.

5. DRIVE

Jerome Effect stutterwarp drives are the main means of transportation between worlds and effectively the only means between star systems. The Stutterwarp Drives Table lists a variety of stutterwarp drives available. As with power plants, three levels of quality are listed, and these have the same restrictions on availability as do power plants. Note that each quality level of drive has a different *drive variable* listed. This will be used later to calculate the ship's drive efficiency.

The table lists the power requirement of the drive, its volume, mass, and price. (Note that, unlike power plants, drives mass a bit more than a ton per cubic meter.) The drive selected may not have a power requirement in excess of the ship's power plant.

Large Ship Example: The *Kennedy* uses a new military 150 MW drive. It masses 85 tons and occupies 72 m³ of internal volume. It costs MLv90.

Small Ship Example: The *Punyuang* uses an old military 1 megawatt drive. It masses 15 tons, displaces 13 m³ of interior volume, and costs MLv9.75.

6. CREW AND WORK STATIONS

A variety of tasks are required of a starship crew, depending on the size and function of the ship. The section below discusses the standard job descriptions of crewmen on a starship and indicates how many work stations are required. Each work station (usually a seat and computer/control console) requires 8 cubic meters of volume and masses 5 tons.

Small ships, which are normally carried in larger ships (such as fighters and landers), have different crew and work station requirements and are treated separately below.

6A. Large Ships

Bridge: For large ships, there are seven separate crew sections that must be addressed—the bridge section, the tactical action center (TAC) section, the engineering section, the shipboard vessel section, the ship's security section, the ship's troops sections, and, finally, the medical section. There are two additional sections that are optional—the steward section and the scientific section.

Captain: Each large ship requires a captain. The captain's only function is to command, but military command personnel are also qualified pilots (and can also fill in on a variety of other work stations if required by battle casualties). (SKILL: Pilot)

Navigation: Each large ship requires a navigator. This is actually a sensor station which mans the navigation radar and deep system scanners. (SKILL: Sensor)

Communications: Each large ship needs one communications work station to monitor broadcast communications from planets and other vessels. Tight beam link (as opposed to broadcast) communication uses a coherent light (laser) or microwave (maser) energy beam between two ships to provide secure communications that the enemy can neither intercept nor jam. However, each ship must keep its directional transmitter/receiver antennae aimed at the other ship in the "comlink." One communications work station has one tight beam link communicator attached to it at no extra cost or mass to the work station. (SKILL: Communications)

Engineering: Usually referred to as the "helm," one engineering station on the bridge is always required. This station controls the drives and is manned by a qualified pilot. (SKILL: Pilot)

An additional engineering work station on the bridge is required for ships with large power plants to monitor power plant status. The number of additional monitoring stations required is equal to the output of the power plant in megawatts divided by 50, rounding fractions down. For example, a 75 MW power plant would require two bridge stations: the helm and one monitoring station. A ship with a 7 MW power plant would only require one station, the helm. (SKILL: Engineering)

Computer: "Computer" stations are flexible work stations with the ability to reconfigure into other bridge work stations, usually in case of battle damage. No more than half of the total bridge work stations may be computer work stations.

Once the total number of captain, navigation, communications, engineering, and computer positions have been determined for the bridge, one work station must be provided for each. Bridge work stations are continuously manned and require two crew members each.

Large Ship Example: The bridge of the *Kennedy* has the following work stations: 1 captain, 1 navigation, 2 communications, 3 engineering (1 helm, 2 monitoring stations), 3 computer. Therefore, the *Kennedy*'s bridge has 10 total work stations and requires 20 crew members.

Tactical Action Center (TAC):

Sensors: Each ship requires one sensor operator for its passive array (if it has one) and one for its active array (if it has one). Beyond those required, redundant stations may be installed in case of battle damage. (SKILL: Sensors)

Flight Controllers: Military ships generally maintain one flight controller per fighter or other small combatant in flight at any time. The flight controller maintains continuous tight beam communication with the craft. For both civilian and military ships one flight controller is necessary if a smaller vessel is to dock with the ship. (SKILL: Communications)

Fire Control Station: Each fire control station is a crew work station which must be manned by a crewman with gunnery skill. Each fire control station can control as many weapons as desired, but can only "service" (engage) one target per turn. (SKILL: Gunnery)

Remote Pilot Stations: Each remote station can control one and only one missile or other remote vehicle. (SKILL: Remote Pilot)

Once the total number of sensor, flight controller, fire controller, and remote pilot positions have been determined for the TAC, one work station must be provided for each. TAC work stations are not continuously manned and require one crew member each.

Large Ship Example: The *Kennedy*-class cruiser has a TAC consisting of two sensor work stations, one for the active array and one for the passive array. No flight control stations are present, as the ship has no small craft. There are 10 fire control stations and 5 remote pilot stations. The TAC has a total of 17 crew and 17 work stations.

Engineering:

The engineering crew of a ship is dictated by the maintenance requirements of its power plant. Power plant maintenance requires the skills of electricians, general mechanics, and specialist starship engineers. Maintenance requirements vary with the type of power plant used and its output in megawatts, as shown on the following table:

Type	*Mechanical*	*Electrical*	*Engineer*
Fuel Cell	1	1	1
MHD Turb.	1+/50	1+/40	1+/40
Fission	1+/5	1+/4	1+/4
Fusion	1+/30	1+/20	1+/20

Explanation: Each of the three maintenance areas (mechanical, electrical, and engineering) always requires one crewman for maintenance. (The appropriate skill is necessary to fill the position; thereafter, every crewman is considered an "engineer.") MHD turbines, fission reactors, and fusion reactors require additional maintenance crewmen based upon the power output of the plant divided by the number shown, rounding all fractions down.

If more than one crewman is required, one is designated the "senior mechanical engineer" (or electrical engineer or drive engineer).

The total number of crew members required in the engineering section is equal to the sum total of the mechanical, electrical, and engineering personnel as determined above. At battle stations the entire engineering crew is on duty. Half man fixed work stations for drive control and monitoring, while the other half form damage control parties, formed in groups of at least three. Thus the total number of work stations required is equal to the engineering crew divided by 2, rounding fractions up.

Large Ship Example: The *Kennedy*, with a 150 MW fusion reactor, requires (1 + 150/30 =) 6 mechanics, (1 + 150/20 =) 8 electricians, and (1 + 150/20 =) 8 engineers, for a total of 22 men in the engineering section. A total of 11 actual work stations are installed in the engineering section.

Shipboard vessels:

If the ship carries manned shipboard vessels (such as fighters, landers, etc.), special maintenance personnel for them will be required on board the mother ship. Allow one maintenance work station and crew member for each such vessel carried. Note that unmanned vessels (such as missiles and remote sensor drones) do not necessitate maintenance personnel in this crew section.

Large Ship Example: The *Kennedy* does not carry any small craft.

Ship's Security:

At the designer's option, the ship may have security personnel. For every 20 crew members (or fraction thereof) in this crew section, there must also be one work station.

Large Ship Example: The Kennedy has no security section.

Ship's Troops:

Also at the designer's option, the ship may carry any number of military personnel generally not charged with the security of the ship itself. For every 20 troops (or fraction thereof) in this crew section, there must be one work station.

Large Ship Example: The *Kennedy* has 10 ship's troops. These require one work station.

Steward Section:

At the designer's option, the ship may carry passengers. For every 10 passengers, there must be one steward crew member, and each of these requires one work station.

Large Ship Example: The *Kennedy* has no passengers; no steward section is required.

Scientific Section:

An optional section of scientists may be included on any ship. (Their make-up can be determined at a later time; only their numbers need be addressed here.) Each scientist is a crew member who requires one work station.

Large Ship Example: The *Kennedy* has no scientific section.

Medical Section:

Total all of the crew members from each of the previous eight sections. Add to this the total number of passengers. For every 30 people there must be one medic in the medical section. Each medic requires one work station.

Large Ship Example: The *Kennedy* has a bridge crew of 20, TAC crew of 17, engineering crew of 22, ship's troops crew of 10, totalling 69. Therefore, the ship requires 3 medics, each with one work station.

Total Crew and Work Stations:

The total crew is equal to the total number of crew members in each of the above nine sections. The total number of work stations is equal to the cumulative total of work stations in each of the above nine sections. Total the mass and internal volume required for the work stations at this time.

Large Ship Example: The *Kennedy* has a total bridge crew of 20, TAC crew of 17, engineering crew of 22, ship's troops section of 10, and a medical section of 3. Its total crew is 72, and it carries no passengers. There are 10 bridge work stations, 17 TAC work stations, 11 engineering work stations, 1 ship's troops work station, and 3 medical work stations, for a total of 42 work stations on the ship. These take up 336 m^3 and mass 210 tons.

6B. Small Ships

Small ships are those designed specifically for limited endurance (12 hours or less) missions. They have considerably reduced crew requirements, as all maintenance is provided by the mother ship. Tight beam communication is controlled by the mother ship as well. Since the mission is of limited duration, there is no requirement for the crew to move about in the craft, and, thus, the work stations are much smaller and have no access to each other or the interior of the craft. To differentiate them from normal work stations, they are instead called cockpits.

Each crewman on a small craft requires a cockpit. A small craft requires one command pilot (SKILL: Pilot). If armed, the craft must also have one TAC officer who both operates the sensors and serves as gunner. (SKILL: Gunner and Sensor). If more than one gunner is required, only one need be cross-trained as a sensor operator.

If the ship has only one fixed forward firing weapon, the ship may dispense with the weapons officer and instead have only a command pilot. However, the weapon may only fire at targets in the same hex as the ship or in its bow aspect.

Each cockpit uses 3 cubic meters of interior volume, masses 2 tons, and uses 2 square meters of hull surface for the access hatch.

Small Ship Example: The *Punyuang* will have one pilot and one gunner. Each requires a cockpit for a total of 6 m^3 and 4 tons, plus 4 square meters of the hull, which are dedicated for the access hatches (make note for later hull design).

7. ACCOMMODATIONS AND LIFE SUPPORT

Only large ships have accommodations and life support.

Accommodations:

Once you know how many people you have in your crew and how many passengers are to be carried, you need to provide them accommodations. The chart below shows how much volume is required to reach certain comfort levels. (As a general rule, military vessels should strive for a comfort level of 0 to avoid adverse effects during combat.)

ACCOMMODATIONS CHART

Volume	*Comfort*
25 m^3	−2
50 m^3	−1
75 m^3	0
100 m^3	+1
150 m^3	+2

The mass of these accommodations is 10 tons plus 0.1 tons per m^3.

Spin Habitat: There are several varieties of spin habitats, broken into the following general categories. The several designs of spin habitats are differentiated more for purposes of deck plans than of design—the requirements of volume and area for each actually vary very little. Their descriptions should help you visualize your ship during design.

Spun Hull: This is the simplest, but usually largest, spin habitat. In it the hull is a large cylinder that spins around its axis, thus providing centrifugal gravity in the outer part of the cylinder. Due to coriolis effects, the central part of the cylinder (within a radius of 6 meters) is unusable for quarters or work stations, and, thus, is usually used for fuel, cargo, and low-maintenance machinery. More often the hull is built like a doughnut, and the central core is occupied by a nonspinning drive/power plant module.

Double Hull: In this design, the outer hull spins but surrounds an enclosed inner hull which does not. Again, this design is most useful for very large ships as the enclosed central hull is at least 9 meters in radius.

Hamster Cage: The hamster cage consists of a cylindrical module that is at least 9 meters in radius, and that spins to create an artificial habitat. Unlike other designs, the hamster cage is usually set at right angles to the main axis of the ship and generally installed in counter-rotating pairs (to eliminate torque effects on the ship's attitude).

Spin Capsule: The most common spin habitat in use is the spin capsule. In this configuration two or more habitats of the desired size and configuration are placed at the ends of pylons that rotate around a common axis. (Usually, but not always, this is also the axis of the ship.) The spin capsules have a rotational radius of at least 9 meters.

Two Body: Two ships can attach themselves together using a pylon and spin about a central point in space to provide spin gravity. The chief disadvantage to this design is that both ships need be present in order to spin.

In all cases, except those of the spin capsule and two-body spin, the machinery required to maintain the spin habitat has a volume equal to 1 percent of the enclosed spin volume beyond the 10 meter radius, and a mass of 1 ton per m³. In the case of the spin capsule, the machinery has a volume equal to 2 percent of the spin capsule volume and a mass of 1 ton per m³. For the two-body spin system there is no additional volume or mass lost to machinery. However, a pylon that is at least 5 percent of the combined mass of the ships must be constructed between the vessels involved, and the pylon must be carried by one or both of the ships involved. Construction of pylons is covered later in this design sequence.

If the crew accommodations have spin simulated gravity, their comfort level is automatically raised by two. For instance, if a ship provides 75 m³ per person in a spin habitat, the overall comfort of the ship is raised to +2. Crew comfort will affect overall crew performance.

Large Ship Example: The *Kennedy* has a crew of 72, but is outfitted with quarters for 100. The ship allows 25 m³ per crewman (comfort −2) for a total of 2500 m³. The accommodations are placed in two spin capsules, raising comfort to 0. An additional 50 m³ of volume is required for machinery, massing another 50 tons. The accommodations themselves mass 260 tons.

Life Support:

Only large ships need deal with life support. All small ships are assumed to have 24 hours of basic life support and an additional 48 hours of emergency life support.

For large ships one m³ of supplies (food, water, oxygen) mass 200 kg and provide 200 man-days of life support. Therefore, one man-day of life support will mass one kg and occupy 0.005 m³ of space.

Life support must be provided for both crew and passengers, referred to here as *total people*. The designer must conclude a maximum number of days of life suppport, referred to here as *duration*. Duration should be at least as long as that of the fuel for the power plant.

Therefore, multiply the total people by the duration and then by 0.005 to determine the volume that the life support takes up. Divide this volume in m³ by 5 to determine the total mass of the life support.

Large Ship Example: The *Kennedy* carries supplies for a crew of 100 for six months (180 days), or 18,000 man-days. This requires 90 m³ and masses 18 tons.

8. SENSORS

Decide which sensors the ship will be equipped with. All sensors are listed on the Sensors Table. After sensors are chosen, subtract the hull surface area and interior volume they use.

All ships require some sort of navigational sensor. Survey, passive, and active detection sensors are optional.

Active and passive detection arrays also have listed a cross section modifier which must be noted upon purchase. This modifier will affect how well other ships can detect the ship design while those sensors are in use.

Some remote objects have no sensors—they must rely upon the sensors of their ship of origin. As long as there is a communication link between the remote object and the owning ship, the remote object can benefit from all sensor data available to the owning ship. (Remote objects can and often do mount a variety of sensors, however.)

Large Ship Example: The *Kennedy* has a deep-system scanner which takes up 30 m² of surface area, 15 m² of volume, and 20 tons of mass, costing Lv100,000. It has a navigational radar which takes up 20 m² of surface area, 5 m³ of volume, and 1 ton of mass, costing Lv20,000. The *Kennedy* has a passive detection array with a range of 10 and cross section modifier of 1 which takes up 30 m² of surface area, 10 m³ of volume, and 1 ton of mass, costing Lv1,200,000. Finally, it has an active detection array with a range of 15 and a cross section modifier of 0 which takes up 10 m² of surface area, 10 m³ of volume, and one ton of mass, costing Lv2,000,000.

Small Ship Example: The *Punyuang* has navigational radar, which takes up 20 m² of surface area, 5 m³ of volume, and 1 ton of mass, costing Lv20,000. It has a passive detection array with a range of 6 and cross section of 36, which takes up 30 m² of surface area, 10 m³ of volume, and one ton of mass, costing Lv400,000. It also has an active detection array with a range of 10 and cross section modifier of 33, which takes up 10 m² of surface area, 10 m³ of volume, and one ton of mass, costing Lv400,000. The *Punyuang* has no survey sensors.

9. WEAPONS

There are two broad classifications of weapons: fixed weapons and launched ordnance.

Fixed Weapons:

Fixed weapons include all energy and particle beam weapons. They are characterized by some sort of turret attachment to the hull of the ship which can hold one or more fixed weapons.

The Weapon: The Weapons Table shows all of the available fixed weapons. Fixed weapons are not designed; they are purchased "off the rack." For each weapon is listed its price, volume, and mass, which apply when the weapon is mounted on the ship. The other values provided (damage multiplier and targetting modifier) come into play only during combat.

The Mount: There are four types of fixed weapons mount, each with different characteristics. Each has an entry on the Weapons Mounts Table. The number of facing aspects reflects the arc of the weapon's fire—that is, how wide an arc in which the weapon may engage targets.

External Mount: A basic turret without any special masking or armoring. External mount weapons can fire into four facing aspects.

Masked Turret: The masked turret has less of a radar signature inherent to its design (this is determined later when calculating the overall signature of the ship). Masked turrets may also fire into four facing aspects.

Jack Turret: These are limited traverse armored mounts that may fire into only three facing aspects.

Gun Towers: These are turrets mounted on pylons away from the ship. This gives them a much greater arc of fire (they may fire into five facing aspects), but at the cost of greatly increased radar signature (determined later).

Fire Control: Each fire control station (as determined when making up the Tactical Action Center of the ship) may control any number of turrets. It is important to note that fire control stations engage targets, and that these, and not turrets themselves, are fired one at a time.

Target Tracking: Each fire control station must have either its own Target Tracking Array (TTA) or be in command of a turret which has a Unified Target Engagement System (UTES). Each TTA is assumed to have two sensor clusters on the hull, each of which scans a full hemisphere of space (4 aspects). Thus, each TTA can engage any target in any aspect, but only with weapons which bear against that aspect. UTES have the same bearing as the mount in which they are emplaced.

A TTA provides all the fire control data for one fire control station. If either the TTA or its fire control station are out of commission during combat, all the weapons controlled by that station cannot fire until repairs are made.

In order to save surface area and decrease vulnerability, American and French naval forces have begun using the UTES system on some of their weapons. As stated on the Weapons Mounts Table, there are additions to the mass and cost of mounts using a UTES. The additions are per mount, not per weapon in the mount. The advantage is that the fire control station controlling a UTES-capable mount does not need a TTA, and, thus, does not have an additional external feature which takes up exterior surface area and is vulnerable to enemy damage.

Arranging Fixed Weapons: The fixed weapons on a ship are a combination of the weapon, its mount, and the organization of the fire control stations. A single mount can hold up to two identical weapons. Note that double mounted turrets get a modifier to hit the target, but do not do twice the damage. The mass of the weapons and the mounts are totalled and added to that of the ship. The volume of the weapons and mounts are ignored—they are considered to be housed outside the ship and therefore do not take away from its internal volume. (Exception: Jack turrets are housed internally and do add to the ship's internal volume.)

See *Evaluation* step 11 for details on determining the facing aspects of each individual weapons mount.

Targetting Computers: There are two types of targetting computers available. The first is available only to the military and is rated +2. The older design is now generally available to everyone, and it is rated +1. A targetting computer is not necessary to fire weapons, and each computer installed can lend its aid to any number of weapons firing from a ship.

Both targetting computers mass one ton and displace 1 m³.

Large Ship Example: The *Kennedy*-class cruiser already has ten fire control stations in its Tactical Action Center. Each of these controls one Hyde Dynamics EA 122 Laser mounted in a masked turret. Each of these has a UTES, so no TTA are required. However, the UTES systems do add to the cost and mass of the mounts, making each weapon/mount/UTES combination mass 9 tons and cost Lv340,000. Since these are masked turrets, their volume does not count against the internal volume of the ship. The turrets take up 300m².

Each of these has four facing aspects to choose from. Four bear toward the bow, bow port quarter, port broadside, and stern port quarter. Four more have the same bearing, but to starboard. One bears to the port broadside, stern, and both stern quarters, while the remaining one bears to the starboard broadside, stern, and both stern quarters.

The *Kennedy* has a +2 targetting computer.

Small Ship Example: The *Punyuang* mounts one Guiscard LL-98 laser in a jack turret. The TTA takes up 30 m² of hull surface area, masses 2 tons, and costs Lv40,000. The mount and weapon take up another 30 m², mass 5 tons and cost Lv217,000. With a jack turret mount, the volume of 5 m³ does count against the ship, and the weapon has only three facing aspects to choose from. For the *Punyuang,* the weapon bears to the bow, bow port quarter, and bow starboard quarter. The *Punyuang* has a +1 targetting computer.

Launched Ordnance:

There are two types of launched ordnance: missiles and sensor drones. Both are launched from a ship and then remotely piloted. Missiles contain weapons, while sensor drones do not; they are otherwise identical in function. Missiles and Sensor Drones list all operational information on missiles and drones. The Missile Data Annex lists the design requirements of all missiles currently available for ship mounting.

Missiles and drones may be mounted in one of four ways: internally in bays, internally as cargo, externally, or in missile packs.

Ordnance Bays: A ship can have internal ordnance bays of varying capacities. The Missile Data Annex lists the hull surface area used for the ordnance's exit port and also lists the volume consumed per missile or drone carried in the magazine. Thus, the ship can be designed with as large or small a magazine per bay as desired. Each bay can launch one drone or missile per turn.

Cargo Hold: A ship can carry ordnance in its cargo space, but must have a team of crewmen in the cargo hold to launch it. The vessel must be at "All Stop" to launch ordnance from its cargo bay. The actual crew in the cargo hold should be equal to the mass of the missile or drone in tons. Thus a 4-ton missile should have a launch crew of 4 men. For each man short of the optimal crew, add one turn to the time required to prepare the missile for launch and add one turn to the time required at "All Stop" to launch it.

External Sling: Missiles and drones can be carried externally in magnetic slings. All ordnance carried externally can be released simultaneously if desired. The data annexes list the mass and reflected signature points of an externally slung missile or drone. The sling has effectively no mass and consumes no interior volume.

Missile Pack: Missile packs are prepackaged canisters of missiles that can be mounted on the outside of the hull. The Missile Data Annex lists the missile packs available for each type of missile, along with their mass and reflected signature points.

The mass of either a missile pack or bay is added to the total mass of the ship. The volume of a missile bay is counted against the internal volume of the ship. Bays mass 2 tons per m³.

Large Ship Example: The *Kennedy* uses Hyde Dynamics One-Mission Definite-Kill Missiles as its main offensive punch. Four bays are built into the ship, each holding five such missiles. Therefore, each bay must provide 4 m³ for each missile or 20 m³ total. Each bay masses 40 tons, and each has a 2 m² exit port on the surface of the ship.

10. SCREENS

Screens are used to provide ships with a measure of protection from laser and particle beam weapons. A ship's screen consists of an electromagnetic field surrounding the ship and holding a high density of extremely reflective particles. When a laser encounters the screen, the particles reflect and dissipate a significant fraction of the light. However, the particles are not perfectly reflective, and absorbing even a small percentage of the energy from a laser weapon is sufficient to destroy the reflectivity of a particle. At that point, the particle stops reflecting and begins absorbing energy until (minute fractions of a second later) it vaporizes. Burning through the dense layers of particles of a shield is possible, but it considerably reduces the effectiveness of the weapon used to do so.

Screens have an internal volume cost, a surface area cost, price, and power requirement, as listed on the Screens Table. All screen equipment has a mass of 1 ton per cubic meter.

11. HANGAR DECKS

If small craft (such as fighters) are to be carried, they may either be carried internally or externally. If carried externally, their various signatures add to the overall signature of the mother ship. All externally mounted craft may be launched at once. For each such craft, the mother ship must have surface area equal to twice the two largest dimensions of the craft.

Alternatively, ships may be stored internally on a hangar deck. The volume of a hangar deck is equal to three times the volume of the craft carried, if cramped, and six times the volume of the craft, if spacious. Intermediate volumes are possible as well. Each launch door uses hull surface area equal to twice the product of the two smallest dimensions of the craft. One ship may be launched per turn per launch door from a spacious hangar deck. If only five times the volume is committed to the hangar, one ship may be launched every other turn. If only four times the volume is committed, one ship may be launched every third turn. If only three times the volume is committed, one ship may be launched every fifth turn. In all cases where several turns are required between launches, that number of turns must be spent preparing for the first launch.

Hangar decks have a mass of 0.2 tons per m^3.

12. HULL MASKING

If the ship is to have masking of its radiated signature, it is installed at this time. Decide which level of masking is desired (basic, extensive, advanced) and consult Hull Masking Table to determine how much surface area of the hull is used by the radiator panels. Hull volume used is equal to the surface area used divided by 4. Mass is 2 tons per m^3.

Large Ship Example: The *Kennedy* has advanced hull masking. For a ship with a 150 MW power plant, this requires 1800 square meters of hull radiators and 450 cubic meters of internal equipment, masses 900 tons and costs MLv1.5.

13. HULL

When designing the hull for the ship, the designer must consider the total interior volume and exterior surface area of all the components thus far designed. Refer back through your design and total these quantities before designing the hull.

Also, streamlining, thruster fuel, and cargo capacity should be addressed at this time; estimates as to their volume requirements should be made before you design the hull. Refer to those sections now in order to make an educated estimate; the actual figures will be calculated later.

There are two methods of creating the hull—using standard hull sections and customizing.

Standard Hull Sections: The Standard Hull Sections Table shows the interior volume, exterior surface area, and material volume of several standard hull sections. Assemble any number of these to make a hull of the required size.

Customizing: Using the formulas provided under the Standard Hull Sections Table, you can determine the interior volume and exterior surface area for hull cylinders of other dimensions. Pi is equal to 3.1416 for these purposes. Determining the material volume of a customized hull section is done through estimating by using the material volumes of the standard hull sections. To do this, divide the internal volume of the customized hull by the internal volume of a standard hull section of approximately equal size. Then multiply the result by the material volume of the standard hull section; the result is the material volume of the customized hull section. Round fractions down.

Assembly of many hull sections into a single hull unit requires no additional considerations; it is assumed to take up no additional space or tonnage. Add the material volumes of each hull section together to determine the total material volume of the hull.

Material Selection: Consult the Hull Materials Table and pick a material from which the hull is to be constructed. Different materials have different characteristics, as shown on the table.

Ships Without Armor: Multiply the total material volume of the hull by the mass per m^3 of its material to determine the total mass of the hull. Multiply the total material volume of the hull by the price of the material to determine the total cost of the hull.

Ships With Armor: If the designer chooses to armor the ship, the total material volume of the hull will change. Armor is applied in levels, starting with 1. Each level of armor requires material equal to the originally calculated material volume of the hull multiplied by the material's armor multiplier. Thus, if that amount (in m^3) of material is allowed for the hull, the ship will have an armor rating of 1. If twice that amount is allowed, the ship will have an armor rating of 2, etc.

The mass of the hull is added to the ship's total mass. The volume of the hull is not taken away from the interior volume of the hull, regardless of the amount of material involved. It is added to the exterior of the vessel and takes up no interior space.

Material volumes of less than two m^3 may be ignored. Objects of that size have effectively no hull material volume.

Large Ship Example: Kennedy-class cruisers are constructed from three 21-meter diameter standard hull sections, three 6-meter diameter standard hull sections, and a tapered hull section (with an average diameter of 12).

The total surface area of the hull is 2,919 square meters, with an interior volume of 12,350 cubic meters. The material volume of the structural components of the hull is 59 cubic meters. It is constructed of advanced composites, and, therefore, the hull weighs 118 tons.

Small Ship Example: At this point, the *Punyuang* requires a hull with at least 140.52 m^3 of volume and 124 m^2 of surface area. Instead of using one of the standard hull sections from the table, one will be customized for the ship. The hull will be a 5-meter diameter cylinder 10 meters long. Using the internal volume formula provided below the Standard Hull Sections Table, the hull has 196.35 m^3. Using the surface area formula, we get 196.35 m^2, coincidentally the same number as internal volume.

To determine the material volume, we will divide the 196.35 figure by the 280 standard hull section internal volume figure. The result, multiplied by 4 (the material volume of the standard hull section with 280 m^3) is 2,805 of a 3 m^3 material volume for our custom hull. The material for the *Punyuang* is synthetic.

We will give the *Punyuang* an armor value of 2. Each level of armor will require 3 (material volume) ×4 (synthetic armor multiplier) = 12 m^3 of material. Armor level 2 will require twice that, or 24 m^3, which makes the hull cost Lv360,000 and mass 96 tons.

14. STREAMLINING AND THRUSTER FUEL

Streamlining: As previously determined, a ship may be streamlined. There are two degrees of streamlining. The first requires that 5 percent of the hull be set aside as waste space and gives the ship a lift value of 0.5. The second requires that 10 percent of the hull be set aside as waste space and gives the ship a lift value of 1.0.

No ship of greater than 10,000 tons total mass may be streamlined.

Thruster Fuel: Total the mass of the ship, including all components and the hull thus far. The fuel required, in tons, for a streamlined ship to make one trip down to a planet's surface and back to orbit through an atmosphere is as follows: Tonnage/6×g, where g is the gravity of the planet in Earth gravities.

When calculating the fuel requirement, the fuel itself does not count as mass. The standard volume assigned to g for calculations during design is 1.

Twice this amount may be set aside to make two trips, etc. Remember that the internal volume is 1.65 m^3 per ton of fuel.

Time to Orbit: The time required to make orbit is a function of the gravity of the world, the MW of the power plant, and the lift volume of the streamlined ship. Use the following formula to determine time in minutes to achieve orbit: (g×MW×12)/lift value.

One-third of this time is spent within the planet's atmosphere. The remaining two-thirds of it is outside of the atmosphere.

15. CARGO

Any remaining interior volume may be devoted to cargo space. One percent of this volume is taken up by interior bracing, massing 5 tons per m^3. Only the remaining 99 percent can be used for cargo.

Large Ship Example: The *Kennedy* has a cargo hold of 3694.68 m^3. This is braced by 37.32 m^3 of material massing 186.6 tons.

Small Ship Example: The *Punyuang* is filled with equipment; there is no room for any cargo.

16. PYLONS:

After constructing the hull, the designer may find that his volume needs result in a hull with insufficient surface area for all of the external fixtures specified. In this case many fixtures can be mounted on pylons instead.

All sensors, TTAs, missile packs, communicators, and hull masking radiators may be mounted on pylons. Pylons mass 10 percent of the total mass of all fixtures mounted on them, in addition to the mass of the fixtures themselves. Fixtures mounted on pylons do not count against hull surface area used. Pylons cost Lv1,000 per ton.

EVALUATION

After completing design, the starship must be evaluated to determine its performance characteristics.

1. Mass

Total the mass of all components, carried vessels, and the full fuel tankage to find the normal average cruising mass of the ship. If the ship includes extensive cargo volume, the mass may be altered considerably from voyage to voyage and needs to be recomputed each time.

Large Ship Example: The *Kennedy* has a total of 7213 tons of components.

Small Ship Example: The *Punyuang* masses 223.1 tons.

2. Drive Efficiency

Divide the drive output of the power plant (that part devoted to running the stutterwarp drive) in megawatts by the mass of the ship in tons. Take the cube root of the result and multiply it by the drive variable of the particular type of drive in use. The result is the drive efficiency of the ship. Many calculators can determine cube roots, or cube root tables exist in some mathematics texts.

For ships that have power plant output less than the total of their energy requirements (for drive, sensors, weapons, and screens), two drive efficiencies must be calculated: one for full power to drives and one for full power to weapons, sensors and screens, and remaining power to drives.

Large Ship Example: The *Kennedy* has a 150 MW stutterwarp drive with a drive variable of 17.5 (new military). 150/7213 = 0.02239. The cube root of that is 0.275. Multiplied by 17.5, the drive efficiency of the *Kennedy* is 4.812.

Since the *Kennedy* has a 150 MW plant and 150 MW drive, the drive will function at a lower efficiency when weapons and sensors are powered. The *Kennedy* has an active array requiring 6 megawatts of power and ten lasers, each requiring 1 megawatt of power, or a total of 16 megawatts. This reduces the drive power in combat mode to 134 MW. 134/7213 = 0.186. The cube root of that is 0.265. Multiplied by 17.5, the drive efficiency of the *Kennedy* in combat mode is 4.635.

Small Ship Example: The *Punyuang* has a 1 MW drive with a drive variable of 16.05 (old military). 1/223.1 = 0.00448. The cube root of this is 0.1649. Multiplied by 16.05, the drive efficiency of the *Punyuang* is 2.646.

3. Fire Statistics

Record the targetting modifiers and damage multipliers for each of the weapons carried. In addition, the modifier for the ships targetting computer (if any) should be noted.

Large Ship Example: The *Kennedy* has a +2 targetting computer. Each of its lasers hits at +1 and does double damage.

Small Ship Example: The *Punyuang* has no targetting computer. Its lasers are +0 to hit and do one point of damage.

4. Comfort

Note the comfort value of the ship given normal loading procedures. Be certain to take into account the effects of any spin habitats. If the comfort value is a negative modifier, it will be used as a negative die roll modifier on all task rolls. If playing a *Star Cruiser* scenario with a custom-designed ship, a negative comfort rating is subtracted from the crew quality. Comfort ratings of 0 or higher have no effect on combat. (Better comfort ratings are necessary only to attract passengers. Negative comfort ratings, however, result in physical deterioration of the crew over time and significantly impair crew efficiency.

Large Ship Example: The *Kennedy* allows 25 m^3 per person (−2) in spin (+2), for net comfort of 0.

Small Ship Example: All small ships have comfort of 0.

5. Expense

Add the cost of all components together to find the total cost of the ship.

Large Ship Example: The *Kennedy* costs MLv154.12.
Small Ship Example: The *Punyuang* costs MLv11.787.

6. Reflected Signature

A ship will have two reflected signature ratings: radial and lateral. Radial is the rating of the ship when viewed from fore or aft, or from the fore or aft quarter. Lateral is the rating used when the ship is viewed from broadside. Two main components determine the reflected signature rating of the ship: hull reflection and fixture reflection. Follow the three steps below.

6A. Hull Reflection: Hull reflection is a function of the viewed area of the hull and the material from which it is constructed.

The radial viewed area of the hull is determined by squaring the radius of the hull and multiplying it by 3.1416. If the hull is constructed of several segments of differing radii, use the greatest radius for this calculation. If a spin habitat rotates around the hull, the rotational radius of the habitat is used unless the radius of the largest hull section is greater. (All spin habitats have a rotational radius of 9 meters or more.) Note that the Standard Hull Sections Table lists the diameter of various hull sections; the radius of the hull section is half the diameter.

The lateral viewed area of the hull is determined by multiplying the length of the hull by its diameter. If the hull is constructed of several segments of differing diameters, break the ship up into several segments each of the same diameter and determine the lateral viewed area of each. Then add them together to find the lateral viewed area of the whole. If a spin habitat rotates separately from the hull, the rotational diameter of the spin habitat is used as the effective diameter of the hull at that point.

The material types are metallic, synthetic, low-profile synthetic, advanced synthetic, composite, and advanced composite. The material from which the hull is constructed provides the signature multiplier for the viewed area of the hull, as shown on the Hull Materials Table.

Once you have determined the lateral and radial viewed areas, multiply them by the construction material multiplier to determine the radial and lateral hull reflection points, rounding up. Record these for later use.

Large Ship Example: The *Kennedy* has greatest dimensions of 21 meters in diameter and 100 meters in length. Its radial viewed area is $(10.5 \times 10.5 \times 3.1416 =)$ 346.36. Its lateral viewed area is 2100. Modified for materials, in this case advanced composites with a signature multiplier of 0.2, these become 69.27 and 420, respectively.

Small Ship Example: The *Punyuang* is constructed from a single hull cylinder. Its radial viewed area is $(2.5 \times 2.5 \times 3.1416 =)$ 19.63. Its lateral viewed area is $(10 \times 5 =)$ 50. The hull is made of synthetics, which have a material modifier of .6, giving the ship a radial reflection of 11.78 and a lateral reflection of 30.

6B. Fixture Reflection: The table below lists the point cost of various external hull fixtures. Add the total points of the external hull fixtures to the hull reflection.

FIXTURE POINTS

External Weapon Mount	10
Masked Turret	4
Gun Tower	100
Active Sensor	note 1
Target Tracking Array	10
Missile Pack	note 3
Slung Ordnance	note 3
UTES Modification	+4
Passive Sensor	note 2
Vehicle Berth	50
Vehicle in Berth	(vehicle's lateral points)
Deep System Sensor	25 note 1
Jack Turret	10
Cartographic Sensor	25 note 1
Life Sensor	25 note 1

Note 1: Only if currently in use.

Note 2: Passive and active sensor suites have reflection modifiers based on their effectiveness and price, as determined when purchased.

Note 3: As listed for the missile or drone used. See Data Annexes.

Pylons: All equipment on pylons adds drastically to the fixture signature. Add the mass of the equipment to the mass of the pylons, and multiply this result by 10. This is the number added to the fixture signature of the ship.

Large Ship Example: The *Kennedy* has 10 masked turrets, each modified as a UTES, for a total of 80 points. Its passive array has 1 reflection point, and its active array has none. Its deep system scanner adds 25 more points when in use.

Small Ship Example: The *Punyuang* has a jack turret worth 10 points, a TTA worth 10 points, passive sensors worth 36 points, and active sensors worth 33.

6C. Total Reflection: Add the ship's radial hull reflection points to its fixture points and consult the table below to determine its radial reflected signature. Add the ship's lateral hull reflection points to its fixture points and consult the table below to determine its lateral reflected signature. If the reflection points are equal to or less than the first number shown, the reflected signature number is the second number.

REFLECTED SIGNATURE

Points	*Signature*
7	1
23	2
63	3
124	4
215	5
342	6
511	7
728	8
999	9
1330	10
1727	11
2196	12
2743	13
3374	14
4095	15

Large Ship Example: The *Kennedy* has 70 radial reflection points to which are added 81 fixture points for a total of 151. This will go up to 176 when the deep system scanner is in use. In both cases this is a reflected signature of 5, so that becomes the ship's radial reflected signature in all cases. The ship has 420 lateral hull points, which becomes 501 points with the fixture points, giving a lateral reflected signature of 7. With the deep system sensor, the ship has 526 points or a value of 8.

7. Radiated Signature:

This is the signature given off by the ship's power plant and detected by a hostile ship's passive sensors. The base radiated signature is shown below:

RADIATED SIGNATURE

MW	*Signature*
1	1
2	2
3	3
10	4
30	5
100	6
300	7
1000	8
3000	9
10000	10

This can be modified if hull masks are used. Basic masking reduces radiated signature level by 1. Extensive masking reduces the signature by 2. Advanced hull masking reduces the signature by 3. Negative numbers are possible. Record both the unmasked result and the masked result for the ship.

Large Ship Example: The *Kennedy* has a 150 MW power plant, giving it a base value of 7. However, it also has advanced hull masking, which reduces this number by three, giving the ship an emission signature of 4.

Small Ship Example: The *Punyuang* has a 1 MW plant and no hull masking, giving it an emission signature of 1.

8. Hull Hit Value:

Take the material volume of the structure of the hull and divide it by the armor multiplier of the material used to construct it. The result is the total number of hull hits before structural failure. 25 percent of this (round up) is the number of hits before the hull suffers a minor breach; 50 percent of the total number of hull hits (round up) is the number of hits before the hull suffers a major breach. Record all of these numbers.

Large Ship Example: The *Kennedy* has 59 m³ of material volume in the hull. The armor divisor of advanced composites is 1. A minor breach occurs after 15 hull hits, a serious breach after 30 hull hits, and structural failure after 59 hull hits.

Small Ship Example: The *Punyuang* has 24 m³ of material volume. The armor divisor of synthetic is 4. Therefore, the *Punyuang* will suffer structural failure after 6 hull hits, major breach after 3 and minor breach after 1.

9. Power Plant Hit Capacity:

If the ship has a fuel cell of MHD turbine, divide the volume of the power plant by 5. If the ship has a fission or fusion power plant, divide the volume of the power plant by 50. The result is the total number of hits required to damage the power plant beyond hope of repair. 20 percent of this number (round up) is the number of hits required to disable the power plant.

Large Ship Example: The *Kennedy* has a 150 MW fusion power plant, which displaces 5000 m³ of interior volume. Dividing this by 50 indicates that the power plant will be damaged beyond repair after 100 hits. It will be disabled after 20 hits.

Small Ship Example: The *Punyuang* has a plant volume of 40 m³. Therefore, it can take eight hits and becomes inoperable after one.

10. Target Profile:

Target profile refers to the size of the target and the consequent ease or difficulty associated with hitting it. Ships have a radial and lateral target profile. The lateral target profile is used when the ship is fired on from its broadside aspect. The radial target profile is used when the ship is fired on from any other aspect.

To determine target profile, consult the Target Profile Table. Compare the ship's radial viewed area to the table to determine its radial target profile. Compare the ship's lateral viewed area to the table to determine its lateral target profile.

Large Ship Example: The *Kennedy* has a radial viewed area of 346.35, which gives it a radial target profile of +0. It has a lateral viewed area of 2100, which gives it a lateral target profile of +2.

Small Ship Example: For the *Punyuang*, the radial viewed area is 19.635, giving a radial target profile of −3. Its lateral viewed area is 50 for a lateral profile of −2.

11. Firing Aspect of Weapons Mounts:

Space is three-dimensional, but for the sake of simplicity, *Star Cruiser* is played on a two-dimensional surface. Nevertheless, some three-dimensional effects cannot be ignored, and primary among these is the inability of a single weapons mount to cover a full sphere without at some point shooting through the ship it is mounted on. Therefore, it is necessary to know the directions in which each turret and TTS bears.

Firing aspect of each weapons mount is selected when the mount is installed. The facing diagram in the *Star Cruiser* rules illustrates the eight aspects of a vessel in the game. Each weapons mount may engage targets in any four adjacent aspects. Thus, a weapons mount could be sighted to engage targets in the port bow quarter, bow, starboard bow quarter, and starboard broadside, for example. Each jack turret may only engage targets in three adjacent aspects. A gun tower may fire into five adjacent aspects.

12. Armor Value:

Note the level of armor acquired for the ship when constructed and record it.

Large Ship Example: The *Kennedy* has an armor value of 0.

Small Ship Example: The *Punyuang* has an armor value of 2.

Data Annexes

Missile Data Annex

FRENCH RITAGE-1 MISSILE

Combat Performance Data:

Movement: 7, *Radiated Signature:* 1, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −4, *Hull Hits:* 1/1/1, *Power Plant Hits:* 1/1, *Armament:* One five-shot limited 1×1 laser, *Active Sensors:* none, *Passive Sensors:* 5

Design Characteristics:

Warp Efficiency: 3.34, *Power Plant:* 0.1 MW Fuel Cell, *Fuel:* 0.27 tons, sufficient for 6 hours of operation, *Mass:* 11.07 tons, *Length:* 5 meters, *Diameter:* 1 meter, *Price:* Lv210,000

Standard Missile Pack for the Ritage-1:

Missiles per Pack: 8, *Mass of Pack:* 4.4 tons, *Volume of Pack:* 83 m³, *Surface Area Cost of Pack:* 35 m², *Reflective Signature Points:* 15, *Price of Pack:* Lv150,000

Bays for the Ritage-1:

Mass per Missile: 10 tons, *Volume per Missile:* 10 m³, *Exit Port for Missile:* 2 m²

FRENCH RITAGE-2 MISSILE

Combat Performance Data:

Movement: 8, *Radiated Signature:* 1, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −4, *Hull Hits:* 1/1/1, *Power Plant Hits:* 1/1, *Armament:* one 10×2 detonation laser, *Active Sensors:* none, *Passive Sensors:* none

Design Characteristics:

Warp Efficiency: 4.22, *Power Plant:* 0.2 MW Fuel Cell, *Fuel:* 0.27 tons, sufficient for three hours of operation, *Mass:* 14.27 tons, *Length:* 4.22 meters, *Diameter:* 2 meters, *Price:* Lv244,000

Standard Missile Pack for the Ritage-2:

Missiles per Pack: 4, *Mass of Pack:* 13.5 tons, *Volume of Pack:* 144 m³, *Surface Area Cost of Pack:* 50 m², *Reflective Signature Points:* 25, *Price of Pack:* Lv203,000

Bays for the Ritage-2:

Mass per Missile: 33.76 tons, *Volume per Missile:* 33.76 m³, *Exit Port for Missile:* 8 m²

ARGENTINIAN EM-1 MISSILE

Combat Performance Data:

Movement: 4, *Radiated Signature:* 2, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −3, *Hull Hits:* 2/1/1, *Power Plant Hits:* 8/2, *Armament:* one unlimited shot 1×1 laser, *Active Sensors:* none, *Passive Sensors:* 0,

Design Characteristics

Warp Efficiency: 1.91, *Power Plant:* 1.1 MW Fuel Cell, *Fuel:* 2.475 tons, sufficient for five hours of operation, *Mass:* 43.5 tons, *Length:* 8 meters, *Diameter:* 2 meters, *Price:* Lv540,000

Standard Missile Pack for the EM-1:

Missiles per Pack: 2, *Mass of Pack:* 16 tons, *Volume of Pack:* 133 m³, *Surface Area Cost of Pack:* 50 m², *Reflective Signature Points:* 25, *Price of Pack:* Lv420,000

Bays for the EM-1:

Mass per Missile: 64 tons, *Volume per Missile:* 64 m³, *Exit Port for Missile:* 4 m²

ARGENTINIAN EM-5D MISSILE

Combat Performance Data:

Movement: 6, *Radiated Signature:* 1, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −4, *Hull Hits:* 1/1/1, *Power Plant Hits:* 1/1, *Armament:* one 1×5 detonation laser, *Active Sensors:* none, *Passive Sensors:* 0

Design Characteristics:

Warp Efficiency: 3.25, *Power Plant:* 0.05 MW Fuel Cell, *Fuel:* 0.045 tons, sufficient for two hours of operation, *Mass:* 6.045 tons, *Length:* 8.4 meters, *Diameter:* 1 meter, *Price:* Lv430,000

Standard Missile Pack for the EM-5D:

Missiles per Pack: 4, *Mass of Pack:* 10 tons, *Volume of Pack:* 75 m³, *Surface Area Cost of Pack:* 30 m², *Reflective Signature Points:* 15, *Price of Pack:* Lv376,000

Bays for the EM-5D:

Mass per Missile: 16.8 tons, *Volume per Missile:* 16.8 m³, *Exit Port for Missile:* 2 m²

BRAZILIAN AAS-2 MISSILE

Combat Performance Data:

Movement: 3, *Radiated Signature:* 2, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −3, *Hull Hits:* 3/1/1, *Power Plant Hits:* 12/3, *Armament:* one unlimited shot 1×1 laser, targetting modifier −2, *Active Sensors:* none, *Passive Sensors:* 1

Design Characteristics:

Warp Efficiency: 1.48, *Power Plant:* 1.5 MW Fuel Cell, *Fuel:*

5.4 tons, sufficient for eight hours of operation, *Mass:* 60 tons, *Length:* 10 meters, *Diameter:* 3 meters, *Price:* Lv865,000

Standard Missile Pack for the AAS-2:

A missile pack was never designed for this missile.

Bays for the AAS-2:

Mass per Missile: 180 tons, *Volume per Missile:* 180 m³, *Exit Port for Missile:* 18 m²

BRAZILIAN AAS-2B MISSILE

The AAS-2B is identical to the original AAS-2 model in all respects except one. The AAS-2B has been refitted with a passive sensor with a range of 2. Otherwise all information is the same.

BRAZILIAN AAS-4 MISSILE

Combat Performance Data:

Movement: 4, *Radiated Signature:* 1, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −4, *Hull Hits:* 1/1/1, *Power Plant Hits:* 1/1, *Armament:* one 2×2 detonation laser, *Active Sensors:* none, *Passive Sensors:* none

Design Characteristics:

Warp Efficiency: 2.37, *Power Plant:* 0.075 MW Fuel Cell, *Fuel:* 0.27 tons, sufficient for eight hours of operation, *Mass:* 17 tons, *Length:* 6 meters, *Diameter:* 1.5 meters, *Price:* Lv355,000

Standard Missile Pack for the AAS-4:

Missiles per Pack: 4, *Mass of Pack:* 7 tons, *Volume of Pack:* 62 m³, *Surface Area Cost of Pack:* 30 m², *Reflective Signature Points:* 10, *Price of Pack:* Lv236,000

Bays for the AAS-4:

Mass per Missile: 27 tons, *Volume per Missile:* 27 m³, *Exit Port for Missile:* 4.5 m²

BRAZILIAN AAS-5 MISSILE

The AAS-5 missile is practically identical to its predecessor, the AAS-4. There are only a few differences. First, a drive with slightly better efficiency was installed, giving the AAS-5 a warp efficiency of 2.65 and a movement of 5. Second, a different weapon has been installed, a 5×2 detonation laser.

GERMAN SR-9 MISSILE

Combat Performance Data:

Movement: 6, *Radiated Signature:* 1, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −4, *Hull Hits:* 1/1/1, *Power Plant Hits:* 1/1, *Armament:* one 5×1 detonation laser, *Active Sensors:* none, *Passive Sensors:* none

Design Characteristics:

Warp Efficiency: 2.77, *Power Plant:* 0.1 MW Fuel Cell, *Fuel:* 0.09 tons, sufficient for two hours of operation, *Mass:* 10.8 tons, *Length:* 4 meters, *Diameter:* 1 meter, *Price:* Lv189,000

Standard Missile Pack for the SR-9:

Missiles per Pack: 12, *Mass of Pack:* 8 tons, *Volume of Pack:* 48 m³, *Surface Area Cost of Pack:* 25 m², *Reflective Signature Points:* 20, *Price of Pack:* Lv200,000

Bays for the SR-9:

Mass per Missile: 8 tons, *Volume per Missile:* 8 m³, *Exit Port for Missile:* 2 m²

GERMAN SR-10 MISSILE

Combat Performance Data:

Movement: 7, *Radiated Signature:* 1, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −4, *Hull Hits:* 1/1/1, *Power Plant Hits:* 1/1, *Armament:* one 4×3 detonation laser, *Active Sensors:* none, *Passive Sensors:* 0

Design Characteristics:

Warp Efficiency: 3.48, *Power Plant:* 0.1 MW Fuel Cell, *Fuel:* 0.09 tons, sufficient for two hours of operation, *Mass:* 10.4 tons, *Length:* 4 meters, *Diameter:* 1 meter, *Price:* Lv233,000

Packs and Bays for the SR-10:

The SR-10 uses the same bays and packs as the SR-9.

MANCHURIAN FANTAN MISSILE

Combat Performance Data:

Movement: 7, *Radiated Signature:* 1, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −4, *Hull Hits:* 1/1/1, *Power Plant Hits:* 1/1, *Armament:* one 5×2 detonation laser, *Active Sensors:* none, *Passive Sensors:* none

Design Characteristics:

Warp Efficiency: 3.56, *Power Plant:* 0.2 MW Fuel Cell, *Fuel:* 0.45 tons, sufficient for five hours of operation, *Mass:* 14.3 tons, *Length:* 7 meters, *Diameter:* 1.5 meters, *Price:* Lv530,000

Standard Missile Pack for the Fantan:

Missiles per Pack: 4, *Mass of Pack:* 7 tons, *Volume of Pack:* 70 m³, *Surface Area Cost of Pack:* 25 m², *Reflective Signature Points:* 25, *Price of Pack:* Lv159,000

Bays for the Fantan:

Mass per Missile: 31.5 tons, *Volume per Missile:* 31.5 m³, *Exit Port for Missile:* 4.5 m²

MANCHURIAN GLOWWORM MISSILE

Combat Performance Data:

Movement: 6, *Radiated Signature:* 1, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −4, *Hull Hits:* 1/1/1, *Power Plant Hits:* 1/1, *Armament:* one four shot 1×1 laser, *Active Sensors:* none, *Passive Sensors:* 3

Design Characteristics:

Warp Efficiency: 2.86, *Power Plant:* 0.1 MW Fuel Cell, *Fuel:* 0.45 tons, sufficient for ten hours of operation, *Mass:* 9.7 tons, *Length:* 5 meters, *Diameter:* 1 meter, *Price:* Lv320,000

Standard Missile Pack for the Glowworm:

Missiles per Pack: 5, *Mass of Pack:* 12 tons, *Volume of Pack:* 30 m³, *Surface Area Cost of Pack:* 20 m², *Reflective Signature Points:* 15, *Price of Pack:* Lv120,000

Bays for the Glowworm:

Mass per Missile: 10 tons, *Volume per Missile:* 10 m³, *Exit Port for Missile:* 2 m²

AMERICAN SIM-14 MISSILE

Combat Performance Data:

Movement: 7, *Radiated Signature:* 1, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −4, *Hull Hits:* 1/1/1, *Power Plant Hits:* 1/1, *Armament:* one 10×2 detonation laser, *Active Sensors:* none, *Passive Sensors:* 8

Design Characteristics:

Warp Efficiency: 3.304, *Power Plant:* 0.07 MW Fuel Cell, *Fuel:* 0.189 tons, sufficient for eight hours of operation, *Mass:* 5.62 tons, *Length:* 7 meters, *Diameter:* 1 meter, *Price:* Lv840,000

Standard Missile Pack for the SIM-14:

Missiles per Pack: 3, *Mass of Pack:* 8 tons, *Volume of Pack:* 25 m³, *Surface Area Cost of Pack:* 15 m², *Reflective Signature Points:* 15, *Price of Pack:* Lv400,000

Bays for the SIM-14:
Mass per Missile: 14 tons, *Volume per Missile:* 14 m³, *Exit Port for Missile:* 2 m²

RUSSIAN SILKA MISSILE

Combat Performance Data:
Movement: 6, *Radiated Signature:* 1, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −4, *Hull Hits:* 1/1/1, *Power Plant Hits:* 1/1, *Armament:* one 5×2 detonation laser, *Active Sensors:* none, *Passive Sensors:* none

Design Characteristics:
Warp Efficiency: 2.99, *Power Plant:* 0.1 MW Fuel Cell, *Fuel:* 0.045 tons, sufficient for one hour of operation, *Mass:* 12.3 tons, *Length:* 6 meters, *Diameter:* 1 meter, *Price:* Lv300,000

Standard Missile Pack for the Silka:
Missiles per Pack: 4, *Mass of Pack:* 12 tons, *Volume of Pack:* 28 m³, *Surface Area Cost of Pack:* 15 m², *Reflective Signature Points:* 15, *Price of Pack:* Lv120,000

Bays for the Silka:
Mass per Missile: 12 tons, *Volume per Missile:* 12 m³, *Exit Port for Missile:* 2 m²

KAFER WHISKEY MISSILE

Combat Performance Data:
Movement: 5, *Radiated Signature:* 1, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −3, *Hull Hits:* 1/1/1, *Power Plant Hits:* 2/1, *Armament:* one 7×2 detonation laser, *Active Sensors:* none, *Passive Sensors:* none

KAFER X-RAY MISSILE

Combat Performance Data:
Movement: 6, *Radiated Signature:* 0, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −4, *Hull Hits:* 1/1/1, *Power Plant Hits:* 2/1, *Armament:* one 14×2 detonation laser, *Active Sensors:* none, *Passive Sensors:* 2

Sensor Drones

FRENCH VOIR SENSOR DRONE

Combat Performance Data:
Movement: 11, *Radiated Signature:* 1, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −2, *Lateral Target Profile:* −3, *Hull Hits:* 1/1/1, *Power Plant Hits:* 10/2, *Armament:* none, *Active Sensors:* 10, *Passive Sensors:* 10

Design Characteristics:
Warp Efficiency: 5.85, *Power Plant:* 5 MW MHD Turbine, *Fuel:* 60 tons, *Mass:* 134 tons, *Length:* 10 meters, *Diameter:* 6 meters, *Price:* Lv 25,320,000

FRENCH VUE SENSOR DRONE

Combat Performance Data:
Movement: 10, *Radiated Signature:* 3, *Radial Reflected Signature:* 3, *Lateral Reflected Signature:* 3, *Radial Target Profile:* −2, *Lateral Target Profile:* −2, *Hull Hits:* 1/1/1, *Power Plant Hits:* 11/2, *Armament:* none, *Active Sensors:* 7, *Passive Sensors:* 10

Design Characteristics:
Warp Efficiency: 4.935, *Power Plant:* 4 MW MHD Turbine, *Fuel:* 32 tons, *Mass:* 103 tons, *Length:* 8.3 meters, *Diameter:* 4 meters, *Price:* Lv15,500,000

AMERICAN HD-5 "SCOUT" SENSOR DRONE

Combat Performance Data:
Movement: 9, *Radiated Signature:* 2, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −3, *Lateral Target Profile:* −3, *Hull Hits:* 1/1/1, *Power Plant Hits:* 10/2, *Armament:* none, *Active Sensors:* 13, *Passive Sensors:* 10

Design Characteristics:
Warp Efficiency: 4.636, *Power Plant:* 10 MW MHD Turbine, *Fuel:* 60 tons, *Mass:* 249 tons, *Length:* 10 meters, *Diameter:* 6 meters, *Price:* Lv37,000,000

GERMAN LH-22 SENSOR DRONE

Combat Performance Data:
Movement: 7, *Radiated Signature:* 1, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −3, *Lateral Target Profile:* −3, *Hull Hits:* 1/1/1, *Power Plant Hits:* 5/1, *Armament:* none, *Active Sensors:* 10, *Passive Sensors:* 5

Design Characteristics:
Warp Efficiency: 3.228, *Power Plant:* 3 MW MHD Turbine, *Fuel:* 15 tons, *Mass:* 95 tons, *Length:* 8.2 meters, *Diameter:* 4 meters, *Price:* Lv5,020,000

Submunition Dispensers

All submunitions have the following characteristics for combat. *Movement:* 0, *Radiated Signature:* 0, *Radial Reflected Signature:* 1, *Lateral Reflected Signature:* 1, *Radial Target Profile:* −4, *Lateral Target Profile:* −4, *Hull Hits:* 1/1/1, *Power Plant Hits:* 1/1, *Active Sensors:* none, *Passive Sensors:* none

The exact armament of the submunition and its dispenser vary from design to design.

GERMAN LHH-637 SUBMUNITION DISPENSER

Submunitions per Dispenser: 4, *Armament per Submunition:* one 2x4 detonation laser, *Mass of Full Dispenser:* 22 tons, *Reflected Signature Points of Dispenser:* 25, *Surface Area Cost of Dispenser:* 35 m², *Price of Dispenser:* Lv100,000, *Price per Submunition:* Lv97,000.

FRENCH LL-2 SUBMUNITION DISPENSER

Submunitions per Dispenser: 5, *Armament per Submunition:* one 3x1 detonation laser, *Mass of Full Dispenser:* 12 tons, *Reflected Signature Points of Dispenser:* 15, *Surface Area Cost of Dispenser:* 15 m², *Price of Dispenser:* Lv120,000, *Price per Submunition:* Lv55,000.

AMERICAN "GRAPE-SHOT" DISPENSER

Submunitions per Dispenser: 24, *Armament per Submunition:* one one-shot 1x1 laser, *Reflected Signature Points of Dispenser:* 30, *Surface Area Cost of Dispenser:* 35 m², *Price of Dispenser:* Lv230,000, *Price per Submunition:* Lv35,000

AMERICAN "BIG CLIP" DISPENSER

Submunitions per Dispenser: 3, *Armament per Submunition:* one 5x2 detonation laser, *Reflected Signature Points of Dispenser:* 20, *Surface Area Cost of Dispenser:* 25 m², *Price of Dispenser:* Lv175,000, *Price of Submunition:* Lv210,000

POWER PLANTS TABLE

MHD TURBINES

MW	Old Commercial m³	Old Commercial MLv	Old Military / New Commercial m³	Old Military / New Commercial MLv	New Military m³	New Military MLv
0.5	10	.1	—	—	—	—
0.6	12	.15	—	—	—	—
0.7	14	.175	10	.30	—	—
0.8	16	.2	—	—	—	—
0.9	18	.225	—	—	—	—
1.0	20	.25	15	.40	10	.8
2.0	40	.275	30	.45	20	.9
3.0	60	.3	40	.5	30	1.0
4.0	80	.35	55	.55	40	1.1
5.0	100	.4	70	.6	50	1.2
10.0	200	.7	135	1.2	100	2.4
15.0	300	1.1	200	1.9	150	3.8
20.0	400	1.4	250	2.6	200	5.2
25.0	500	1.6	340	3.4	250	6.8
50.0	1000	3.5	650	7.1	500	14.2
75.0	—	—	1000	10.5	750	20.5
100.0	—	—	—	—	1000	40.0

FUEL CELLS

MW	Old Commercial m³	Old Commercial MLv	Old Military / New Commercial m³	Old Military / New Commercial MLv	New Military m³	New Military MLv
0.01	.3	.05	.2	.1	.2	.2
0.02	.7	.1	.4	.2	.3	.3
0.03	1.0	.15	.6	.3	.4	.4
0.04	1.3	.2	.8	.4	.6	.6
0.05	1.7	.25	1.0	.5	.7	.7
0.06	2.0	.3	1.2	.6	.9	.9
0.07	2.3	.35	1.4	.7	1.0	1.0
0.08	2.7	.4	1.6	.8	1.1	1.2
0.09	3.0	.45	1.8	.9	1.3	1.3
0.1	3.3	.5	2.0	1.0	1.4	1.5
0.2	6.7	1.0	4.0	2.0	2.8	3.0
0.3	10.0	2.0	6.0	4.0	4.3	4.5
0.4	13.0	3.0	8.0	6.0	5.7	6.0
0.5	17.0	4.0	10.0	8.0	7.1	7.5
0.6	20.0	5.0	12.0	10.0	8.6	9.0
0.7	23.0	6.0	14.0	12.0	10.0	10.5
0.8	27.0	7.0	16.0	14.0	11.0	12.0
0.9	30.0	8.0	18.0	16.0	13.0	13.5
1.0	35.0	10.0	20.0	20.0	14.0	15.0
2.0	70.0	20.0	40.0	40.0	30.0	30.0
3.0	100.0	30.0	60.0	60.0	40.0	45.0
4.0	—	—	80.0	80.0	55.0	60.0

FISSION

MW	m³	MLv
15	1000	4
20	1300	6
25	1500	8
50	3000	16
75	5000	20
100	6500	24
120	8000	30
140	9000	35
160	10000	39
180	12000	42
200	13000	45
250	16000	51
300	20000	70

FUSION

MW	m³	MLv
150	5000	50
180	6000	90
200	6500	100
250	8000	150
300	10000	200

FUEL TABLE

Long-term Operations MHD	Long-term Operations Fuel Cell	Short-term Operations MHD	Short-term Operations Fuel Cell
100	75	0.60	0.45

Fuel per MW per week, in tons. Fuel per MW per hour, in tons. Fuel occupies 1.65 m³ per ton, always.

STUTTERWARP DRIVES TABLE

Power	Old Commercial (Var: 14.5) m³	tons	MLv	Old Military / New Commercial (Var: 16.05) m³	tons	MLv	New Military (Var: 17.5) m³	tons	MLv
0.01	3	3	0.6	3	3	2.0	3	3	3.6
0.02	3	4	0.8	4	4	2.5	4	4	4.6
0.03	3	4	0.9	4	5	2.9	5	5	5.2
0.04	4	5	1.0	5	5	3.2	5	5	5.7
0.05	4	5	1.1	5	5	3.4	5	6	6.2
0.06	4	5	1.2	5	6	3.7	6	6	6.6
0.07	5	5	1.2	6	6	3.9	6	7	7.0
0.08	5	6	1.3	6	6	4.0	6	7	7.2
0.09	5	6	1.4	6	7	4.2	7	7	7.6
0.1	5	6	1.5	6	7	4.3	7	7	7.9
0.2	6	8	1.7	8	9	5.5	8	9	9.9
0.3	7	9	2.0	9	10	6.3	10	11	11.4
0.4	8	10	2.2	10	11	7.0	10	12	12.5
0.5	8	11	2.4	10	12	7.5	11	13	13.5
0.6	9	11	2.5	11	12	7.9	12	13	14.2
0.7	9	12	2.7	12	13	8.4	12	14	14.7
0.8	10	12	2.8	12	14	8.8	13	15	15.7
0.9	10	13	2.9	13	14	9.1	14	15	16.4
1	10	14	3.0	13	15	9.7	14	16	17.5
2	13	17	3.9	16	19	12.0	17	20	21.2
3	14	19	4.2	18	21	13.5	20	24	25.0
4	16	21	4.8	20	24	15.0	22	26	27.5
5	17	23	5.1	22	26	16.5	24	28	30.0
10	22	30	6.6	27	32	20.2	29	34	36.2
15	25	33	7.5	31	36	23.2	33	39	41.2
20	27	36	8.1	34	40	25.5	37	44	46.2
25	29	39	8.7	37	44	27.7	40	47	50.0
50	37	49	11.1	46	54	34.5	50	59	62.5
75	42	56	12.6	53	62	39.7	57	67	71.2
100	46	61	13.8	58	68	43.5	63	74	78.7
120	49	65	14.7	62	73	46.5	67	79	83.7
140	52	69	15.6	65	76	48.7	70	82	87.5
150	53	71	15.9	67	79	50.2	72	85	90.0
160	54	72	16.2	68	80	51.0	73	86	91.2
180	56	75	16.8	71	83	53.2	77	91	96.2
200	58	77	17.4	74	87	55.5	79	93	98.7
250	63	84	18.9	79	93	59.2	85	100	106.2
300	67	68	20.1	84	99	63.0	91	107	113.7

STANDARD HULL SECTIONS TABLE

(10-meter-long cylindrical sections)

Diam	m²	m³	Mat	Diam	m²	m³	Mat
3	94	70	2	18	565	2550	12
6	188	280	4	21	660	3460	13
9	280	635	6	24	750	4525	15
12	375	1130	8	27	850	5725	17
15	471	1770	10	30	950	7050	19

Diam=diameter of hull section, *m³*=interior volume of hull section, *m²*=surface area of hull section, *Mat*=material volume of hull section.

Custom Hull Formulas: The internal volume of a cylinder is $\pi r^2 h$. The surface area is $2\pi rh + 2\pi r^2$.

HULL MATERIALS TABLE

Material	Signature Multiplier	MLv per m³	Tons per m³	Armor Multiplier
Metallic	1.0	1,000	8	×4
Synthetic	0.6	15,000	4	×4
L.P. Synthetic	0.3	35,000	3	×4
Advanced Synthetic	0.1	75,000	2	×3
Composite	0.6	50,000	3	×2
Advanced Composite	0.2	100,000	2	×1

HULL MASKING TABLE

Type	Area per MW	Price per MW
Basic	5	1,000
Extensive	10	5,000
Advanced	12	10,000

For all types of masking, volume in m³ is equal to surface area/4. Mass in tons is equal to 2×m³.

SENSORS TABLE

NAVIGATIONAL SENSORS

Navigation Radar: Takes 20 m² of hull surface area, has a volume of 5 m³, a mass of 1 ton and costs Lv20,000.

Deep System Scanner: Takes 30 m² of hull surface area, has a volume of 15 m³, a mass of 20 tons and costs Lv100,000.

Gravitational Scanner: Takes 50 m² of hull surface area, has a volume of 20 m³, a mass of 40 tons and costs Lv130,000.

SURVEY SENSORS

Cartographic Sensors: Take 10 m² of hull surface area, and they mass 1 ton per m³ of volume.

Type	*Volume*	*Price*
Minimal	5 m³	20,000
Standard	8 m³	30,000
Advanced	10 m³	60,000

Life Sensors: Take 30 m³ of hull surface area and mass 1 ton per m² of volume.

Type	*Volume*	*Price*
Minimal	10 m³	100,000
Standard	15 m³	300,000
Advanced	15 m³	800,000

ACTIVE SENSORS

All use 10 m² of hull surface area for the antennae. Additional antennae may be mounted for 10 percent of the base cost of the system. (This adds redundancy for purposes of absorbing battle damage. It has no other effect.) All use 10 m³ of hull volume and mass 1 ton.

Range	*CS*	*Lv*	*MW*
5	35	200,000	1
7	41	300,000	1
10	33	400,000	3
10	0	600,000	2
13	53	1,000,000	5
13	0	1,500,000	4
15	66	1,600,000	8
15	0	2,000,000	7
16	31	2,000,000	7
16	0	2,300,000	6

PASSIVE SENSORS

All use 30 m² of hull surface area for the array. Additional antennae arrays may be mounted for 10 percent of the base cost of the system. (This adds redundancy for purposes of absorbing battle damage. It has no other effect.) All use 10 m³ of volume and mass 1 ton.

Range	*CS*	*Lv*
0	10	100,000
1	34	100,000
3	18	400,000
3	4	500,000
5	10	600,000
5	0	800,000
6	36	400,000
6	6	700,000
10	38	900,000
10	1	1,200,000
12	41	3,000,000
12	10	5,000,000

WEAPONS TABLE

LASERS

Guiscard LL-98: *Type:* Laser, *Damage:* ×1, *Targetting:* none integral, *Price:* Lv97,000, *Volume/Mass:* 1

Guiscard LL-88: *Type:* Laser, *Damage:* ×1, *Targetting:* −1, *Price:* Lv58,000, *Volume/Mass:* 1

Hyde Dynamics EA 122: *Type:* Laser, *Damage:* ×1, *Targetting:* +1, *Price:* Lv105,000, *Volume/Mass:* 3

Hyde Dynamics EAA 1000: *Type:* Laser, *Damage:* ×2, *Targetting:* +1, *Price:* Lv174,000, *Volume/Mass:* 4

PARTICLE ACCELERATORS

Allen BMZ 150MW PBWS: *Type:* Particle Accelerator, *Damage:* ×3, *Targetting:* -2, *Price:* Lv212,000, *Volume/Mass:* 8

DunArmCo ALS-22: *Type:* Particle Accelerator, *Damage:* ×2, *Targetting:* -3, *Price:* Lv146,000, *Volume/Mass:* 8

WEAPONS MOUNTS TABLE

External Mount: *Hull Area:* 30 m², *Mass/Volume:* 1, *Price:* Lv10,000, *Aspects:* 4

Masked Turret: *Hull Area:* 30 m², *Mass/Volume:* 1×weapon m/v, *Price:* Lv35,000, *Aspects:* 4

Jack Turret: *Hull Area:* 30 m², *Mass/Volume:* 3×weapon m/v, *Price:* Lv120,000, *Aspects:* 3

Target Tracking Array (TTA): *Hull Area:* 30 m², *Mass:* 2 tons, *Price:* Lv40,000, *Aspects:* All

To add Unified Target Engagement System (UTES): *Mass/Volume:* +2, *Price:* +Lv200,000

TARGET PROFILE TABLE

Viewed Target Area at most	*Target Profile*	*Viewed Target Area at most*	*Target Profile*
5	−4	6400	+4
30	−3	9500	+5
115	−2	13700	+6
315	−1	19000	+7
710	+0	26000	+8
1400	+1	35000	+9
2500	+2	45000	+10
4100	+3	>4500	+11

SCREENS TABLE

Old Military

Rating	*m³*	*m²*	*MW*	*Lv*
1	20	40	1	1,500,000
2	30	40	8	3,000,000
3	40	40	18	5,000,000
4	50	40	32	7,000,000

Current Military

Rating	*m³*	*m²*	*MW*	*Lv*
1	10	30	1	2,000,000
2	20	30	4	3,500,000
3	30	30	9	6,000,000
4	40	30	16	8,000,000
5	50	30	25	12,000,000
6	60	30	36	15,000,000

DESIGN CHECKLIST

1. Conceptualization.
Decide the approximate size and purpose of the ship being designed.

2. Power Plant.
Using the Power Plant Table, choose a power plant for the ship.

3. Fuel.
Based on the megawattage of the power plant, determine necessary fuel.

4. Thrusters.
Decide if the ship needs thrusters. Also, decide if the ship will be streamlined.

5. Drive.
Using the Stutterwarp Drive Table, pick a stutterwarp for the ship.

6. Crew and Workstations.
6A. Large Ships. Determine the number of personnel and workstations required for the bridge, tactical action center, engineering, shipboard vessels, security, troops, steward, scientific, and medical sections.

6B. Small Ships. Determine the number of crew members and provide a cockpit for each.

7. Accommodations and Life Support (large ships only).
Provide accommodations for all crew and passengers. Decide if a spin habitat will be installed. Finally, provide life support for all personnel.

8. Sensors.
Using the Sensors Table, pick any number of navigational, survey, active, and passive sensors.

9. Weapons.
Using the Weapons Table, pick and assemble weapons and mounts. Decide whether UTES or TTA systems required. Also, if missile bays or packs and submunition dispensers should be considered.

10. Screens.
Using the Screens Table, pick a screen generator for the ship.

11. Hangar Decks.
If the ship is to house other vessels, provide hangar decks at this time.

12. Hull Masking.
Using the Hull Masking Table, provide the ship with a level of masking, if desired.

13. Hull.
Using the Standard Hull Sections Table, construct a hull for the ship. Make certain all components fit into or on the hull. If armoring is desired, adjust the hull accordingly.

14. Streamlining and Thruster Fuel.
Take into account the effects of streamlining on the hull at this time. Also, provide interior fuel tankage for thrusters.

15. Cargo.
Any excess area can be devoted to cargo space, provided bracing is installed.

16. Pylons.
Exterior fixtures in excess of the total exterior surface area of the hull must be placed on pylons.