STARCLUSTER 2
STARSHIP CONSTRUCTION AND ENGINEER'S GUIDE

BY
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ILLUSTRATIONS BY CLASH BOWLEY

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INTRODUCTION

The engineer has perhaps one of the least understood jobs on a starship. Everyone knows the engineer is in charge of the drives, but there's a whole lot more involved in being an engineer than drives, although that is plenty to be responsible for. In this guide for engineers, we will try and detail what an engineer is and what he does. Shipboard maintenance workers work for Engineering, and are responsible for the care and upkeep of the minor systems, but they do not have the depth of knowledge or skills to replace an engineer.

Several systems are involved in running a starship. They are all interrelated, and the engineer is responsible for all of them. We have laid out the ship, system by system, to show how things work and how the engineer earns his salary. We hope it will entertain and enlighten you.

STARCLUSTER SPACESHIP DESIGN

Designing and building a spaceship in StarCluster can be done both out of the game by the GM and players and in the game by the characters. Spaceships can be hideously expensive. Even a modest pod can cost more than any single player character can afford. Players can pool their moneys and purchase a small craft, or perhaps they have during the course of play gained a spacecraft through whatever means. Older craft can be traded in for newer craft at 60-80% of the original purchase price. Used ships can be bought for 70-90% of the original cost. The exact percentage is best left to the GM and depends on the condition of the ship. At the discretion of the GM, a player may have inherited a craft.

Players enjoy designing their own craft, and take real pride in their designs. The Bahamut class vessel appended after the tables was designed in character by a player. Each type of spaceship has its own particular design compromises. Small craft are tight and cramped. Large ships are monstrously expensive. Jump Ships lose a tenth of their volume to the Jump Drive, and faster vessels need larger A-Grav which also takes up volume. Speed always restricts cargo area which restricts cool features. Always keep firmly in your mind the *reason the spaceship was designed.* A freighter will not have a tiny cargo area. A Courier ship will always be fast. An exploration vessel will have labs and cargo area for vehicles. A non-atmospheric ship without a shuttle is restricted to Starport types C and D with their orbital components.

The tech level of the construction yard is vitally important. Jump Drive and Mattran are TL10 technologies, and a TL9 or 8 yard cannot possibly install them. Similarly, anything involving A-Grav - this includes weapons pods, studios, weight rooms, etc. - is TL9 technology, and a TL8 yard simply cannot build it. Be careful of this. On TL8 ships, since weapons are not in pods, the hull shape affects what weapons will bear on the target. This should also be kept in mind.

Spacecraft generally run two shifts, Mainday and Alterday. Mainday, all stations are occupied. On Alterday, only certain stations need to be manned. These are Pilot, Scan, Comm, and Shields. All other stations are optional. Some ships duplicate these stations in an Alterday bridge. This is also very useful in combat should the main bridge be destroyed. Robots do not need to sleep, but they do need to rest from work. This refreshes their brains, particularly self-aware robots. They can share their owner's room, though, and do not need beds.

INSTRUCTIONS FOR DESIGNING AND BUILDING SPACECRAFT

Determine the tech level of the builders of the craft. This one determination affects any possible solution to building. All Spaceship components are separated by system. Any components from the yard's tech level or lower may be used in ship construction.

Decide on the hull tonnage of the craft. The raw cost of the tonnage is not used in the final cost of the ship, it is only used as modified by the hull shape. Choose a hull shape and multiply the preliminary cost by the shape factor. Remember shape factors 1-3 are non-atmospheric and cannot land on a planetary surface if there is an atmosphere present. "Hull tonnage" always refers to the total mass of the ship, not the tonnage of the hull alone.

Add in the large, vital systems like drives. Set aside enough fuel space. Fuel space given for G-Drive and Mini G-Drive is Factor 1, which is enough to run the ship for approximately 100 hours. This can be increased for longer voyages. Remember the tech level.

Establish the crew stations you need, and add those which are optional if desired. Add up all the crew and add in housing, Galley (kitchen) space, and a suitably large Lounge/Game Room. The Galley and Lounge space given in the tables are a minimum, and the crew and passengers will thank you if you overbuild them. Remember the Alterday crew and possible passengers when you apportion space. Remember also that while robots need not be counted in housing, they *do* need to be counted for Lounge space. These sophisticated robots do not sleep, but they need to relax. Don't forget the WC! Some crew quarters will have a WC built in, and these do not have to be provided for separately.

Add in the desired weapons. Pods require space in the ship's bay or weapons bays, and turrets require recessing and fairing on atmospheric ships. In these cases, do not add the pod or turret itself to the tonnage. Instead, add it into the space required under ship's bay. Weapons which are built in-line, that is aimed by aiming the ship, do not need a gun station as they can be fired by the pilot. Remember to set aside space for payload when using a mass driver. These are like bullets in a gun. When you run out of bullets, you can't shoot the gun. The same applies for missiles and other projectile weapons.

Add in any optional components at this point. Things like Hydroponics, Holorooms, Swimming Pools, and Theatres. The more of these a ship has, the more specialized its purpose. Any remaining space should be allotted to cargo.

TECH LEVEL 7 SPACECRAFT DESIGN GUIDE

On Tech Level 7 ships, the problems of fuel usage are paramount. TL 7 engines are gluttonous, and suck down fuel in an astonishing manner. The typical fuel factor on a TL 7 ship is 10 minutes, excepting only Orion Engines. The use of fission drives such as Nerva or Orion in a planet-to-orbit situation is discouraged, because of the environmental impact, but it is perfectly possible, and many TL 7 cultures set aside uninhabited areas to use as launch sites. Of the 2 fission drives, Nerva is cleaner, but Orion is a far better mass lifter. Except for Orion craft, the typical TL 7 ship boosts up to orbit using all it's fuel and enough strap-on boosters to make up the difference, and refuels in orbit. Orion craft have plenty of lift, but use up between 25 and 100 bombs to achieve orbit, depending on how dirty you want to get (you can decrease the kiloton yields and throw down more bombs to be cleaner) and the gravity of the world in question.

Tech Level 7 ships - no small craft are possible with these drives - typically boost for short periods of time, and spend extended periods in weightlessness. Centrifuges and Rotating Sections are paramount in combatting bone mass and muscle mass loss. Consequently, TL 7 ships tend to be oriented axially for spin rather than along the axis of thrust. Periods of boost are just too short in comparison to the periods of no boost to bother with.

TECH LEVEL SPACECRAFT DESIGN GUIDE

With Tech Level 8 ships, space travel becomes cheap and practical. In contrast to the 10 minute thrust fuel factor, or even the hour long fuel factor of Orion ships, the fusion drives of Tech Level 8 are factored in units of 100 hours. Continuous thrust travel is suddenly practical, though at one G and below only. Tech Level 8 ships are roomy and fast, and any place in the system is accessible in a matter of days, rather than months.

Tech Level 8 ships tend to use continuous boost to achieve fast transit times, and the floors of TL 8 ships are built perpendicular to the thrust axis. No need for revolving sections or centrifuges, although those technologies can be used to save on fuel. The main difference in the 2 fusion drives available is monetary. Deuterium fuel ships have small, cheap engines, but the fuel itself is very expensive. Protium drive ships use plain, cheap hydrogen for fuel, but the drives are expensive and much larger than deuterium drives.

Ships are usually assembled in orbit in TL 8 cultures. Space stations are roomy and practical, and energy is cheap. Space stations in TL7 cultures generally are scientific in nature and run at a great loss, but at TL8, they become profitable. Asteroids and small moons are mined for metal, and any materials not available are shuttled up to orbit by the same methods as TL 7 cultures use or by fusion atmospheric ships, which become available in later TL 8. One interesting possibility is that TL 8 cultures can build Beanstalks, which are essentially space elevators, at enormous cost, but once completed, surface-to-orbit transfer is extremely cheap.

At Tech Level 8, true colonization of other worlds is possible and practical. Trade between worlds is common, and contact with other cultures routine.

TECH LEVEL 9 SPACECRAFT DESIGN GUIDE

Tech Level 9 is rich with possibilities. The routine use of gravity is the defining technology of TL 9. Moving mass from surface-to-orbit becomes trivial. Matter-Antimatter drives become practical with control of gravity, and space travel becomes even cheaper than with fusion drives. High G thrusts are practical, as artificial gravity can be used to counteract the pseudo-gravity of the thrust.

Tech Level 9 ships have decks which are typically parallel to the axis of thrust, although they can be oriented in any direction at all. Use of arbitrary gravity allows luxuries like swimming pools and zero-G sports and sleeping plates where you sleep floating in mid-air. Large ships routinely land on planet. Pods are not only practical, they become attractive, and affordable even to a person of relatively modest means. No more expensive, really, than an airplane in TL 7 cultures.

TECH LEVEL 10 SPACECRAFT DESIGN GUIDE

Tech Level 10 is, by contrast with TL 9, fairly non-earthshaking. The main difference is the existence of very fast movement between stars. TL 9 cultures were limited to long inter-stellar voyages at relativistic speeds. Jump Drive radically changes that, and trade between stars becomes as practical - and nearly as cheap - as trade within a system. TL10 ships generally use anti-methane rather than anti-hydrogen because it is far denser. One can pack a ton of anti-methane into 1/15 the space required by a ton of anti-hydrogen. The same - of course - applies to methane vs. water vs. hydrogen matter fuels, also. Anti-water is much more difficult to synthesize, so is generally not available. The drives, of course, don't care what M or AM fuel they use.

THE STRUCTURAL SYSTEM

The structural systems are part of the hull package, and are integral to the ship. The structural systems support the ship, and everything depends from them.

THE HULL SUBSYSTEM

An aerodynamic (factor four and above) vessel's hull is a strong and rigid shell, and the interior of the vessel is attached to the hull in a monocoque construction method. Usually there is a double hull, with an inner, pressurized hull attached to an outer, armored, unpressurized hull by shock absorbing columns. Decks are spanned across the inner hull on strong beams, and are each sealable with bulkhead partitions in case of rupture. Decks are generally three meters apart, with a dropped ceiling containing ventilation, data lines, water supplies, and access tubes. The outer hull is armored somewhat to protect from damage via weapons or collisions, and this armoring can be optionally upgraded. Airlocks, turrets, cabling, and bay doors pierce the outer hull where needed. The hull is designed to distribute drive loads evenly, and protect the internal hull from damage. Changes to the hull on aerodynamic hull shapes should only be made by competent shipyards, otherwise hull integrity can be severely compromised.

For non-aerodynamic hulls, the girder-frame construction method is used. This allows maximum strength with maximum versatility, as hull components are attached to strong, stiff girders and built out from there. The drives are directly attached to and thrust against the girders. Armoring is done around the outermost modules. Factor one (connected) hulls are very open and strung out. Factor two (cubic) hulls are bunched together with a distinct interior and exterior. Factor three (globular) hulls are built with a girder framework inside a spherical armored skin, for a somewhat transitional structure

The Basic Hull Package covers not only the hull, but also certain other subsystems - namely **Docking Connector**, **In-Ship Comm, Radio Comm, Maser Comm, Retractable Landing Gear, Standard Grade Attitude Jets, HVAC,** and **Waste Recycling**. If you want to customize the Basic Hull Package, use the Bare Hull Tonnage column and add the tonnages and costs of the items you want (i.e. Courier Grade Attitude Jets) separately. For example, fighter small craft do not need **HVAC** or **Waste Recycling** as they depend on the crew's vac suits for such necessities, and don't usually need **Docking Connectors** or **Retractable Landing Gear**. The Bare Hull Tonnage column gives only the hull without any included systems - not even an airlock.

STARSHIP HULLS

ITEM	DESCRIPTION	COST	BASIC HULL PACKAGE TONNAGE	BARE HULL TONNAGE	TL	REQ'D SKILL
FACTOR 1 HULL	CONNECTED	100CR/TON	TOTAL SHIP TONNAGE *.02	TOTAL SHIP TONNAGE *.012	7	N/A
FACTOR 2 HULL	CUBIC	200CR/TON	TOTAL SHIP TONNAGE *.02	TOTAL SHIP TONNAGE *.012	7	N/A
FACTOR 3 HULL	GLOBULAR	300CR/TON	TOTAL SHIP TONNAGE *.02	TOTAL SHIP TONNAGE *.012	7	N/A
FACTOR 4 HULL	OVOID	400CR/TON	TOTAL SHIP TONNAGE *.02	TOTAL SHIP TONNAGE *.012	7	N/A
FACTOR 5 HULL	DISCOID	500CR/TON	TOTAL SHIP TONNAGE *.02	TOTAL SHIP TONNAGE *.012	7	N/A
FACTOR 6 HULL	WEDGE/WINGED	600CR/TON	TOTAL SHIP TONNAGE *.02	TOTAL SHIP TONNAGE *.012	7	N/A
FACTOR 7 HULL	CONE	700CR/TON	TOTAL SHIP TONNAGE *.02	TOTAL SHIP TONNAGE *.012	7	N/A
FACTOR 8 HULL	NEEDLE	800CR/TON	TOTAL SHIP TONNAGE *.02	TOTAL SHIP TONNAGE *.012	7	N/A

THE DOCKING SUBSYSTEM

The docking system consists of various airlocks, personnel and cargo elevators, and the docking connector itself. The docking connector is sometimes built out from the hull into a docking spur, and sometimes is recessed into the hull. The docking connector mates with a station's dock to form a single rigid attachment. The other elements of the system can be integral to the connector, or can be separate and connected by tubes. The vessel connects to the station by means of grapples, gravitic, magnetic, or mechanical, and the craft is maneuvered into docking position via the grapples. The connectors on the craft and the station are aligned, and pushed together to mate. The grapples and connectors on the various types of station dock are downward compatible, but not upward compatible. That is, a small craft can dock at a medium or large station dock, but a medium sized ship cannot dock at a station's small craft dock, as the connections and grapples are not strong enough. As docking connectors are male - the station docks are female - two ships cannot directly dock together without a double ended female tube (called a docking ring adapter) for each to connect to. I

Item	Description	Cost	Tonnage	TL	Req'd Skill
Docking Connector	Allows Docking to Stations	100 cr each	5 tons	7	N/A
Docking Ring Adaptor	Allows Docking to other Ships	50 cr each	5 tons	7	Mechanics +1

EMERGENCY AIRLOCK SUBSYSTEM

Emergency airlocks are not normally used, but are available for use if necessary. They do not have docking structures and are thus lighter and less expensive than a docking system. They are used for extra-vessel activities such as hull area repairs and for use in emergency situations where the docking system is damaged. Vessels can be built with only emergency airlocks, but these cannot mate with station docks and are not typical on larger small crafts and ships.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Emergency Airlock	Allows passage through hull	50 cr each	2.5 tons	7	N/A

SHIP'S BAY SUBSYSTEM

The Ship's Bay and Weapon Bays are huge airlocks with equipment for bringing in small craft or pods. The craft can be accessed when the bays are filled with air., and are protected from atmospheric drag or weapons fire when sealed in. Fairings are blisters in the hull metal designed to shield turrets and reduce drag during atmospheric transit. The turret is retracted into its Fairing and cannot be fired until it is brought back to firing position. A Rptating Section contains living quarters rotated for pseudogravity for TL 7 and 8 ships.

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Item	Description	Cost	Tonnage	TL	Req'd Skill
Weapons Bay	Enclosure for carried weapon pods	100cr/Ton	Pod Mass * 0.1 Tons	9	N/A
Ship's Bay	Enclosure for carried small craft	100cr/Ton	Craft Mass * 0.1 Tons	7	N/A
Fairing	Turret drag minimizer	100cr/Ton	Turret Mass * 0.1 Tons	7	N/A
Rotating Section	Entire section roataes for Pseudogravity	100 cr/Ton	rotated components * 0.25 Tons	7	N/A

THE DRIVE SYSTEMS

The ship's drive systems are the central area of responsibility for an engineer. Not only do the drive systems move the ship, they supply power to all the other systems on board. Even space stations have drives, both for internal power and for attitude control and stabilization.

THE G-DRIVE AND MINI-G DRIVE SUBSYSTEM

G-Drives and Mini-G Drives are Matter/AntiMatter (M/AM) drives. They both combine matter and antimatter and use the resulting reaction to drive the ship forward. Like fusion drives, M/AM drives use constant acceleration, that is they accelerate in one direction to a turnover point, turn around, then decelerate the rest of the way. This means that the speed they reach is dependant on the amount of time they are able to accelerate, and is constantly changing. Usually, the turnaround point is halfway, and the rate of acceleration and deceleration are the same. This is not necessarily true all the time, however.

The standard ratio of M to AM is 1:1. This is not necessarily the best ratio to use. A 1:1 ratio ensures that all matter and antimatter is thoroughly consumed, leaving no appreciable residue in the exhaust. This is known as a "stealth" mix, because a ship using a 1:1 M/AM ratio is untraceable to all intents after a very short period. By increasing the ratio of M to AM, thrust increases enormously, as unconsumed M pours out of the exhaust as reaction mass. Typically, a trading ship - a merchanter - will have the smallest engines possible, and run on a very lean ratio of AM to M. This gives the maximum thrust for the least cost, as anti-hydrogen fuel is 200 times more expensive than liquid hydrogen matter fuel. Also, the total **rate** of fuel used can be increased to the limit of the drive, the faster the fuel goes in the faster the ship will go.

The size of the engines dictates the ship's **reserve thrust**. This reserve thrust is the amount of thrust able to be achieved in emergency situations by increasing the M to AM ratio. Merchanters generally have very little reserve thrust, while military vessels and couriers generally have huge amounts of reserve thrust. This reserve thrust can be used for fast, fuel gulping transits, or for quick maneuvering in combat or emergency situations. To illustrate this, let us take 2 small craft, a typical 100 ton merchanter small craft, and a typical 100 ton courier small craft:

The merchanter small craft will devote 2 tons to its G-Drive, eschewing Mini-G drive as uneconomical. The standard mix on such a ship would perhaps be a 4% mix at a low rate. Assuming 1G thrust (it can be lower or higher depending on the flow rate) the small craft would have 40 hours of fuel per ton of M, and 1600 hours of fuel per ton of AM. Let us assume the merchanter carries 5 tons of M and one of AM. The total hours of boost at 1G is now 200. If there were an emergency situation, the merchanter could achieve an acceleration of 4 Gs, but at such a rate of M fuel use that it would only have 5 hours of thrust per ton of M and 1000 hours of thrust per ton of AM. That means the ship would have a maximum of 25 hours of thrust at this rate, as the ship's tankage is M limited, that is the duration is limited by the amount of Matter it carries, not the amount of AM. See the following chart for some typical mixes.

G-Drive- Assumes 20 ton Small Craft. Scale accordingly. *

Description	AM Flow (kg/hour)	M Flow (kg/hour)	AM Frac. 100%	Thrust (ton-G)	Engine Weight (tons)	Thrust Ratio (per G)	AM Tonnage 100 Hours	M Tonnage 100 Hours	Acceleration (Gs)
Stealth Mix	1	1	50%	20	1.000	20.0	0.1	0.1	1
Clean Mix	1	2	33%	28.28	1.000	28.3	0.1	0.2	1.4
Cruise Mix	1	9	10%	60	1.000	60.0	0.1	0.9	3
Full Mix	1	25	4%	100	1.000	100.0	0.1	2.5	5
Overdrive Mix	1	100	1%	200	1.000	200.0	0.1	1.0	10
Stealth Mix	1	1	50%	20	1.000	20.0	0.1	0.1	1
20% Mix	0.5	2	20%	20	1.000	20.0	0.05	0.2	1
10% Mix	0.333	3	10%	20	1.000	20.0	0.03	0.3	1
4% Mix	0.2	5	4%	20	1.000	20.0	0.02	0.5	1
1% Mix	0.1	10	1%	20	1.000	20.0	0.01	1.0	1

MINI-G DRIVE- ASSUMES 50 TON SMALL CRAFT. SCALE ACCORDINGLY

DESCRIPTION	AM FLOW (KG/ HOUR)	M FLOW (KG/ HOUR)	AM FRAC. 100%	THRUST (TON-G)	ENGINE WEIGHT (TONS)	THRUST RATIO (PER G)	AM TONNAGE 100 HOURS	M TONNAGE 100 HOURS	ACCELERATION (GS)
STEALTH MIX	5	5	50%	50	1.000	50.0	0.5	0.5	1
CLEAN MIX	5	10	33%	70.71	1.000	70.7	0.5	1.0	1.4
CRUISE MIX	5	45	10%	150	1.000	150.0	0.5	4.5	3
FULL MIX	5	125	4%	250	1.000	250.0	0.5	12.5	5
OVERDRIVE MIX	5	500	1%	500	1.000	500.0	0.5	50.0	10
STEALTH MIX	5	5	50%	50	1.000	50.0	0.5	0.5	1
20% MIX	2.5	10	20%	50	1.000	50.0	0.25	1.0	1
10% MIX	1.667	15	10%	50	1.000	50.0	0.17	1.5	1
4% MIX	1	25	4%	50	1.000	50.0	0.1	2.5	1
1% MIX	0.5	50	1%	50	1.000	50.0	0.05	5.0	1

* EXAMPLE OF SCALING: 100 TON SMALL CRAFT, 2 TON G-DRIVE, 1 TON AM FUEL, 1 TON M FUEL.
AM FLOW AND M FLOW MULTIPLIED BY 2, ACCELERATION MULTIPLIED BY 0.2
M DURATION = DURATION OF MATTER FUEL
AM DURATION = DURATION OF ANTI-MATTER FUEL
CONTINUOUS THRUST IS LIMITED TO THE LESSER DURATION

MIX	THRUST (TONS)	ACCELERATION (GS)	M DURATION	AM DURATION
STEALTH MIX	40	0.4	500 HOURS	1000 HOURS
CLEAN MIX	56.56	0.56	200 HOURS	1000 HOURS
CRUISE MIX	120	1.2	56 HOURS	1000 HOURS
FULL MIX	200	2.0	20 HOURS	1000 HOURS
OVERDRIVE MIX	400	4.0	5 HOURS	1000 HOURS
1% MIX	40	0.4	50 HOURS	10000 HOURS
4% MIX	40	0.4	100 HOURS	5000 HOURS
10% MIX	40	0.4	333 HOURS	3003 HOURS
20% MIX	40	0.4	500 HOURS	2000 HOURS

As our courier small craft is not concerned as much with economy and cargo space, it carries not only a much larger drive, but much larger tankage. The drive is ten times larger than that of the merchanter, at 20 tons. This is capable of producing 4 Gs at standard (Stealth) mixture. Typically, the vessel will use Cruise Mix, which gives it a sustained acceleration of 12 Gs. This mix gives 5.6 hours per ton of M fuel and 100 hours per ton of AM Fuel. The vessel will carry 2 ton of AM and 20 tons of M, giving it 200 hours of AM and 112 hours of M fuel. The small craft is thus M limited. The small craft is capable of emergency acceleration using Overdrive Mix of 40 Gs, much higher than the humanoid body can withstand. Even using Full Mix, the 20 Gs resulting are more than a humanoid can take for more than very short periods, even using A-Grav compensation. Using Full Mix, the courier small craft has a duration of 2 hours per ton of M fuel, and 100 hours per ton of AM fuel. The M fuel is thus limited to 40 hours at 20 Gs, assuming the humanoid body could take that acceleration.

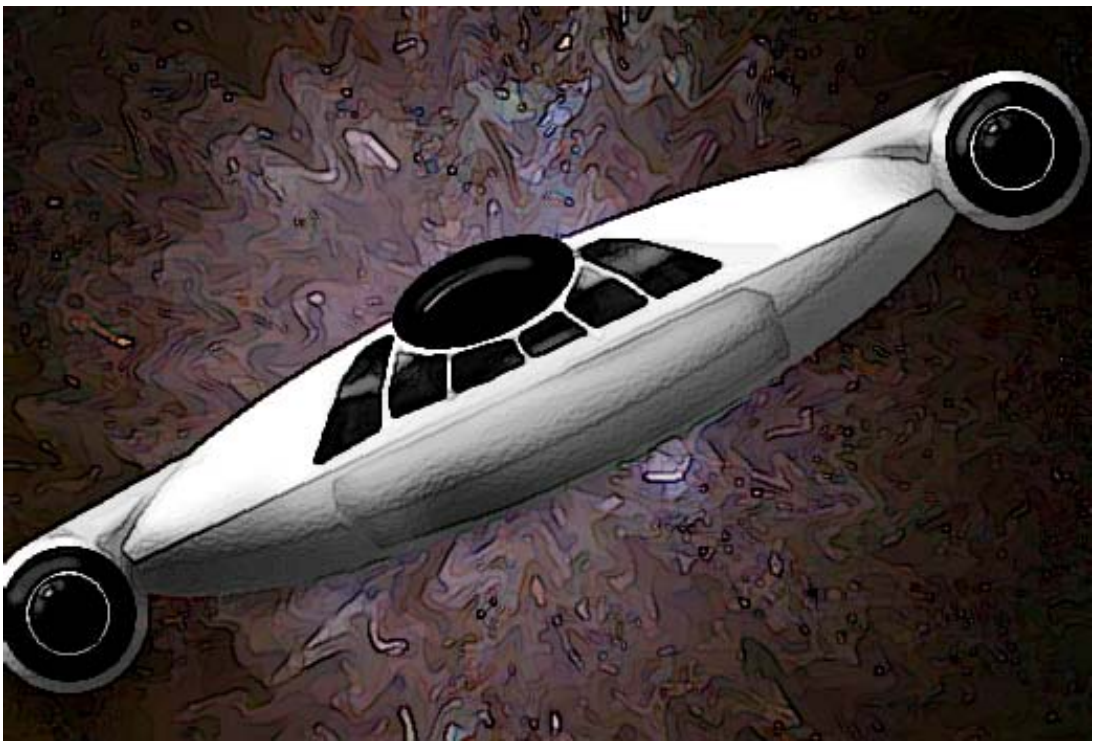
As you can see, every ship is always a compromise between cost, acceleration, duration, and cargo carrying capacity. Our 100 ton merchanter has 8 tons of drive and fuel, leaving 92 tons free for other purposes, including carrying cargo. Our courier has 42 tons of drive and fuel, leaving only 58 tons free for other purposes. The merchanter has 3 Gs of reserve thrust, while the courier has at least 8G. If not limited by human A-Grav tolerance, the courier would have a reserve thrust of 28 Gs.

At this point we should get into dealing with volumes and densities rather than just mass. One of the down sides of using liquid hydrogen (and liquid anti-hydrogen), is that the density is so low (0.07 gm/ml). For matter tankage, it would ordinarily make better sense to carry something denser, such as methane or water. At TL10, liquid anti-methane fuel is available at a slight cost increase over liquid hydrogen. Anti-methane is easier to produce by fusion than anti-water, which would otherwise also be suitable. One could store about 15 times as much fuel as anti-methane than as anti-hydrogen in the same volume, although the mass would be the same.

Mini-G drives are a refinement of G-Drives available at TL 10. They are 0.4 times the mass of the equivalent rated G-Drive, but use fuel at 2.5 times the rate of that same G-Drive. Where the mass of the engine is more important than the mass of the fuel, Mini-G drives are used - for example in small craft., particularly fighters which have a small operational radius. they are also more expensive than the equivalent G-Drive.

M/AM drives do not have a 'torch' like fusion drives. They are very bright when seen from directly behind the vessel, but are almost invisible from the sides. A M/AM drive may be used as a clumsy but powerful weapon, with -30 to HF and +30 to DF. The pilot uses the attitude jets to swing the drive trail across the opponent ship.

Item	Description	Cost	Tonnage	TL	Req'd Skill
G-Drive	Matter-Anti-Matter Reaction Drive	1000cr/Ton	Ship tonnage * Gs of Thrust * 0.05	9	Drives+1
Mini-G Drive	Miniaturized G-Drive	5000cr/Ton	Ship tonnage * Gs of Thrust * 0.02	10	Drives+2



THE A-GRAV SUBSYSTEM

Each type of creature has an in-built tolerance for A-Grav. The A-Grav fields are not true gravity, and at higher G values, depending on the type of creature, the differences are noticeable and uncomfortable. Humanoids - that is, Humans, Sastra, Tagris, and Vantors, with all the in-between races - begin to notice A-Grav fields at 8 G. At 9G, A-Grav fields are tolerable for up to 200 hours. At 10G, A-Grav fields are tolerable for up to 40 hours. At 11G, they can be tolerated for up to 8 hours. At 12G, the tolerance goes down to 1.6 hours. Tolerance goes down to 20 minutes at 13G, and fields of 14G cannot be tolerated at all.

At each step, duration of toleration decreases by a factor of 5. This rate of decreasing toleration holds true for all creatures, but the point at which aliens first notice A-Grav fields, and thus where intolerance begins, differs. Tappi cannot tolerate A-Grav fields at all. Uramkup, Kiskit, and Ven der Opt begin to notice A-Grav at 8G, like humanoids. Tumuran and Formenai begin to notice the fluctuations at 10G. Kertu-Drua and Etvar begin to notice A-Grav at 6G, Tumentamenata at 4G, Tommu and Guaru at 9G, and Kolusien and Ronaure at 7G. Exceeding a creature's A-Grav tolerance makes a creature violently ill. Such creatures lose 1 points of constitution per minute, per G of A-Grav. For instance, a Human using an A-Grav rating of 11G for more than 8 hours loses 11 points of constitution per minute.

The ability to withstand uncompensated thrust also varies between creatures. Humanoids can withstand 2G indefinitely, and up to 7G for very short periods. Tappi, Tumuran, and Tumentamenata can withstand up to 2G for a few minutes. Uramkup, Tommu, and Ronaure can withstand up to 3G indefinitely, and up to 8G in bursts. Guaru can withstand up to 3.5G indefinitely, and up to 8G for short periods. Formenai can withstand up to 2G indefinitely, and up to 8G in bursts. Kertu-Drua and Kiskit can withstand up to 1.5G indefinitely, and up to 5G for short periods. No one knows what Ven der Opt can withstand, but it is at least as high as humans. Kolusien and Etvar can withstand up to 4G indefinitely, and perhaps as high as 9G in bursts, although Kolusien prefer a zero-G environment. in their spacecraft.

The engineer should attempt at all times to use A-Grav to compensate for thrust, as even if a creature can withstand higher G forces, it is always uncomfortable, if not actually painful. Quick maneuvering in combat or emergency situations can throw passengers and crew about violently. Adequate warning of emergency maneuvering must always be given, if possible under the circumstances. Ships built with decks parallel to the axis of thrust can become nightmares to move in if the A-Grav compensation is exceeded, and ships must be designed with this in mind if they are expected to exceed their A-Grav rating. Military ships are almost always designed to be used under heavy acceleration.

Use of proper equipment can drastically raise the ceiling of maximum Gs. Anti-G training alone, given to all Navy and Marine personnel, can raise this ceiling by 1 G. Use of an anti-G body suit, which incorporates a positive pressure breather making the proper breathing automatic, can raise the threshold by 4 Gs. An anti-G Station which is designed to pivot and properly support the body can raise the ceiling another 3 Gs. Thus a humanoid trained in anti-G techniques, wearing an anti-G suit, and in a anti-G station can stand up to (7+1+4+3) 15 G for brief periods and remain conscious. This, however, raises the **sustained** G tolerance only to 3 G, mainly due to the station.

Although the actual A-Grav plates are distributed throughout the ship, control over those plates is vested in the Engineering control systems. If a change in gravitic slope is requested, the engineer can change it remotely. For the most part, the A-Grav subsystem works automatically within parameters set by Engineering, but those parameters can be overridden temporarily or reset to new levels by the engineer.

Item	Description	Cost	Tonnage	TL	Req'd Skill
A-Grav Drive	Artificial Gravity/ Anti Gravity System	1000cr/Ton	Ship tonnage * Gs of Thrust * 0.01	9	Drives+1

THE JUMP DRIVE SUBSYSTEM

The Jump Drive is not really a drive at all. It is technically far more similar to a stasis field than to a G-Drive or fusion drive. Like a stasis field, time does not exist in the Jump Drive's field, but a stasis field is surface bounded with the controls and generation nodes outside the field, where a jump drive is a point source within a spherical area of effect. If the Jump Drive is triggered at a Jump Point, the mass within the area of effect is isolated from the rest of the universe, and may optionally be somewhere else along the available jump routes. Each Jump Drive is mass limited, and if too much mass is in the area of effect, called the "Jump Bubble", the jump will fail. Objects which are partially in and partially out of the field at the time of the jump can cause the jump to fail. If the mass of the object makes the mass within the field too much for the Jump Drive, the jump will fail. If the mass is within the parameters of the Jump drive, the jump will succeed, and the partially-in object will be cleaved, the part within the field taken along, and the part outside of the field left behind. Crowding a jump is a dangerous maneuver not to be taken lightly.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Jump Drive	Spatial Discontinuity Field Generator	1000cr/Ton	Ship tonnage * 0.1	10	Drives+2

THE FUSION DRIVE SUBSYSTEM

There are three types of fusion drives, Deuterium, Protium, and Atmospheric. Deuterium and Protium drives cannot be used in atmosphere, while the Atmospheric Fusion drive **requires** an atmosphere. Deuterium fusion drives are very cheap and quite small, but use more expensive fuel than Protium drives. Protium drives are large and expensive, but the fuel is very cheap, in fact with a scoop and separation system it is free. Atmospheric fusion drives use the same fuel as a Deuterium drive, but are far more fuel efficient as they use intakes to scoop up atmospheric gasses and use them as reaction mass. It is in fact a type of jet engine.

Deuterium and Protium drives are both detectable in use from far away, as the craft rides a fusion 'torch' which is extremely large and bright. They leave behind them a 'trail' of fused helium, which is easily detectable. Like a M/AM drive, the fusion torch can be used as a clumsy but powerful weapon, having a -30 To Hit, and +30 as weapon Damage Factor (DF). In effect, the pilot uses the attitude jets to swing the craft (use pilot/small craft skill To Hit) around and across the opponent's craft.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Deuterium Drive	Fusion Torch Reaction Drive	100cr/Ton	Ship's Tonnage * Factor *0.05	8	Drives+1
Protium Drive	Fusion Torch Reaction Drive	1000cr/ton	Ship's Tonnage * Factor *0.3	8	Drives+2
Atmospheric Fusion Drive	Fusion Jet Drive	100cr/ton	Ship's Tonnage *0.25	8	Drives+1
Deuterium Fuel	Fuel for Deuterium Fusion Factor = 100 hours boost	100cr/Ton	Ship's Tonnage * Factor *0.1 (Deuterium Drive) Ship's Tonnage * Factor *0.0001 (Atmospheric)	8	N/A
Liquid Hydrogen (Protium Fuel)	Fuel for Protium Fusion Factor = 100 hours boost	5cr/Ton	Ship's Tonnage * Factor *0.1	7	N/A

THE NERVA DRIVE SUBSYSTEM

The Nerva drive is a fission based system, using a radioactive pile controlled by damping. The drive forces liquid hydrogen into the pile, where it acquires a large amount of energy and exits at high speed through the thrust nozzles. This drive is far more efficient than chemical rockets, although it is fuel-hungry (or rather reaction mass hungry) compared to fusion drives. The exhaust gasses are slightly radioactive, but not terribly dangerous, and the Nerva equipped ship can take off from a planet with little ill effect. The drives themselves are highly radioactive, and must be shielded. When a Nerva drive reaches the limit of its useful lifetime, it is disposed of into the nearest stellar mass and replaced.

One hundred tons of thrust is enough to push a 100 ton ship forward at 1G, a 50 ton small craft at 2G, and a 200 ton ship at 0.5G. To lift off a planet, at least 2Gs of acceleration are needed.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Nerva Drive	Fission Reaction Drive Factor is 100 Tons thrust	100cr/Ton	10 tons * Factor	7	Drives+1
Nerva Fuel	Liquid Hydrogen Reaction Mass Factor is 10 minutes Thrust	5cr/ton	2.5 tons per factor * drive tonnage	7	N/A

THE ORION DRIVE SUBSYSTEM

Orion Drives are simple and rather brutal in design, but represent by far the most efficient mass moving technology available to TL7 cultures. Orion drives are enormous. They consist of a thick parabolic thrust shield, auto-loading cannon, and enormous shock absorbers. At least half the mass of an Orion ship is given over to the drive, and the smallest drive masses 5000 tons. The large minimum size is dictated by the composition, shape and size of the blast shield, which must meet certain minimums in order to work effectively.

The drive works by shooting 20 megaton fission or fusion bombs behind the craft with the cannon, where they detonate. The blast is partially contained by the blast shield, and the reaction thrusts the ship forward sharply. The shock absorbers smooth out the sudden acceleration somewhat, so that the crew are not damaged, although the ride is very jerky nonetheless. Another bomb is shot back every 10 seconds for the duration of thrust.

It is possible to use the Orion drive to lift from planet to orbit. It is, in fact, the most efficient way to put any mass into orbit at TL7. It does, however, damage the launch site and spew some radioactivity into the atmosphere. Orion ships tend to launch from remote and uninhabited areas where the damage will be least noticed. The Orion blast shield gets extremely radioactive with use on the underside, although the blast shield also protects the crew from radiation. Care should be taken not to maneuver too close to an Orion ship, especially when docked at station. Many higher Tech Level cultures which trade frequently with TL7 cultures will build separate stations for Orion ships for this reason. Orion drives can easily be used as weapons. An Orion fission bomb is -30 To Hit, and +2 as weapon Damage Factor (DF). In effect, the pilot uses the attitude jets to swing the craft (use pilot/small craft skill To Hit) around and hit the opposing craft with the projectile blast.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Orion Drive	Fission or Fusion pulse drive 2G Thrust	0.5cr/Ton	Ship Tonnage * 0.5 5000 tons Minimum	7	Drives+1
Orion Fuel Bombs	20 megaton Fission or Fusion bomb	18000cr/1 Hour Thrust	45 Tons/1 Hour Thrust	7	N/A

THE BOOSTER ROCKET SUBSYSTEM

Rockets are very inefficient mass lifters, but are frequently used in TL7 cultures. Liquid fuel rockets use a fuel - such as kerosene or hydrazine or liquid hydrogen, and an oxidizer - liquid oxygen or nitrogen tetroxide, in a reaction chamber. The chamber contains the resulting chemical reaction, venting the gasses through thrust nozzles. Solid fuel rocket boosters use a fuel/oxydizer mix in a relatively stable, solid form, but otherwise are similar in principle. The main difference is that liquid rockets can be stopped and started at will, while solid fuel rockets must burn out completely once they are started. Solid fuel rockets are typically used as strap on boosters to assist a ship in getting to orbit, where liquid fuel rockets are more typically used in space, although they can be, and are, used to lift to orbit.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Strap on Booster	Solid Rocket Lifts 50 Tons at 2G per Factor	100cr/Factor	15 Tons/ Factor	7	Drives+1
Rocket Engine	Liquid Rocket Lifts 100 Tons at 2G per Drive Factor	1000cr/Factor	Ship's Tonnage* 0.1 per Drive Factor	7	Drives+1
LO-LH Liquid Oxygen Liquid Hydrogen	Fuel for liquid rocket factor is 10 minutes Thrust	15cr/Ton	60 tons* Factor* Drive Factor	7	N/A
Hydrazine-nitrogen Tetroxide	See LO-LH	25cr/Ton	80 tons* Factor* Drive Factor	7	N/A
Kerosine-Liquid Oxygen	See LO-LH	15cr/Ton	70 tons* Factor* Drive Factor	7	N/A

THE FUEL SCOOPING & SEPARATION SUBSYSTEMS

The fuel scooping subsystem allows the ship or small craft to dive into the atmosphere of a gas giant and skim off gasses. The vessel must have an atmospheric hull shape, i.e. factor four or higher. The vessel dives along a parabolic path into the upper atmosphere of the gas giant, where the atmosphere is scooped into large intakes in the hull. The gasses collected would be typical of the gas giant in question, but all gas giant atmospheres have large amounts of hydrogen, usually locked in hydrocarbon gasses. The separation subsystem disassociates hydrogen from other elements and collects it in pure liquid form. The two subsystems are intrinsically interrelated, and are usually sold as one subsystem, but they can each be used separately. For instance the scooping subsystem can be used to obtain gasses other than hydrogen, and the separation subsystem can be used to disassociate hydrogen from oxygen in water.

The waste gasses for the separation are used in Life Support, Control, and Shield systems. Protium fusion drives require pure liquid hydrogen. M/AM drives do not, as any easily handled liquid will do for the matter fuel, although anti-hydrogen is the only anti-element available at TL9. TL9 and 10 ships usually use either water or liquid methane as their matter component because of their density and ease of handling. At TL10, anti-methane becomes available. Anti-methane is far more dense than anti-hydrogen, so it is less bulky at the same weight, and is preferred even though it is slightly more expensive. M/AM ships thus do not require the separation function of this system, although it is trivial in mass and cost, and usually thrown in anyway, as the separation function can be useful for life support.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Fuel Scooping & Separation System	scoops and selectively collects gasses from Gas Giants and Bodies of Water	1000cr/ton	Ship Tonnage* 0.01	8	Chemistry+1

THE LIFE SUPPORT SYSTEMS

The life support systems are built into the ship as part of the standard hull package, except for the Hydroponics systems, which are optional. Life support is a necessary part of all large ships.

THE HVAC SUBSYSTEM

The Heating, Ventilation, and Air Conditioning (HVAC) system supplies air to the various areas in the ship, and cools or heats the air to make the ship a constant temperature. Waste heat from the reactors/drives is used to heat the air, and hull radiators are used to cool it. Holds and other storage areas are by default heated ambiently by contact with heated areas, and are thus usually quite cold. Holds can be heated at a small cost, and frequently are. Air ducting feeds air throughout the ship. This ducting is located above the dropped ceilings, and it is possible for a humanoid to move around in them. 'Used' air is brought to a central location where it is "scrubbed", i.e. the carbon dioxide is separated into carbon and oxygen, and "freshened" chemically and/or through the hydroponics section if present. Precipitates are filtered out and passed into the Hydroponics and/or Waste Recycling systems before the air is returned into circulation

Item	Description	Cost	Tonnage	TL	Req'd Skill
HVAC System	Heating, Ventilation, & Air Conditioning	50cr/Ton	Hull Tonnage * 0.05	7	Mechanics+1

THE WASTE RECYCLING SUBSYSTEM

Wastes are brought from the WCs into the waste recycling system. Here they are irradiated to destroy any bacteria or viri, and passed into the Hydroponics system if present. Returning waste water is again irradiated, filtered, and purified before being passed in turn to the food and water system. Irradiated solid waste is either passed into the Hydroponics system or compressed and stored for later dumping. These wastes are taken free of charge at stations where they are used to make up for losses in the station's own recycling system.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Waste Recycling System	Liquid & Solid waste conditioning & disposal	50cr/ton	Hull Tonnage * 0.02	8	Mechanics+1

THE HYDROPONICS SUBSYSTEM

The Hydroponics system grows some vegetables under intensive cultivation in irradiated waste water, using some waste as fertilizer. The Hydroponics system at TL 9 also contains bioengineered bacteria which take in irradiated solid waste and water and return food primitives, which can be processed into food of various types in the galley. Processed food is, by TL9 or 10, quite good, but the food processing is fairly limited in scope. A ship can generally process 5 different food types per ton of Hydroponic section, as a rule of thumb. Thus a one ton galley could process - say - raw chicken breast, raw chicken thigh, raw beef loin, ham, and raw pork. These can be prepared into actual meals in the galley along with stored spices and hydroponically grown vegetables, either by the robo-cook or by interested crew. Some people enjoy cooking, just as some people enjoy gardening, but the robo-cooks are usually quite competent.

Item	Description	Cost	Tonnage	TL	Req'd Skill
hydroponics Section	Vegetables to feed 5 adults per ton	500cr/Ton	As Required	7	Biology+1 Chemistry+1
Hydroponics & Synthesis Section	Vegetables and protein product to feed 10 adults per ton	500cr/Ton	As Required	8	Biology+1 Chemistry+1
Water Farm	Vegetables and synthetic meat to feed 15 adults per ton	500cr/Ton	As Required	9	Biology+1

THE CREW SUPPORT SUBSYSTEM

Food is grown in the vessel's Hydroponics section and/or purchased from the station. Even ships with hydroponics sections usually supplement their food supplies with additions grown or bred on stations and worlds. Foods can be bought in bulk and stored in cargo areas and/or the galley. TL10 worlds sell foods ready-made in stasis fields, where one need only stop the field, select and remove the foods you wish to eat, restart the stasis generator, and eat the food. Of course there is a hefty price for the stasis field generator, but one need only buy one once and restock it as needed.

Recreation onboard ship grows more sophisticate as the ability of the ships to haul mass further, faster, and more economically increases. At first limited to televisions, game machines, and traditional games, now entire swimming pools and parks can be found on the latest cruise ships.

Item	Description	Cost	Tonnage	TL	Remarks
Galley	Place for food prep and incidental consumption	25 cr per ton	Varies	7	includes small eating area, 1 ton req. per 10 people, minimum
WC	Place for waste elimination and bodily cleaning.	10 cr	1 ton	7	Serves up to 5 people
Game room	Area for crew relaxation	100cr	Varies	7	Includes game player and screen. 1 ton per 10 people
Exercise Room	Area used for exercise	150 cr per ton	Varies	8	1 ton per 10 people
Centrifuge	Device for inducing spin gravity in a small area	1500 cr	10 tons	8	Used to maintain bone mass during zero-G flight
Sick Bay	Area for convalescing patients	2000 cr	10 tons	8	up to 10 people
Lounge	Area for crew rest and relaxation	50 cr per ton	Varies	8	Includes Trivox, mini-bar, and lounge seating, 1 ton per 5 people
Conservatory	Park-like area with grass, flowers, and trees.	100 cr per ton	As required	9	Minimum 10 tons
Pool	Swimming pool with cover doors	500 cr per ton	As required	9	Minimum 10 tons
Ballroom	A room used for dancing	100,000 cr	50 tons	9	includes bandstand and auto-music system
G-Studio	Room with fully adjustable gravity	5000 cr	10 tons	9	Used for sparring, working out, and dance training
Null G Tank	Area without gravity used for some sports	50000cr	50 tons	9	Includes spectator area for up to 50 people
Diagnostic Room	Area with specialized instruments for diagnostics	5000 cr	5 tons	9	Includes diagnostic beds and instruments
School Room	Area designed for learning	10000 cr	15 tons	9	Seating for 20 students and one teacher, includes comps and WC
Holo Room	Area with interactive hologram projection for leisure activities	10000 cr	20 tons	10	N/A
Stasis-Galley	Stasis field meal storage device	500 cr	0.1 tons	10	Stores 66 hot cooked meals in individual trays.

THE SCAN SYSTEMS

The Scan systems are the principle means of data acquisition and delivery on a vessel. Data is acquired through sensor arrays, and preprocessed before being displayed on operational stations.

THE RADAR ARRAY SUBSYSTEM

The radar array monitors events in a 360 degree globe around the ship. The array is sensitive in the radio wave subspectrum. The radar array consists of 8 radar emission and detection radomes placed in strategic locations around the ship in order to give full coverage. A smaller version for small craft is also available called the Radar Detection Subsystem, which consists of an emitter/detector radome on the front of the ship and a passive radome on the rear, covering the most vulnerable areas.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Radar Array	Radar emission and detection array	10,000cr	5	7	Electronics+2
Radar Detection	Radar emission and detection	3,000cr	1	7	Electronics+1

THE STANDARD SENSOR ARRAY SUBSYSTEM

The standard sensor array monitors events in a 360 degree globe around the ship. The array is sensitive to the entire electromagnetic spectrum from radio waves to x-rays and gamma rays. The standard array consists of 48 one square meter sensor plates massing 5 kg each, mounted on the ships hull. The sensor plates can be shaped as desired to conform with the hull configuration. On a small small craft, much of the ship surface is covered with sensor plates. In addition to the sensor plates, there are 4 active illumination lasers (50 kg each), at points on the ship. These can be used to increase the illumination of an object, allowing it to be examined in more detail. However, any object must first be detected passively before the active scan lasers can be used. Use of active scan laser also alerts any ship on which it is trained of the scanning ship's presence.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Sensor Array	Electromagnetic emission and detection array	1,000cr	0.5	8	Electronics+1 Astronomy+1

THE MILITARY SENSOR ARRAY SUBSYSTEM

Many military ships (and some special survey ships) carry a more capable sensor unit. To increase light gathering and optical baseline beyond the limit set by the ship size, the passive military sensor unit uses the ship's shields to form a reflective mirror, concentrating light on the sensor units. This combination allows a ship so equipped to scan approximately 10 times as far away. However, a ship must have plasma shield generators to use the passive military scan system, and the system is unusable when the shields are being used for defense. When the shields are in use, passive scan capability is degraded to the same level as standard scan units. The military sensor unit also includes 8 laser scanners, more powerful than those of the standard unit, allowing more sensitive active scanning. These active scan sensors are usable even with shield defenses in use. A scan station or module is required.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Military Sensor Array	Electromagnetic emission and detection array	10,000cr	5	8	Electronics+2

THE GRADAR SENSOR ARRAY SUBSYSTEM

A gravity plate can detect a mass at a distance by noting the force produced when a mass is within its volume of effect. This effect can be used as a sensor mechanism to detect the mass of ships at distances up to 10,000 km. While other sensors are usually able to detect a ship before GRADAR, it can provide information on the mass of a stealthy or shielded ship at ranges where the shape and size of the ship are not yet observable. Unlike electromagnetic sensors, GRADAR cannot be effectively countered. However, it can only determine the mass of an object, not any other details. A GRADAR array masses 2 tons and costs 2000cr. It can, however, also function as a gravity grapple, thus doing double duty. It can be controlled from the same scan station as the other sensors.

ITEM	DESCRIPTION	COST	TONNAGE	TL	REQ'D SKILL
GRADAR ARRAY	GRAVITY DETECTION AND RANGING ARRAY	2,000CR	2	9	ELECTRONICS+2 DRIVES+2 ASTRONOMY+1

STANDARD SCAN DISTANCES (KM)

Scan Type	Detection Accuracy	Boosting (Non-stealth)	Coasting or Stealth Mix	Stealth Cloaked	Shields Up
Std Passive Scan	Detect 6%	2,0000,000	60,000	2,000	200,000
	Detect 25%	1,000,000	30,000	1,000	100,000
	Detect 100%	500,000	15,000	500	50,000
	Basic Shape	10,000	3000	100	100
	Details	1,000	300	10	10
Active Scan	Basic Shape	10,000	10,000	3,000	1,000
	Details	1,000	1,000	1,000	100
Mil Passive Scan	Detect 6%	20,000,000	600,000	20,000	2,000,000
(Shields down)	Detect 25%	10,000,000	300,000	10,000	1,000,000
	Detect 100%	5,000,000	150,000	5,000	500,000
	Basic Shape	100,000	30,000	1,000	1000
	Details	10,000	3,000	100	100
Mil Active Scan	Basic Shape	30,000	30,000	10,000	3,000
	Details	3,000	3,000	3,000	300
GRADAR	Mass	10,000	10,000	10,000	10,000

The table above gives the detection distances for detecting a ship massing 100 tons. Larger craft could be detected at greater distance, smaller craft could not be detected until they were closer. The table below gives the correction factors for ships of different mass. Multiply the distance by the correction factor for the mass of the ship in question.

Note that detection only means being able to discern that something is out there, it does not imply the ability to tell anything about the size, shape, or nature of the object. An object that is detected could be a meteoroid, a small merchant small craft, or a large warship; and there were be no way to distinguish which is was until within the Basic Shape sensor range. (A fast moving object is probably a ship rather than a meteoroid, but a slow object could be either one.) Coming to within the Details range for sensors allow one to distinguish the basic components of a ship (drives, shield units, weapons small crafts, etc.). It is necessary to come to within this range to specifically target designated portions of a ship. It is necessary to come to within Basic Shape range to target a ship at all.

Ship or small craft mass (tons)	10	20	50	100	200	500	1000	2000	5000	10,000
Detection Range Factor	0.45	0.6	0.8	1.0	1.25	1.7	2.15	2.7	3.7	4.65

THE SPECTRAL ANALYSIS SUBSYSTEM

This subsystem can quantify the elemental composition of an object. It can work passively on emissive objects, such as stars or radioactive elements, and can work actively on EM reflective objects such asteroids or hulls. The emissive beam it uses is effective only within 5 km. Spectral analysis of the detected reflective and fluoresced object can most often (80%) identify the substance by name, 100% if it is common, such as plasteel. It has a 60% chance of determining where the substance was made if it is artificial, based on the distribution of trace elements. The spectral analysis subsystem is found on virtually every asteroid mining craft.

The spectral analysis system can also be used to detect and analyze the trail left by a vessel. Chance of detection is 100%, with the following modifiers:

Mix	**Bonus/Penalty**
Stealth	-90%
Clean	-50%
Cruise	+0
Full	+50%
Overdrive	+90%
20%	-75%
10%	-35%
4%	+10%
1%	+45%
Fusion	+40%

There is also a time modifier, in that the chance decreases 1% per hour after the ship passed. If the trail is detected, the system can give an immediate answer as to whether a trail is fused helium (Fusion), hydrogen (TL9 M/AM Drive), or methane (TL10 M/AM Drive).

For deeper analysis, better fundamental knowledge on the part of the operator is needed. The base chance of success would be the operator's chemistry or physics skill chance, with the time modifier above. In this deeper analysis mode, individual ships can be recognized by their drive's 'fingerprint'. Each drive has peculiarities in design, manufacture, and maintenance which together form the drive's fingerprint. There is no central database of ship drive fingerprints, but certain states, such as Glorianna and Mickey's Birthday among others, do require that each drive made by their manufacturers be fingerprinted, and fingerprinting is always attempted at the scene of criminal activities. If a fingerprint has been successfully detected, further analysis may show (60% chance) the drive manufacturer or (60%) the place where the drive was manufactured. The spectral analysis system is not part of the standard scan package, and is operated from a standard scan station.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Spectral Analysis Subsystem	Elemental quantification subsystem	1,000cr	0.5	8	Electronics+1

THE DATA INTEGRATION AND PROJECTION SUBSYSTEM

The data integration and display subsystem gathers data from the various sensor arrays and attempts to make sense of the data before sending it on to the scan station. It will identify and isolate known bodies such as planets, moons, marked asteroids, stars, etc. and integrate them into the scan display. Ballistic objects - objects moving without being self powered - can be projected linearly, as their speed and path do not change over time, and light speed time lag can be compensated for. Powered objects, ships and small craft, are projected as a probability cone from the lightspeed-lagged detected position, with the most likely probabilities being most solid. The system attempts to correct for Doppler shifts and other quirks of space-time to the best of its ability. The data integration and projection system is part of the standard scan package.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Data Integration and Projection	Scan preprocessor	200cr	0.5 Ton	9	Programming+2

THE SHIELD/DEFLECTOR SYSTEMS

The shield and deflector systems for ships consist of a variety of different protective measures used by vessels in combat. For purposes of game play, all these protective measures are collectively lumped together as "shields" and their overall effectiveness is denoted by a single "shield factor". Shield technology is similar for tech levels 8 through 10, except where noted. The standard components of shield systems are reflective plasma shields, anti-missile lasers or mass drivers, and hull armor.

STANDARD SHIELD/DEFLECTOR PACKAGE

Item	Description	Cost	Tonnage	TL	Req'd Skill
Deflector Equipment Package	Equipment used is protecting ship from missiles and beam weapons	1000cr/Ton	Hull Tonnage * Factor * 0.01	8	N/A
Shield Package	Equipment used is protecting ship from missiles and beam weapons	1000cr/Factor	Hull Tonnage * Factor *.005	9	N/A

THE MASS DRIVER ANTIMISSILE SUBSYSTEM

This system uses tiny kinetic energy masses fired at extremely fast velocities at intruding masses. These devices are much smaller than mass driver weapons, and are distributed around the ship. They are part of the standard TL8 deflector equipment package. They are replaced by the more effective antimissile lasers at TL9, when lasers can be built small and effective enough. The antimissile mass drivers on a ship can be used offensively, being equivalent to a mass driver weapon collectively.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Mass Driver Antimissile Subsystem	Kinetic Energy defensive system	300cr/Ton	Hull Tonnage * Factor *.002	8	Ship's Guns+1

THE SANDCASTER SUBSYSTEM

Sandcasters dispense clouds of reflective particles which semi-effectively diffuse beam weapons by light scattering. They are available at TL7 and up, although they are far less powerful and versatile than reflective plasma shields, so are seldom used beyond TL7.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Sandcaster Subsystem	Light Scattering Anti-laser System	100 Cr/Ton	Hull Tonnage * Factor *.005	7	Electronics+1

THE ANTIMISSILE LASER SUBSYSTEM

This system consists of a number of small lasers distributed over the hull of the ship - one targetable antimissile laser per shield factor per area protected. These are typically 1 micron wavelength free electron lasers, emitting 100 megawatts of energy in a 1 square centimeter beam. Since in combat, plasma shields are only dropped for a few microseconds at a time, antimissile lasers cannot be effectively used against targets until after they have penetrated the ship's plasma shields.This system is made up of many tiny lasers distributed over the hull of a vessel. They are designed to prematurely trigger missiles or destroy their guidance systems and/or propulsion systems. Antimissile lasers are part of the standard shields package available at TL9 and above.

Antimissile lasers can also be used offensively, with a damage factor (DF) equal to the number of targetable antimissile lasers (i.e., the Shield Factor). Thus, for example, the antimissile lasers of a ship with a SF of 5 could be used as the equivalent of a laser with a DF of 5. For purposes of game mechanics, all antimissile lasers are treated as a single offensive weapon. However, in order to do significant damage against a ship, they must be fired in 10 second long bursts, making them impossible to be used with shields raised.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Antimissile Laser Subsystem	Defensive laser System	700cr/Factor	Hull Tonnage * Factor *.002	9	Ship's Guns+1

THE REFLECTIVE PLASMA SUBSYSTEM

The reflective plasma system works with areas of charged plasmas which are manipulated from the vessel's shields stations. They deflect beam weapons at angles away from the vessel. Reflective plasma is most effective when drawn tight around the vessel, but this prevents the anti-missile lasers from working soon enough, allowing missiles to get too close before exploding. The plasma reflects beam weapons from either side, so they must be lowered and re-raised when the vessels own beam weapons are fired, a matter of 50 microseconds duration. The down period is so short that due to light speed limitations it is effectively impossible for a ship to discover that an opposing ship's shields are down and to attack with its own weapons before their shields are back in place. Reflective plasma systems are a part of the standard deflector equipment package available at TL8, and the standard shield package available from TL9 on.

The reflective plasma shields are typically deployed about 100 meters to 1 kilometer from the surface of the ship, though they can be set as far as 10 kilometers out or a close as 10 meters from the ship surface. Due to the smaller area they need to cover, shields are more effective closer to the ship; however, this gives less time to engage missiles with antimissile lasers, as they cannot be used beyond the shield radius. The plasma is thus drawn in against beam weapons and pushed out against kinetic or missile weapons continuously throughout a battle. As an optional rule, game masters may allow for players to set the shield radius closer or further away than the typical distance, trading off relative protection against missiles and shields. For example, a ship with shield factor 10 could pull its plasma shields in closer, giving them an effective SF against beam weapons of 15, at the cost of reducing their SF against explosive and kinetic energy weapons to 5. It could also extend its plasma shields out further, giving them an effective SF against explosive and kinetic energy weapons of 15, at the cost of reducing their SF against beam weapons to 5.

In order for a ship to continue to accelerate while under thrust, all shield have a null region behind the ships engine. Thus a ship could easily be attacked from directly behind, were it not for the fact that the ships exhaust beam itself acts as an effective defense for this region.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Reflective Plasma Subsystem	Reflective Anti-laser System	700cr/Ton	Hull Tonnage * Factor *.003	8	Electronics+1

HULL ARMOR

The final and essential component of the shield system is the ship's hull armor. Even with effective antimissile lasers and plasma shields, hull armor is required to protect a ship against kinetic weapon fragments, diffuse beam radiation, and nuclear explosions at the shield periphery. Hull armor is the least expensive, but the most massive of the ship's shielding components. Thus, for a given shield factor, the cost of shielding is relatively independent of the mass of the ship; but the mass of the shielding is roughly proportional to the mass of the ship. At TL8, hull armor is typically made of ablative fiber-reinforced ceramic. At TL9 and TL10, it is typically blackened plasteel with light-scattering substructure. Factor 1 hull armor is included in the Basic Hull Package.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Hull Armor	Protective Sheathing on Hull	100cr/Ton	Hull Tonnage * Factor *.05	7	N/A

THE DRONE LURE SUBSYSTEM

The drone lure is a tiny small craft which mimics the EM output of a ship in an attempt to trick missiles into targeting it rather than the real ship. When the missiles close in, the EM output is switched off, and the missiles lose their target. Drone lures are not effective against torpedoes or other missiles guided by Gun Stations. They are not part of any standard package, and must be purchased and fitted separately. They are available from TL9 on.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Drone Lure	Device for luring missiles away from target	500cr each	0.5 Tons each	9	Small Craft+1

THE CONTROL SYSTEMS

The control systems are the means a spacecraft uses to "steer". While thrust can be vectored somewhat for most types of drives, usually the drive is fixed due to the cost and complexity involved in building vectoring thrust nozzles, and the thrust is always from the same direction. Control systems are built into the hull, and require a full shipyard for retrofitting.

THE ATTITUDE JET SUBSYSTEM

Attitude jets are used to steer a vessel in space. Also called "thrusters", these devices use gasses as reaction mass to turn the ship. There are typically several attitude jets located at different positions along the hull, and they are used singly or in combination to change the 'attitude' of the vessel - the relative angle of the vessel, and consequently the direction of the thrust. Rather than vectoring the thrust, attitude jets allow the whole ship to be vectored, thus the thrust can remain static in relation to the ship. Standard grade attitude jets are factor 1. The factor is used in combat as a bonus to the pilot skill check in determining the vessel's defense, and is the measure of how quickly the ship can be maneuvered. Courier grade attitude jets are set at factor 2 and add +10% to the pilot skill check, while military grade attitude jets are factor 3 and add +20%. Standard grade attitude jets are part of the standard hull package, while courier and military grade jets are a more expensive option, both in tonnage and in cost.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Standard Grade Attitude Jets	Space maneuvering Devices	500 cr/Ton	Hull Tonnage * 0.01	7	Pilot+1 or Small Craft+1
Courier Grade Attitude Jets	Space maneuvering Devices	500 cr/Ton	Hull Tonnage * 0.02	7	Pilot+1 or Small Craft+1
Military Grade Attitude Jets	Space maneuvering Devices	500 cr/Ton	Hull Tonnage * 0.03	7	Pilot+1 or Small Craft+1

THE LIFT SUBSYSTEM

Some hull forms, types 5 and 6 - discoid, wedge, or winged - can be used to create lift in atmosphere. The hull functions as a lifting body, and the ship can use movable control surfaces to maneuver the craft. Vessels with a lift subsystem are able to maneuver as if they had military grade (factor 3) attitude jets while in atmosphere. A lift system is optional, but must be built into a hull when the ship is designed. It cannot be retrofitted.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Lift Surfaces	Atmospheric maneuvering aids	500 cr/Ton	Hull Tonnage *.01	7	Pilot+1 or Small Craft+1

THE LANDING SUBSYSTEM

Vessels which are required to land on-world need a landing system. This consists of landing legs, wheels or other support structures which are built into the hull. Usually, these are retractable, but this is not required. Non retractable landing systems are half the mass and one-quarter the cost of the retractable version, but cannot be used on craft with a lift subsystem, as they drastically affect a vessel's airflow, and consequently the lift and control. Retractable Landing Legs are part of the Standard Hull Package.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Retractable Legs	Devices for landing on worlds	500cr/Ton	Hull Tonnage * 0.04	7	N/A
Non-Retractable legs	Devices for landing on worlds	500cr/Ton	Hull Tonnage * 0.02	7	N/A

THE CLOAK AND DAGGER SYSTEMS

Cloak and dagger systems are designed to enhance stealth characteristics in vessels. They are mostly illegal, and are much sought after by those with reason to be stealthy, such as pirates, smugglers, and spies.

THE EM COUNTERSCAN SUBSYSTEM

The EM Counterscan system is designed to disrupt EM scanning by active interference. When an EM scanning beam hits a ship or small craft with EM Counterscan, the targeted ship immediately broadcasts a mirror image of the scan beam. This has the effect of flattening the amplitude of the scan beam to almost nothing, as peaks and valleys cancel each other out. All that returns to the scanning ship is the merest echo of a return, which is usually lost in the general noise of space. In game terms, the EM Counterscan reduces the percentage chance of a standard scan beam detecting the target ship by 90%. Remember, that is 90% of the scan's usual chance, which is modified by distance. Thus it is 90% reduction of 85% up to 50 km, or 8.5% chance of detection, 90% reduction of 50% up to 75 km, or 5% chance of detection, and 90% reduction of 10% up to 100 km, or 1% chance of detection. In any case, the return is blurred and distorted, so no clear picture of the target is received.

There is a nasty side effect, in that vessels using EM Counterscan are **extremely** visible to any other vessel in the vicinity because of the mirror image broadcast. The target vessel in effect flares when painted by the scan beam. EM Counterscan is also worse than useless against Military scan sensors, as the larger collection area acts effectively as if it was another ship. Possession of an EM Counterscan system by nonmilitary vessels is regarded as equivalent to intent toward piracy, and is extremely illegal. EM Counterscan systems can be purchased and fitted on Thieve's Worlds and through the black market at very steep prices.

Item	Description	Cost	Tonnage	TL	Req'd Skill
EM Counterscan	Reverse amplitude flattening scan emitters	10000cr	0.5 Tons	8	Electronics

THE ACTIVE GRADAR COUNTERMEASURE EMITTER SUBSYSTEM

Active GRADAR countermeasure emitters work in basically the same fashion as EM Counterscan systems, only instead of working in the EM spectrum, they work with gravitics. They are just as illegal as EM Counterscan systems, and can be obtained from the same sources.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Active Gradar Countermeasure	Reverse amplitude flattening Gradar emitters	10000cr	0.5 Tons	10	Electronics

THE CONFIGURABLE TRANSPONDER SUBSYSTEM

Transponders are the ID devices built into all vessels. They broadcast the name and registration details of the vessel when queried by a scan from another vessel or station. A configurable transponder is programmable by the user to respond as the user wishes. This allows the vessel to masquerade as another vessel, real or fictitious, or to not say anything at all when queried. Sale of a configurable transponder is illegal most everywhere. Although possession of one is not considered a crime, use of one to give false information is. Configurable transponders are available from Thieve's Worlds, the black market, or certain independent states..

Item	Description	Cost	Tonnage	TL	Req'd Skill
Configurable Transponder	Device to allow changing ID	5000cr	N/A	7	Programming+1

THE REFLECTIVE PLASMA SHAPING SUBSYSTEM

This system allows the user to shape the reflective plasma shields of a standard shield package into various shapes. The effect is the ability to change the apparent shape and size of a ship into whatever the user wants, from a military vessel to an asteroid. The effect only works well with standard scan, as the increased baseline of military scan allows the scanning vessel to discern the real ship inside the false ship. Vessels using scan against a vessel with the plasma reshaping system are 85% likely to be fooled. Vessels with military scan are only 25% likely to be fooled. The false image is always at least 100% larger than the real vessel. Reflective plasma shaping is totally ineffective against GRADAR, as the GRADAR system can compare the ship's mass to its apparent volume, and would note such a large discrepancy. Possession of this system is considered a crime in both SaVaHuTa and the DC. It is obtainable at Thieve's Worlds and through the black market.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Reflective Plasma Shaping	Device to disguise ship size and shape	10000cr	1 Ton	8	Programming+1

EM ABSORPTIVE COATING

EM absorptive coating is not actually a system per se. It is a coating applied over the hull of a vessel which cuts the echo induced by a scan beam by between 10 and 50%, as it is available in 5 factors of absorptive quality, each one increasing the absorptiveness of the coating by steps of 10%, i.e. a factor 2 coating decreases the scan echo by 20%. It also increases damage from beam weapons (lasers, cougars, and paccs) by the same amount as the scan echo is decreased, i.e. a factor 2 coating increases beam DF by 20%. EM Absorptive coatings are not illegal, although they are frowned upon. Use of the coating can be used as corroborating evidence of ill intent if other evidence is also present.

Item	Description	Cost	Tonnage	TL	Req'd Skill
EM Absorbtive Coating	Hull Coating to absorb active scan	1000cr/Factor	N/A	8	N/A

THE COMMUNICATIONS SYSTEMS

Communications are used to connect crew and passengers with the vessel, vessels to other vessels, and vessels to worlds. There are several different systems available, and all are part of the standard hull package. Routing for the system is performed through the comm station, although comm station function can be accessed through any station if an emergency requires this, as the comm station is the least complex of any standard station. Security stations are modified comm stations, and are generally limited to surveillance and monitoring functions, along with access to coding and decoding functions.

THE IN-SHIP SUBSYSTEM

The in-ship subsystem is a dual method data delivery system, consisting of a short range radio frequency carrier and a secure line carrier. The radio frequency carrier is used for convenience and portability, but is broadcast, and thus liable to be intercepted and possibly compromised. Use of the radio frequency carrier can also be detected by passive scan sensors. The secure line carrier is routed over physical optical wiring and is preferred for high bandwidth and secure communications. One must be physically connected to the system in order to use it. All stations use this carrier for security reasons.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Inship Comm	In Ship Communications and Data transfer	100cr/Ton	Hull Tonnage * 0.005	7	Programming+1

THE RADIO SUBSYSTEM

The radio subsystem is a long range radio frequency system used to communicate with other craft and with worlds. It is separate from the in-ship system, and is far more powerful. All types of data can be carried over this system, but it is broadcast, and thus very liable to interception and inherently insecure. Radio carried data can be encrypted securely, but often isn't as there is no particular need.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Radio Comm	Broadcast Radio Frequency Comm and Data Transfer	100cr	N/A	7	Programming+1

THE *MASER* SUBSYSTEM

The MASER system is the most secure long-range communication medium. It is a microwave emitter (MASER is short for Microwave Amplification by Stimulated Emission of Radiation) which is pulsed in code to permit tight beam communications. Only vessels and worlds in a straight line from the MASER can intercept the data communications, and objects in between can block the signal. The beam spreads out slightly the further it gets from the source, but is still very tight. The MASER can be swiveled to aim it at a particular point.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Maser Comm	Tight Beam Microwave Frequency Comm and Data Transfer	100cr	N/A	7	Programming+1

WEAPONS SYSTEMS

Weapons systems are the offensive half of a ship's self-defense capabilities. It is not necessary to have weapons on a ship, but having weapons when you don't need them is safer that needing weapons when you don't have them.

LASERS

The standard ship laser is a 1 micron wavelength free electron laser coupled to an optical storage cavity that stores the output of the laser over a 10 second period, allowing it to be emitted quickly in a 10 gigajoule, 200 pentawatt, 5 nanosecond burst. This short burst ability allows for the ship's shields to be dropped, the laser fired, and shield re-raised before an enemy ship can detect that the shields have been lowered. These powerful, short-burst, lasers (DF=10) are available at TL8 and above. Lower weight, half power lasers (laselets) which use the same technology somewhat miniaturized, are available at TL 9. Weaker, chemical pulse lasers are available at TL7, having energies of 1 gigajoule in 10 gigawatt, 100 millisecond pulses, with a ten second recharge period. These lasers have a damage factor of 1.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Inline Short Burst Laser	Pilot aimed Burst Laser	400cr Each	3 Tons Each	8	Ship's Guns+1
Short Burst Laser Turret	Shirt Burst Laser in Turret	500cr Each	4 Tons Each	8	Ship's Guns+1
Short Burst Laser Pod	Short Burst Laser in Pod	500cr Each	4 Tons Each	9	Ship's Guns+1
Inline Laselet	Pilot Aimed laselet	1000cr Each	1 Ton Each	9	Ship's Guns+1
Inline Pulse Laser	Pilot aimed Pulse Laser	500cr Each	5 Tons Each	7	Ship's Guns+1
Pulse Laser Turret	Pulse Laser in Turret	750cr Each	8 Tons Each	7	Ship's Guns+1

COGAR BEAM WEAPONS

COGAR Beam Weapons are coherent gamma ray lasers. They emit high energy (0.511 MeV) photons produced by electron-positron annihilation. COGAR beam pulses are typically of approximately 10 gigajoule energies and 0.1-10 nanosecond duration. While a COGAR pulse has no more energy than an optical laser beam, the energy from a COGAR is more penetrating and less easily diffused, and so is about 3 times as damaging (DF=30). COGAR Beam Weapons are available from TL9 up.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Inline COGAR	Gamma Ray Laser	650cr Each	8 Tons Each	9	Ship's guns+1
COGAR Pod	Gamma Ray Laser Pod	750cr Each	10 Tons Each	9	Ship's guns+1

NUCLEAR *MISSILES* AND TORPEDOES

Nuclear missiles at TL7 and TL8 are rockets with fission-fusion warheads, of about 1 megaton yield. At TL7 they are propelled by chemical solid rocket fuels; while at TL8, monatomic hydrogen fuel is used. These missiles have a damage factor (DF) of 2.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Inline Missile Launcher	Missile Launcher Tubes	400cr Each	5 Tons Each	7	Ship's Guns+1
Missile Turret	Missile Launcher Turret	500cr Each	6 Tons Each	7	Ship's Guns+1
CG Nuke Missile	Comp Guided Missile	75cr Each	0.25 Tons Each	7	Ship's Guns+1
GG Nuke Missile	Gunner Guided Missile	100cr Each	0.25 Tons Each	7	Ship's Guns+1

At TL9 and TL10, with the development of antigravity containment, matter-antimatter explosive missiles become available, with 100 megaton yields. These are propelled by plasma jets produced by leaking antimatter into a gas jet flow. These missile are approximately 10 times as damaging as the TL7 and TL8 missiles, with a DF of 20.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Inline Missile Launcher	Missile Launcher Tubes	400cr Each	5 Tons Each	7	Ship's Guns+1
Missile Pod	Missile Launcher Pod	800cr Each	6 Tons Each	9	Ship's Guns+1
CG M/AM Missile	Comp Guided Missile	75cr Each	0.25 tons Each	9	Programming+1
GG M/AM Missile	Gunner Guided Missile	100cr Each	0.25 Tons Each	9	Ship's Guns+1

If a nuclear missile were to detonate in contact with a spaceship, the ship would be utterly destroyed, regardless of the hull armor. However, this hardly ever happens; as warheads detonate some distance from a ship and depend on the radiation and blast to do damage from a distance. Ships in space can survive nuclear detonations at distances that would be fatal within a planetary atmosphere. Lacking the addition mass of surrounding gas, the momentum of a nuclear explosion is vastly less: radiation damage is more important. Anti-missile lasers can easily destroy missiles with a few millisecond laser burst, once they have a clear fix on them, so missiles use a variety of stealth technologies to prevent this. However, once a missile encounters a ship's plasma shield, its position is clearly marked and it will swiftly be eliminated by antimissile lasers. Due to this fact, nuclear missiles are usually set to detonate immediately upon penetration of a opposing ship's plasma shield, 100 meters to 1 kilometer from the ship.

Missiles engines are generally able to propel them at accelerations of approximately 100g, far greater than any ship acceleration. However, at typical ship combat distances, this means that missiles take from 10 to 30 seconds from launch before reaching the enemy ship. In this period of time, the attacked ship could easily dodge, so all missiles use active tracking mechanisms, guided either by an onboard computer and sensor array, or guided from a Gun Station.

Rather than relying on direct explosive power, some warheads are designed to detonate far from an opposing ship, the nuclear blast being used to pump an X-ray laser array directed at the enemy ship. Due to the additional mass of the X-ray rod mechanisms, the actual blasts of these missiles are less by a factor of 10 to 100, and so they are ineffective as directed explosive warheads. Such lasers produce a 5 gigajoule laser pulse with a DF of 20. These weapons weigh about one ton at TL7 and TL8, but weigh and cost the same as other missiles (250 kg) at TL9 and TL10.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Early GG X-Ray Missile	Gunner Guided Nuke-pumped X-ray Laser Missile	300cr Each	1 Ton Each	7	Ship's Guns+1
Early CG X-Ray Missile	Comp Guided Nuke-pumped X-ray Laser Missile	300cr Each	1 Ton Each	7	Programming+1
Late CG X-Ray Missile	Gunner Guided M/AM-pumped X-ray Laser Missile	75cr Each	0.25 Tons Each	9	Ship's Guns+1
Early GG X-Ray Missile	Comp Guided M/AM-pumped X-ray Laser Missile	100cr Each	0.25 Tons Each	9	Programming+1

Matter-Antimatter torpedoes are large missiles that are actively guided by an operator. They usually carry large warheads with exceptionally large antimatter charges (80 kg, 1600 megaton yield, +40 DF), and weigh 1 ton each. They are usually housed outside the hull...

Item	Description	Cost	Tonnage	TL	Req'd Skill
Torpedo	Large Gunner Guided M/AM Missile	250cr Each	1 Ton Each	9	Ship's Guns+1

A TL9 or TL10 ship carrying 250 kg missiles will generally carry a mix of missiles, some with direct explosive warheads and some with X-ray laser warheads. Prior to detonation, these warheads are indistinguishable by an enemy craft. Thus a reflective plasma shield is needed even when encountering a ship armed only with missiles. Note that from a game mechanics standpoint, it is irrelevant where a missile carries a direct explosive or a X-ray laser warhead, both have the same damage factor. However, noting which type of warhead is used can be significant to the character of game play.

PARTICLE BEAM WEAPONS

The shielding protection afforded by plasma screens and antimissile lasers led to the creation of neutral beam weapons. These weapons emit beams of neutrons, which are unaffected by plasma shields or laser beams. The only forms of protection that are effective against them is the ship's hull armor and the pilot's skill. Particle beam weapons produce 1 second bursts of high speed neutrons. These fast neutrons are produced by a variant of the same technology used for fusion drives. These weapons are heavy but quite powerful, with a damage factor (DF) of 40. In common space parlance, they are usually called Paccs, for Particle Accelerators.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Inline Pacc	Pilot aimed Particle Accelerator	1000cr Each	18 Tons Each	8	Ship's Guns+1
Pacc Turret	Particle Accelerator Turret	1200cr Each	20 Tons Each	8	Ship's Guns+1
Pacc Pod	Particle Accelerator Pod	1200cr Each	20 Tons Each	9	Ship's Guns+1

KINETIC ENERGY WEAPONS

Most commonly used at lower tech levels (TL7 and TL8), kinetic energy weapons work by the force of impact at high speeds, typically about 100 km per second or higher. Magnetic mass drivers are used to accelerate the projectiles, usually made of nickel-iron. To reach the required speeds in a few meters requires acceleration at tens of millions of gravities, so only simple mass lumps can be used, not anything with any mechanism. All Mass Drivers require associated Magazines, with 1000 shots per Magazine.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Inline Mass Driver	Pilot Aimed Mass Driver	500cr Each	2 Tons Each	7	Ship's Guns+1
Mass Driver Turret	Turreted mass Driver	750cr Each	3 Tons Each	7	Ship's Guns+1
Mass Driver Magazine	Storage for Mass Driver ordinance	50cr Each	1 Ton Each	7	N/A

Even without the use of a mass driver, kinetic energy weapons are useful in a combat pass between ships that have unmatched velocities. In this case no mass driver is needed: the difference in the ship velocities provides the impact velocity. Such passive kinetic energy weapons are known as KEW (Kinetic Energy Weapon) mines.

Item	Description	Cost	Tonnage	TL	Req'd Skill
KEW Mine	Unguided Kinetic Energy Weapon	50cr Each	1 Ton Each	7	Ship's Guns+1 -20

ANTIMATTER PROJECTILES

When antimatter handling first became practical at TL9, it was thought that projectiles of antimatter would be powerful weapons, inasmuch as even a small chunk of antimatter hitting a ship would be sufficient to destroy it. This proved to be not the case. Antimatter projectiles were easily deflected by ejecting a small amount of gas from the attacked ship; the energy of the annihilation of the gas would propel the antimatter projectile away from the ship. It was not even necessary to provide an additional mechanism for doing this; gas could be ejected through the maneuvering jet nozzles. As a result, most ships do not bother to carry antimatter projectiles. Still, in a surprise attack situation, they can be devastating weapons.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Antimatter Projectile	Unguided M/AM Weapon	250cr Each	1 Ton Each	9	Ship's Guns+1 -60

REACTION CANNONS

Reaction cannons are artillery pieces firing small nuclear warheads, used mostly at TL7. There are cannons firing three sizes of nuclear warheads: small (0.25 megaton, DF=1), medium (2 megaton, DF=3), or large (6 megaton, DF=5). Because of the slow projectile velocities (2 kilometers/second), these have a -20% penalty to hit.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Inline Small Reaction Cannon	Pilot Aimed Small Cannon	300cr Each	4 Tons Each	7	Ship's Guns+1 -20
Small Reaction Cannon Turret	Small Cannon Turret	400cr Each	5 Tons Each	7	Ship's Guns+1 -20
Small Reaction Cannon Magazine	Magazine for Small Cannon 20 Shots	100cr Each	2 Tons Each	7	N/A
Inline Medium Reaction Cannon	Pilot Aimed Medium Cannon	600cr Each	8 Tons Each	7	Ship's Guns+1 -20
Medium Reaction Cannon Turret	Medium Cannon Turret	800cr Each	10 Tons Each	7	Ship's Guns+1 -20
Medium Reaction Cannon Magazine	Magazine for Medium Cannon 20 Shots	200cr Each	4 Tons Each	7	N/A
Inline Large Reaction Cannon	Pilot Aimed Large Cannon	1000cr Each	12 Tons Each	7	Ship's Guns+1 -20
Large Reaction Cannon Turret	large Cannon Turret	1200cr Each	15 Tons Each	7	Ship's Guns+1 -20
Large Reaction Cannon Magazine	Magazine for large Cannon 20 Shots	300cr Each	6 Tons Each	7	N/A

WEAPON ADD-INS

Weapon Add-ins are standardized modules designed to be swapped in and out of small craft. Weapon add-ins contain an appropriate Weapons Station.

Item	Description	Cost	Tonnage	TL	Remarks
Laser Add-In	Limited Traverse Laser	500 cr	5 tons	9	Atmosphere or Space, +10 Damage
Missile Add-In	Missile Launcher Tube and space for 4 GG 250 kg missiles	500 cr	5 tons	9	Atmosphere or Space, +20 Damage
Mag Gun Add-In	Remote turreted Mass Driver	250 cr	5 tons	9	Atmosphere only +5 damage
Minigun Add-In	Remote Turreted Mini-Gun	100 cr	5 tons	9	Atmosphere only, +1 damage

CREW COMMAND SYSTEMS

CREW STATION SUBSYSTEM

Crew Stations can be either hard-coded for the particular applications or Configurable fro several different stations. Hard-Coded stations are cheaper, but not as flexible, and cannot perform more than one task. Configurable stations can be changed to adapt to the task needed on the fly, but are more expensive and can have up to four tasks coded into the station.

HARD CODED STATIONS.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Pilot Station	Controls for steering the ship	500 cr	1 ton Each	8	Pilot or Small Craft
Engineering Station	Controls for Engineering Bots, drive mix, & monitoring	500 cr	1 ton Each, Drive Tonnage *.01	8	Drives or Physics
Maintenance Station	Controls for maintenance bots	100 cr	1 Ton Each, Hull Tonnage *.001	8	Electronics & Mechanics
Security Station	Displays & Controls for Security Systems	100 cr	1 Ton Each, Hull Tonnage *.001	8	Programming
Gun Station	Controls for Weapons	500 cr	2 Tons Each, 1 Station per Weapon	8	Ship's Gins
Comm Station	Controls for Communications	50 cr	1 Ton Each	8	Programming
Comp Station	Controls for Programming	1000 cr	1 Ton Each	8	Programming
Scan Station	Controls for Broadband Sensor systems	500 cr	1 Ton Each, Hull Tonnage *.001	8	Astronomy & Electronics
Defence Station	Controls for TL 8 Defences	1500 cr	1 Ton Each, Deflector Tonnage *.1	8	Programming & Ship's Guns
Shield Station	Controls for TL 9+ Defences	500 cr	1 Ton Each, Shields Tonnage *.1	9	Programming & Ship's Guns
Observatory	Ultra High Def Sensor Package and Controls	1000 cr	10 Tons Each	8	Astronomy
Nav Station	PSI Interface and Booster for Jump Translation		2 Tons Each	10	Transfer

Tonnages given in the form of "X tons each" require only 1 station per ship.
Tonnages given in the form of "X tons each, Y Tonnage * Z" require multiplying the tonnage of Y times the constant Z for the number of stations needed.
More than the minimum number of stations may be installed for redundancy. Many warships have a second bridge, for example.
TL 9 Stations are equipped with Jack - direct brain input via plug - technology.
TL 10 Stations are equipped with Veil - direct brain input via induction net - technology.
The minimum stations needed are Pilot, Scan, Comm, Engineering, and Comp.
Nav Station and Observatory needed for Jump Travel
Gun Stations needed for armed ships. Shield Stations needed for shielded ships.

CONFIGURABLE STATIONS

Item	Description	Cost	Tonnage	TL	Req'd Skill
Configurable Station	Configurable Station with space for 4 modules	1000 cr	1 ton	9	Varies
Pilot Module	See Pilot Station	250 cr	N/A	9	Pilot or Small Craft
Engineering Module	See Engineering Station	200 cr	N/A	9	Drives or Physics
Maintenance Module	See Maintenance Station	100 cr	N/A	9	Electronics & Mechanics
Security Module	See Security Station	100 cr	N/A	9	Programming
Gun Module	See Gun Station	500 cr	N/A	9	Ship's Gins
Comm Module	See Comm Station	100 cr	N/A	9	Programming
Comp Module	See Comp Station	500 cr	N/A	9	Programming
Scan Module	See Scan Station	200 cr	N/A	9	Astronomy & Electronics
Shield Module	See Shield Station	150 cr	N/A	9	Programming & Ship's Guns
Waldo Module	Controls Waldo, Weldiing. and Cutter Arms	100 cr	N/A	9	Construction

CONSOLES

Consoles are primitive Tech Level 7 versions of the sophisticated Stations used at TL 8 and above. Consoles use flat video screens, manual controls, and straight numeric readouts.

Item	Description	Cost	Tonnage	TL	Req'd Skill
Pilot Console	Controls for steering the ship	250 cr	1 ton Each	7	Pilot or Small Craft
Engineering Console	Telemetry for monitoring Drives	150 cr	1 ton Each, Drive Tonnage *.01	7	Drives or Physics
Security Console	Displays & Controls for Security Systems	50 cr	1 Ton Each, Hull Tonnage *.001	7	Programming
Weapons Console	Controls for Weapons	100 cr	2 Tons Each, 1 Console per Weapon	7	Ship's Gins
Radio Console	Controls for Communications	50 cr	1 Ton Each	7	Programming
Comp Console	Controls for Programming	500 cr	1 Ton Each	7	Programming
Radar Console	Controls for Radar	100 cr	1 Ton Each, Hull Tonnage *.001	7	Astronomy & Electronics

The minimum consoles needed are Pilot, Scan, Comm, Engineering, and Comp.
Weapon Consoles needed for armed ships.

CREW LIVING AREA SYSTEMS

These components can be used on either a station or a ship as living areas. Each component has benefits and drawbacks. One may pack a large number of crew into a small tonnage, while another may be luxurious and draw high rent or passage fees. Choose the living areas that match the functions of the ship. All living areas include the tonnage required for ventilation and power required as well as personal storage areas sufficient to support the listed number of crew or passengers. Military ships and small civilian ships may practice "hot-bunking" where two or three crew members share the same bunk space due to watch differences.

Item	Description	Cost	Tonnage	TL	Includes
Crew Quarters	Bunks for 4 people	125 cr	5 tons	7	WC
Cabin	Bunks for 2 people	250 cr	5 tons	7	small living/work area
Steerage	hammocks for 5 people	125 cr	5 tons	7	N/A
Apartment	Bunks for 5 people	500 cr	10 tons	8	WC, Mini-Galley
Luxury Suite	Sleeping plates for 2 people	1000 cr	10 tons	9	Internal rooms, Trivox, mini-bar, Dining Area
Stateroom Add-in*	Sleeping Plates for 2 people	1000 cr	5 tons	9	Trivox, WC
Efficiency Add-In*	Hammocks for 10 people	500 cr	5 tons	9	N/A
Standard Add-In*	Bunks for 5 people	500 cr	5 tons	9	WC
Shuttle Add-in*	bare seating for 30 short run passengers	1000 cr	5 tons	9	WC
Condo	Sleeping Plates for 5 people	1500 cr	20 tons	9	Internal rooms, Trivox, mini-bar, Dining Area

* Add-ins are standard shaped and sized modules designed to be swapped in and out of small craft.

COMMERCIAL ENTERPRISE SYSTEMS

These components are money-making ventures rather than cost centers. These are typically found on stations, but sometimes are found on ships - particularly famous are the roving showboats which ply the backwards areas of the Cluster.

Item	Description	Cost	Tonnage	TL	Remarks
Large Dock	For ships over 1000 tons	50,000 cr	100 Tons	8	Includes grapple, emergency access, and cargo handling equipment
Medium Dock	For ships over 100 tons	12500 cr	25 Tons	8	See Large Dock
Small Dock	for craft up to 100 tons	2000 cr	10 Tons	8	See Large Dock
Craft Yard	Area for manufacturing up to 1 small craft per month	100,000 cr	150 tons	8	Employs 10
Shipyard	Area for manufacturing up to 1000 tons of ships per month	1,000,000 cr	1500 tons	8	Employs 50
Big Shipyard	Area for manufacturing up to 5000 tons ships per month	10,000,000 cr	15000 tons	8	Employs 250
Naval Shipyard	Area for manufacturing up to 25000 tons of ships per month	100,000,000 cr	150000 tons	8	Employs 1000
Factory	Manufactures good for export or domestic consumption - 1000 tons per month	1,000,000 cr	1500 tons	8	Employs 250
Shop	Area dedicated to retail sale	2500 cr	10 tons	8	Employs 1
Store	Area dedicated to retail sale	5000 cr	25 tons	8	Employs 3
Import Export House - Small	Buys, warehouses, and sells ship cargo	50000 cr	100 tons	8	Employs 20
Import Export House - Medium	Buys, warehouses, and sells ship cargo	100000 cr	200 tons	8	Employs 50
Import Export House - Large	Buys, warehouses, and sells ship cargo	150000 cr	400 tons	8	Employs 150
Design House	Designs products	50000 cr	50 Tons	8	Employs 20
Fuel Generator	Generates Deuterium from Water	1000 cr per ton	As needed	8	Generates 0.01 Ton of Deuterium per week per ton
Power Plant	Generates Antimatter from LH	1000 cr per ton	As needed	9	Generates 0.5 tons per ton. 100 tons of LH makes 1 ton AM
LH Storage	Stores LH	5 cr/ton	As needed	9	60 tons per day per Power Plant tonnage
AM Storage	Stores AM	5 cr/ton	AS Needed	9	1 ton per day per Power Plant tonnage
Auditorium	Designed for simple presentations and shows.	5000 ct	20 tons	9	Seats 50, includes prop room
Music Hall	Designed for more ambitious performances	7500 cr	40 Toms	9	As Auditorium, except seats 80 and includes lighting and Sound, and two dressing rooms

Performance Hall	Designed for most performance needs	12500 cr	60 tons	9	As Music Hall, except seats 160, Includes 5 dressing rooms, 2 story stage, and audience balconies
Opera House	Designed for the most intricate performances	25000 cr	80 tons	9	As performance Hall, except seats 250, stage elevators, three story stage, orchestra pit, and second tier of balconies
Machine room	Automated room for manufacturing items from raw materials	10000 cr	10 tons	10	Manufactures 1 ton per day. Chain together rooms to increase tech level. 1 room = TL7, 2 = TL8, 3 = TL 9, 4 = TL10
Recording Studio	A studio for recording music	2000 cr	5 tons	7	Includes all necessary equipment.
Small Factory	As Factory	350000 cr	300 tons	8	Manufactures 2000 tons of product per year. Employs 25
Entertainment Studio	Creates Trivox entertainment titles, including games and shows	250000 cr	100 tons	8	Employs 50
Restaurant	Serves elaborate meals	20000 cr	20 tons	8	Seats 50 and employs 8
Large Restaurant	As Restaurant	35000 cr	40 tons	8	Seats 100, Employs 16
Arena	an area for playing sports	150000 cr	100 tons	8	Seats 5000
Nightclub	A n establishment for drinking and entertainment	50000 cr	40 tons	8	Seats 100, employs 20

TRANSPORTATION SYSTEMS

These components deal with transportation in its many guises

Item	Description	Cost	Tonnage	TL	Remarks
Public Transport System	A system for moving numbers of people around	100 cr per ton	Varies	8	Hull Tonnage *.001 Employs 1 per 10 tons
MatTran	Matter Transfer cells to transport people and cargo from orbit to ship or ship to ship	50000 cr per cell	0.25 tons per cell	10	Mostly used for cargo - people use it only in emergencies as there is some loss. Transports up to 1 ton per cell
Chain hoist	Ab endless chain that can lift people or cargo	20 cr per ton	varies	8	Hull Tonnage *.001 Employs 1 per 25 Tons
Slidewalk	Endless belts in the ground to carry people in congested areas	50 cr per ton	varies	8	tonnage of area served *.005

STARCLUSTER 2 SPACESHIP CONSTRUCTION SHEET

Hull	Description	QTY	Factor	Cost	Tonnage
Basic Hull	_____	____	_____	_____cr	_____ T
Hull Shape	_____	____	_____	_____cr	_____ T
Ship's Bay	_____	____	_____	_____cr	_____ T
Drive	_____	____	_____	_____cr	_____ T
Drive	_____	____	_____	_____cr	_____T
Drive	_____	____	_____	_____cr	_____T
Observatory	_____	____	_____	_____cr	_____T
Station	_____	____	_____	_____cr	_____T
Station	_____	____	_____	_____cr	_____T
Station	_____	____	_____	_____cr	_____T
Station	_____	____	_____	_____cr	_____T
Station	_____	____	_____	_____cr	_____T
Station	_____	____	_____	_____cr	_____T
Station	_____	____	_____	_____cr	_____T
Station	_____	____	_____	_____cr	_____T
Station	_____	____	_____	_____cr	_____T
Station	_____	____	_____	_____cr	_____T
Station	_____	____	_____	_____cr	_____T
Computer	_____	____	_____	_____cr	_____T
Shields	_____	____	_____	_____cr	_____T
Fuel	_____	____	_____	_____cr	_____T
Fuel	_____	____	_____	_____cr	_____T
Weapon	_____	____	_____	_____cr	_____T
Weapon	_____	____	_____	_____cr	_____T
Weapon	_____	____	_____	_____cr	_____T
Weapon	_____	____	_____	_____cr	_____T
Weapon	_____	____	_____	_____cr	_____T
Weapon	_____	____	_____	_____cr	_____T
Crew/Passengers	_____	____	_____	_____cr	_____T
Crew/Passengers	_____	____	_____	_____cr	_____T
Galley	_____	____	_____	_____cr	_____T
Lounge	_____	____	_____	_____cr	_____T
WC	_____	____	_____	_____cr	_____T
Special _____	_____	____	_____	_____cr	_____T
Special _____	_____	____	_____	_____cr	_____T
Special _____	_____	____	_____	_____cr	_____T
Special _____	_____	____	_____	_____cr	_____T
Special _____	_____	____	_____	_____cr	_____T
Special _____	_____	____	_____	_____cr	_____T
Special _____	_____	____	_____	_____cr	_____T
Special _____	_____	____	_____	_____cr	_____T

STARCLUSTER 2 SPACESHIP CONSTRUCTION SHEET

Item	Description	QTY	Factor	Cost	Tonnage
Basic Hull	Std Hull Pkg	1	1	(2000)	20T
Shape	Wedge	1	6	12000	---
Ship's Bay	For Laser Pod	1	1	440	4.4T
Drive	Mini-G	1	10	20000	20 T
Drive	A-Grav	1	10	10000	10 T
Drive					
Station	Combo *	3	1	3000	3 T
Station					
Station	Combo A Modules	1	1	350	---
Station	Combo B Modules	1	1	850	---
Station	Combo C Modules	1	1	800	---
Shields		1	6	6000	3 T
Fuel	Anti-Methane	1	0.5	12000	10 T
Fuel	Liquid Methane	1	0.5	50	10 T
Weapon	Laser Pod	1	1	500	(4 T)
Weapon	M/AM Torpedo	2	1	500	2 T
Weapon					
Crew/Passengers	Standard Add-in	1	1	500	5 T
Crew/Passengers					
Galley	For 5	1	1	25	1 T
Lounge	For 5	1	1	50	1 T
WC	Built into add-in				
Special					
Special	Standard Scan Pkg	1	1	1500	1 T
Special	Gravitic Grapple	1	1	1200	1 T
Special					
Cargo					
	TOTALS			69565 cr	100 T

* Combo Station A Functions: Pilot, Comm
Combo Station B Functions: Scan, Shields, Comp
Combo Station C Functions: Eng, Maint, Gun

BEAK CLASS DISPATCH POD

The Beak class of dispatch or courier pods was designed by noted designer Carson deVille (of Damien Studios on Glorianna in the Gloria system) for fast in-system transit. The Mini-G and A-Grav drives are capable of enormous acceleration of up to 10 G on Stealth Mix, with consequently higher acceleration with larger proportions of M fuel. Accommodations are spartan, and cargo is small, but the pod is extremely fast.

STARCLUSTER 2 SPACESHIP CONSTRUCTION SHEET

Item	Description	QTY	Factor	Cost	Tonnage
Basic Hull	Std Hull Pkg	1	1	(7000)	70 T
Hull Shape	Discoid	1	5	35000	---
Ship's Bay	For COGAR Pods	2	1	2200	22 T
Drive	Jump Drive	1	1	35000	35 T
Drive	Mini-G	1	3	105000	21 T
Drive	A-Grav	1	3	10500	10.5 T
Observatory		1	1	1000	10 T
Station	Nav	1	1	1000	2 T
Station	Combo A	1	1	1350	1 T
Station	Combo B	1	1	1850	1 T
Station	Combo C	1	1	1300	1 T
Station	Combo D	1	1	1350	1 T
Station	Combo E	1	1	1850	1 T
Station	Combo F	1	1	1300	1 T
Station	Gun A	1	1	1000	1 T
Station	Gun B	1	1	1000	1 T
Shields		1	5	5000	3 T
Fuel	Anti-Methane	1	1	12600	10.5 T
Fuel	Liquid Methane	1	2	105	21 T
Weapon	Cogar Pod	2	1	1500	(20 T)
Weapon					
Crew/Passengers	Crew Quarters	2	1	250	10 T
Passengers	Luxury Suite	4	1	4000	40 T
Galley		1	1	600	12 T
Lounge		1	1	1000	15 T
WC		2	1	20	2 T
Cargo					10 T
TOTALS				225775 cr	350 T

BAHAMUT CLASS EXCURSION VESSEL

The Bahamut class excursion vessel was a one-off (class of one) vessel designed by Bishop Billy Black as a combination of yacht, passenger, and freighter. The model is that of the successful Manticore class excursion vessels, which are much smaller and less luxurious. The four luxury suites and huge lounge make the Bahamut into a mini liner, and the owner-crew consortium can use the vessel as a private yacht in between charters.

The vessel is well armed, with two COGARs, and fairly fast. The Mini-G drives are small, but gulp down a large amount of fuel. An interesting feature is the mainday and alterday bridges, a feature not often seen outside of the military. The Bahamut was built at Rohn Shipyards above Beider in the Pearl system to the Bishop's order.