# Star Travel

Starships travel between the stars using the stutterwarp, the star-drive that makes faster-than-light travel possible. Stutterwarp is an implementation on the macro scale of the tunnelling phenomenon common to electrons. The proper introduction of energy in a field around a starship allows it to move instantaneously from one location to another without passing through the intervening space.

The distances that the stutterwarp can travel, however, are very small. One cycle of the drive moves a ship less than a few hundred meters. By cycling the drive very rapidly, however, the ship can travel vast distances in very short times. The speeds commonly achieved depend on the output of the powerplant, but approach several light-years in a day.

Stutterwarp drives function best in unstrained space; within a gravity well, their efficiency drops enormously. At a threshold of 0.0001 Gs, maximum speed for stutterwarp ships drops below lightspeed. In truly high gravity fields (around planets), speeds are reduced to efficiencies less than chemical rockets. As a result, stutterwarp is efficient as an interstellar and interplanetary drive, but ordinary methods are still necessary for travel between orbit and world surfaces.

The structure of the stutterwarp drive imposes some limitations on distances travelled. As a stutterwarp drive is used, it builds up an energy contamination that stalls the drives when it reaches a threshold level. Energy contamination is reversed by discharging it in a gravity well. If the discharge is not made before the ship has travelled its range value in light years, the ship will be completely irradiated and the crew killed.

The discharge must take place in a significant gravity well. Getting into the inner system of a star is sufficient. The entire process takes approximately 40 hours, during which time the drive can still be used (for in-system travel). Ships operating with a stutterwarp within a system are continually discharging, and need never make a special effort to do so.

The actual speed of the ship relative to our three dimensions using stutterwarp is threefold. In deep space, the warp efficiency is equal to light-years per day. A warp efficiency-1 ship would require one week to travel between stars seven light-years apart. In the inner system of a star where the gravity becomes greater than a few thousandths of a G, the efficiency of the stutterwarp drops off enormously (by a factor of approximately 10,000). Ships with stutterwarp in the inner system are still moving at enormous speeds, but no longer at multi-light speeds. Stutterwarp powered ships in moving between worlds in the inner system can expect travel times ranging from hours to at most a couple of days. Finally, when gravitation reaches some tenths of a G, the efficiency of the stutterwarp drops off once again, down to a point where the stutterwarp cannot overcome that gravitation and some other means of propulsion will be required.

Stutterwarps are capable of keeping a ship in an orbit around a planet, but, due to gravitational problems, they cannot be used to land a ship on a planet. Another form of drive will be necessary, or, if the ship is a streamlined airfoil design, it might be able to glide in under little or no added propulsion.

## TINKERING WITH YOUR SHIP

It is possible to fine-tune various aspects of ship performance, provided the skilled individuals are available to do the job. Turning your ship into a hot-rod might make the difference in a tight situation.

**Increasing Power Output:** This translates into increased power for the stutterwarp drives, which means greater warp efficiency.

To increase power output. Difficult. Drive Engineering. Four hours.

*Referee:* Success increases stutterwarp efficiency 1D6 percent. This task needs to be re-performed each time the ship makes a discharge, or once per month minimum. If failed, the ship reverts to its normal warp efficiency.

When enhanced in this manner, the general maintenance number of the ship is automatically raised by three. It reverts to its original level when enhancement fails or is removed.

**Delaying Discharge:** Certain steps can be taken to delay the requirement for the energy discharge.

To delay discharge. Difficult. Drive Engineering. One hour.

The task must be attempted before a journey is undertaken. Success will delay discharge by one day.

**Heightening Sensors:** Each type of sensor (military, navigational, and investigative) can be enhanced.

To enhance sensor values. Formidable. Electronics. One hour.

The effects of enhancement are lost after one month, and the task must be repeated.

Enhanced military sensors add three to both the passive and active sensor number. Enhanced navigational and investigative sensors act as if they are one degree better than they are (minimal act like standard; advanced remain advanced).

**Overpowering Lasers:** Lasers and particle weapons can be overpowered to allow greater delivery of energy.

To enhance weapons station. Difficult. Electronics.

The effects of enhancement are lost after one month, and the task must be repeated.

Each enhanced laser delivers double hits (twice as much damage per roll on the hit location table). However, each time it is fired, an enhanced laser will burn out on a roll of 10 on 1D10. On a subsequent roll of 10 on 1D10 the laser explodes, probably killing any non-remote gunner, and doing one point of battle damage to the ship. Burnt out lasers cannot be repaired; they must be replaced.

Detonation lasers cannot be enhanced.

## REMODELLING YOUR SHIP

Moving walls and rearranging the interior of a ship is relatively easy. Provided all installations remain within the confines of the hull, virtually anything can be done to the interior.

Minor changes such as new partitions, new rooms, rearrangement of cargo space, and so forth, are very easy to accomplish. Materials are easily available as are tools and instructions necessary. The total cost runs about Lv50 per cubic meter involved.

Major changes like changing the computer system or drives, putting in a new power plant, relocating the bridge, etc., are considerably more difficult. These require putting in at a space facility and generally cost some percentage of the purchase price of the ship.

Details of major changes must be determined by the referee.

## ARMING YOUR SHIP

The end of the starship listings gives several examples of laser and particle weapons. Any of these can be placed on a ship and are readily available at any space facility on the frontier.

The maximum number of point laser weapons which can be placed on a ship is one per megawatt of power plant output. Attaching one to a hull is the sum of three tasks.


To install point laser. Routine. Drive Engineering. One hour.
To install point laser. Routine. Electronics. One hour.
To install point laser. Routine. Mechanical. Two hours.

Once all three tasks have been completed, the weapon is ready for use.

Any number of missiles can be carried by a ship up to the cargo capacity. However, they can only be launched one per remote station on the ship per space combat player turn.

## SENSORS

There are several types of sensors which can be installed on a ship. These are military, navigational, and investigative.

Military sensors are described in space combat.

**Navigational Sensors:** The following are varieties of navigational sensors which may or may not be included in a ship's sensor package.

*Deep System Scan:* Generally employed by starships entering a new system, a deep system scan uses various telescopic devices to evaluate the stellar and planetary population of the system. A deep system scan relays the location, size, and type of all stellar bodies; location and physical characteristics of all planetary bodies; and the existence of rings or belts in the system. The deep system scan can be used from any point within a stellar system.

Many ships forego the use of a deep system scan if entering a familiar system.

*Gravitational Scan:* Not as detailed as a deep system scan, a gravitational scan gives only the size of all planetary and stellar bodies within a star system. It can also be used from anywhere within the system.

**Investigative Sensors**: Various sensors can be used to investigate unexplored environments. A ship need have none of these to function. The characteristics of each of the minimal, standard, and advanced models of each are described below.

*Cartographic Sensors:* Mapping a planet's surface can be accomplished from orbit. The time involved is twenty hours for the entire planetary body, or less if only portions of the body are to be mapped. Exactly what information is gathered by the cartographic sensors depends on its level of complexity.

*Minimal Cartographic Sensors:* A complete sweep of the planet will map all land and liquid masses and major geographic features. In terms of mapping, this scan will reveal the presence of mountainous terrain, large rivers, and coastlines only.

*Standard Cartographic Sensors:* A complete sweep will generate maps of the entire planet; all terrain types will be determined. The scan also picks up large urban areas, large scale land manipulation such as agriculture or mining, and weather patterns.

*Advanced Cartographic Sensors:* Advanced sensors can perform just like standard sensors, but down to individual beings, animals, buildings, etc. They also can be used to explore the mineral wealth of the planet from orbit.

*Life Sensors:* Sensors have been developed which can detect characteristics of living animals. Fine-tuning of the equipment allows greater accuracy and distinction. Note that life sensors measure the raw size of the creature in question, not its intelligence. A dinosaur registers larger than a rabbit; a herd of cows register larger than a dinosaur.

*Minimal Life Sensors:* These can detect the existence of life within a single kilometer radius of the device. Each registering item cannot be distinguished further using minimal sensors, but its location can be determined to within ten meters.

*Standard Life Sensors:* Range is increased to ten kilometers, and not only the existence but also the size of everything in that radius is scanned. Location can be pinpointed to within a meter.

*Advanced Life Sensors:* Range is up to one hundred kilometers. The size of each organism is determined. Advanced sensors allow the operator to scan for a specific type of creature; a scan for humans, for instance, will pinpoint all things with human characteristics within the hundred kilometer range. However, this is not an exact science, and mistakes will occur, especially at long-range.

## STARSHIP POWER

Starships need fuel to generate electricity in their power plants and to provide reaction mass for their thrusters. The type of fuel varies with the type of power plant used.

Power plants are rated in megawatts per week. Fuel tankage for ships is generally allocated in terms of what will supply the power plant for a week.

**Direct Energy Conversion:** Two types of power plants utilize the technique called direct energy conversion: Fuel Cells and MHD Turbines. Both combine hydrogen and oxygen and in the process produce electricity; the difference is only in their efficiency and their handling of the waste gases.

Fuel for both types consists of liquid oxygen and liquid hydrogen (stored in compartmentalized, separate tanks).

Fuel Cells require 100 tons (165 cubic meters) per megawatt per week.

MHD Turbines are more efficient and require 75 tons (125 cubic meters) per megawatt per week.

**Fission Power Plants:** Fission power plants use decaying radioactive elements to produce heat which then drives electrical generating equipment. The fuel is carried within the reactor vessel and provides continuous energy for two years.

Refuelling a fission power plant is a major operation requiring the attention of skilled operators and heavy tool sets. It is usually performed at a world with an industrial base (and a fission fuel processing plant); it is possible to refuel anywhere if the fuel package is available.

A fission fuel package masses 750 kilograms (2 cubic meters) and will last for two years. Fission fuel packages are dated for freshness and must be installed within two years of manufacture or they provide unreliable service. Used fission fuel packages may be returned to a recycler for reprocessing; they are so dangerous that most are dropped into a star if a reprocessor is not immediately available to handle them.

**Fusion:** Fusion power plants are constructed with their supply of fuel already in them; they never need refuelling. By the time the fuel supply is exhausted, the plant has worn out and must itself be replaced.

**Refuelling:** Fuel Cell and MHD Turbines need hydrogen and oxygen for fuel. These gases are obtained by breaking down water.

*Terminals:* Any colony world and many other star systems have orbital terminals which provide liquid oxygen and liquid hydrogen as fuel for ships. The terminal has performed the work of locating water or ice, transporting it to orbit, and then cracking it using solar power. In exchange, the terminal fuel station charges Lv100 per ton.

*Self-Fuelling:* Many ships carry the necessary equipment to process water or ice into fuel. In some systems, self-fuelling is necessary because there is no terminal present. In other systems, self-fuelling saves money, but at a cost of time and effort.

Self-fuelling requires that the ship visit a location where ice or water is available, obtain it, and transport it to the ship. Ice or water equal to twice the cubic meters required is necessary (to allow for wastage). The ships's solar arrays are then used to melt the ice and crack the water into fuel. One solar array will process 23 tons (40 cubic meters) in a week. Ships often carry more than one solar array.

*Closed-Cycle Fuel Cells:* Fuel cells can be operated on closed-cycle; their exhaust gas (water vapor) can be condensed and saved in the fuel tanks. Upon arrival in a system, the ship's solar array can be opened up and the electricity used to crack the water back into fuel.

A closed cycle system eliminates the need to find a local source of water or ice, but still requires one week to process 23 tons (40 cubic meters).

*Solar Arrays:* MHD Turbines and Fuel Cells are often shut down to conserve fuel when a ship is in orbit and does not have to maneuver. Auxiliary power is provided by solar arrays that provide electrical energy direct from sunlight.

Solar arrays are produced in a standard size and configuration; they are easily procured and replaced when damaged. One standard solar array expands to produce a flat screen 10 m by 10 m and massing about 100 kilograms.

The standard array produces 2 megawatts. One solar panel can substitute for 2 megawatts of power plant.

## STUTTERWARP EFFICIENCY

Stutterwarp efficiency is equal to the cube root of (megawattage of the ship power plant/mass of ship in tons) multiplied by a constant. In most cases, this constant is 14.25, but varies slightly with the technology used to build the stutter drive.

## CREWING YOUR STARSHIP

Starships are largely automated pieces of equipment, but they nevertheless require a minimum number of people to crew them. In general, humans serve in roles that automation cannot fill. Many times, these different roles overlap.

**Workstations:** A workstation is a physical location which provides the basic materials, tools, equipment, and facilities that allow a job to be performed. Each workstation requires at least one individual to crew it.

**Workstation Types:** Workstations may be either constant duty or individual positions. Constant duty workstations require one person at the workstation at all times; the ship must have two persons to fill the position, and they work in alternating twelve-hour shifts. Individual work stations require only one individual, and that person performs his duties at that workstation only when required by circumstances.

Bridge and Engineering workstations are constant duty. All other (medical, steward, weapons, remote, and other) workstations are individual unless specifically noted.

Workstation implies a computer terminal, acceleration couch, and other specific equipment, but some workstations may be less specific: the medical compartment for the paramedic or ship's doctor, the drive sector for the engineers, or the corridors for security crew.

**Crew Positions:** Each starship description specifies the workstations aboard, the type and location of the workstation, and the skills required. Any individual with a skill level of one or more can fill such a crew position.

For a ship to operate efficiently it must have each crew position filled by a qualified, skilled individual with at least level-1 in the required skills for the position.

It is possible for a ship to operate with constant duty workstations crewed by only one person and with individual workstations unfilled. Under such circumstances, the level of difficulty of nearly all tasks associated with operating the ship are increased by one level, and many of the tasks become hazardous.

The ship's captain may create additional crew positions (additional pilots, gunners, or cargo handlers, for example), but the total number of crew may not exceed the total life support for the ship.

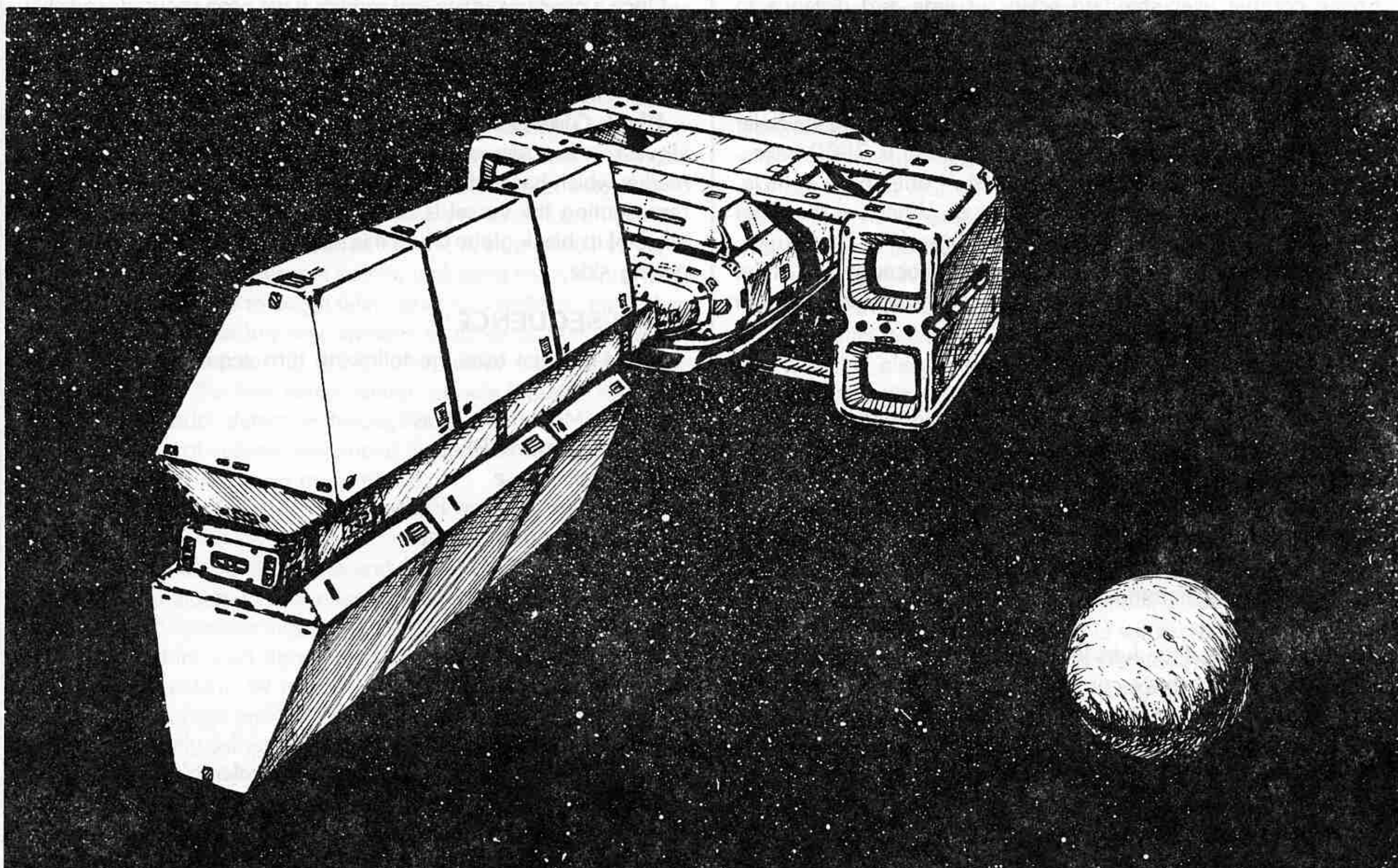
**Crew Pay Levels**: Crew members are paid in a variety of ways. Members of the military and navy are paid according to their service's pay scales. Civilian crew members are generally hired at standard pay rates established by the marketplace. Some ships hire crew and pay them life support plus a share of the profits.

**Standard Pay Rates**

| *Skill* | *Pay Level* |
|---|---|
| Communications | Lv3,000 |
| Engineering | Lv4,000 |
| Medical | Lv4,000 |
| Navigation | Lv3,000 |
| Remote | Lv3,000 |
| Steward | Lv2,000 |
| Weapons | Lv2,000 |

Pay rates shown are monthly salaries.

**In Lieu of Pay:** Most commercial ships reduce their salary costs by providing cargo space *in lieu of* some portion of payroll. The cargo space is then usable by the crew member for whatever purpose he wants: recreation, personal storage, non ship-threatening research, or (most commonly) free-lance cargo transport. In lieu of pay is commonly provided at one cubic meter of space (or one ton of mass, whichever is less) per each Lv500 in salary foregone. The cargo space provided must be pressurized (if requested by the crew member), accessible during starflight, and secure. It cannot make additional demands on life support systems (beyond the crew member's own demands) and is not insured by the ship.



# Space Combat

Adventures often call for some sort of space combat. Even if no shots are fired, encounters with other vessels help the players and referee to visualize the situation as it unfolds. These rules rely heavily on the information given in the ship descriptions and on the ship status sheets which will be filled out for each vessel involved.

## SCALE

Space combat uses standard scales of time and distance to regularize play.

**Time:** Each turn represents one minute.

**Distance:** Each hex on the playing surface represents approximately 600,000 kilometers. At this scale, the diameter of the Solar system (30 au, the diameter of Neptune's orbit) is 7500 hexes.

**Units:** Markers or ship models represent one space vehicle, whether it is a missile, drone, or space craft. Whatever the exact nature of the craft, they are referred to as vessels in these rules.

For purposes of space combat, planets may occupy any of the hexes on the map. However, they do not interfere with play in any way.

## PREPARATION FOR PLAY

In the course of any adventure, situations might arise which require resolution using space combat. When such a situation comes to pass, the referee is called upon to perform certain functions in preparation for the ensuing battle.

**Playing Surface:** Space combat requires a playing surface with a hex grid. The grid size should be tied to the type of units being used, keeping in mind that each hex should be large enough to contain one unit.

**Units:** Any type of markers to represent the forces of both sides will be sufficient for space combat. Actual models of space craft and missiles are the most aesthetically pleasing, but are not strictly necessary. Counters, coins, or virtually anything else will suffice.

**Ship Data Sheets:** Each ship likely to be engaged in fighting must have a ship status sheet. A blank data sheet is provided with the game, but be certain to only use photocopies. Save the original as a master. All of the information necessary for the status sheet is given with the description of the vessel in the ship listings. This information is given as follows:

Ship name, movement (in hexes), screens, passive signature, masked passive signature, active signature, passive sensors, active sensors, hull hit capacity, power plant hit capacity, total crew complement, weaponry installations, and remote stations.

Each of these are fully described in the associated sections below.

Other information may be necessary or useful when filling out the ship status sheet. The skill level of the sensor operator is helpful to know, as is the notation of each appropriately skilled individual assigned to damage control. Also, if backup systems for sensors, computers, remote stations, or targetting computers are available, they should be noted under hit capacity. Finally, the skill levels of any gunners or remote pilots should be noted.

Once a playing surface and models have been secured, and ship status sheets have been filled out for each of the participating vessels, play may begin. Initial contact range is approximately thirty hexes, but this depends on the situation and is up to the referee.

**Black Globes:** Until detected, as described in detection below, all vessels are represented by black globes. A black globe is a marker which has nothing but a facing. The actual marker or model representing the vessel is only placed on the playing surface in place of its black globe when it is successfully detected by the opposing side.

## TURN SEQUENCE

Space combat uses the following turn sequence.

Side A Movement Phase
Sensor Commit Phase
Detection Phase
Detonation Commit Phase
Damage Control Phase

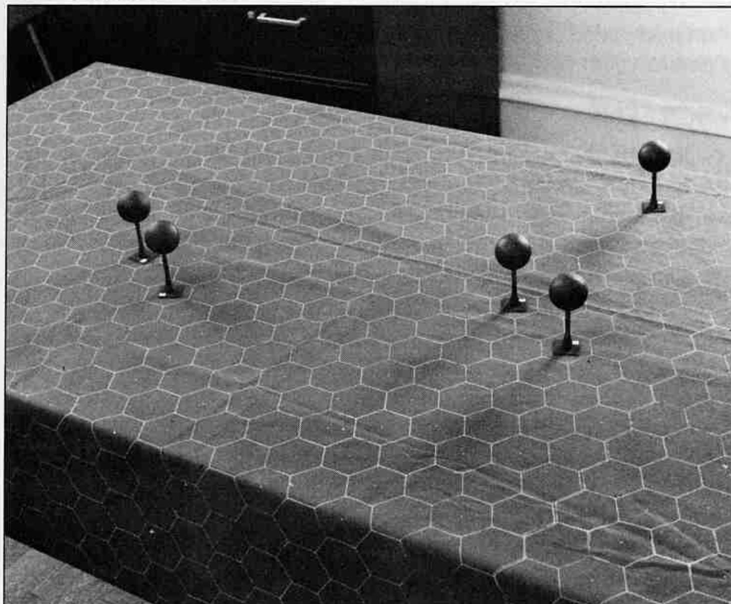
Side B Movement Phase
Sensor Commit Phase
Detection Phase
Detonation Commit Phase
Damage Control Phase

Which side is A and which is B is the referee's decision prior to play. Combat progresses using this sequence until the logical conclusion of the battle.

Only the designated player moves during the movement phases. All other phases are simultaneous—both players undertake activity in those phases. One sequence from movement to damage control is called a player turn. There are two player turns per game turn.

## MOVEMENT

Each ship is given a movement rating in the equipment list,



which is also on the ship status sheet. This is the number of movement points which may be expended by the ship in a movement phase.

Note that only stutterwarp driven ships have a movement rating greater than zero. Any ship without a stutterwarp, regardless of its other drive system, has a movement rating of zero.

**Facing:** Each ship model on the map must be situated so that it faces one of the six possible hexsides. The facing of the ship dictates the direction of movement and can only be changed by expending movement points.

**Expending Movement Points:** One movement point allows a vessel to move one hex in the direction it is facing. One movement point will turn the vessel one hexside; the vessel remains in its original hex when changing facing. Each vessel may expend up to its total number of movement points each turn.

**Expending No Movement Points:** A ship which elects to expend none of its movement points, including ships which have no movement points to begin with, have two options. First, they may change their facing any number of times in their hex. Second, they may voluntarily bring their passive signature ratings down to one for the next two detection phases (passive signature is explained under detection below).

Any number of vessels may move through or occupy a hex at any time during the movement phases.

## DETECTION

Each vessel has two signatures and two possible means of detecting those signatures in other vessels. Signatures may be active or passive. The passive signature of a ship represents its neutrino emissions and infrared signature created by its power plant; both can, to some extent, be masked by the hull of the ship. Active signature is the high energy radar emissions of the vessel created when it is actively using its radar. Particularly advanced materials and ship designs have greater stealth characteristics which reduce a ships vulnerability to detection by active radars.

Ships usually carry sensors capable of detecting passive signatures; they also may have high energy radars that can actively search for enemy vessels.

**Signatures:** The numbers given for each ship in its description are its passive signature, its masked passive signature, and its active signature. The masked passive signature follows the passive signature in parentheses. When determining the passive signature of a ship, use the masked value until such time as there has been battle damage to cause a breach or serious breach (both are explained under damage below). The minimum signature in each area is one; the maximum is ten.

**Sensors:** The numbers given for each ship in its description are its passive sensors and its active sensors. The numbers express the ship's perfect detection range in hexes; perfect dectection range is the range at which the sensors can detect a target with a signature of one or greater. Active sensors can only detect active signatures; passive sensors can only detect passive signatures. Each hex beyond perfect detection range raises the minimum signature detected by one.

*Example:* A ship with a passive sensor rating of five would be able to detect any ship up to five hexes distant. At six hexes, it could only detect a ship with a passive signature of two or greater. At seven hexes, it could only detect ships with passive signatures of three or greater. Since the maximum possible passive signature is ten, the maximum passive detection range for this ship is fourteen (and at that range, it could only detect a ship with the maximum passive signature of ten).

**Committing Active Sensors:** During the commit sensors phase, both players decide whether or not they will be using their active sensors. During the phase, both sides place either "commit sensors" or blank chits next to their vessels. Markers are revealed simultaneously for all vessels on the playing area.

Committing active sensors allows the ship to use its active sensor rating in an attempt to detect all targets it can for the next two detection phases: the one immediately following the commit phase, and the detection phase following that.

Committing active sensors also has some consequences. Since the radar is basically a burst of energy, the passive signature of the vessel which committed goes up enormously. In fact, the ship is automatically detected by the opposing side when using active sensors. This automatic spotting takes place for the rest of the current player turn and all of the next player turn. After those two player turns have passed, the detection must be maintained by the opposing side (as described in maintaining detections below), or it is lost and the black globe returns to the map.

**Initial Detection:** In order to detect a black globe, a ship must attempt initial detection. This is done in the following sequence. The detecting player counts the range to the black globe he wishes to detect and determines the minimum signature which he can detect at that range. The detecting player then asks the target player "Is the passive/active signature of this black globe x or greater?" The target player then answers either yes or no—yes results in the black globe being replaced with a marker or model; no indicates that the initial detection attempt has failed and the black globe remains on the map.

**Maintaining Detection:** Once initial detection has been successful, maintaining that detection is somewhat easier. Maintaining a detection is a task for the sensor operator.

To maintain detection. Routine. Sensor Operation. Instant.

*Referee:* Apply DM−1 for each detection he is attempting to maintain in a given detection phase beyond one (if he is trying to maintain three detections, the modifier is −2 on each attempt). Detections can only be maintained to the maximum range of the detecting player's radar for a signature 10 target.

Any number of initial detections may be attempted per detection phase. Any number of detections may be maintained, though this results in a negative modifier for each attempt beyond one maintenance.

**Effects of Detection:** Until detected and the model or marker is placed on the playing area, a black globe may not be fired at.once detected by either active or passive sensors, the black globe is

replaced with the model or marker of the correct vessel, and it is eligible for all types of weapons fire.

Also, if the vessel detected is of a fairly familiar variety, the exact nature of the vessel becomes readily apparent to the detecting side. (The computer calls up the appropriate information, including displacement, drives, crew complement, etc.) If the item detected is foreign to them, then only the general nature of the vessel is given—this includes displacement in cubic meters and its exact signatures (active and passive). Other information cannot be determined in the context of the space combat rules (the vessel will have to be closely investigated, if that is possible, after the battle).

## FIRING

Weapons may be fired at any time during the movement of a turn. Items which are detected are eligible targets, provided they are in range. Firing is in the form of laser or particle weapons, all hereinafter referred to as lasers.

**Weapon Descriptions:** Each type of laser has several descriptive elements which affect how its hits are determined and/or how its damage is inflicted.

Particularly high tech, well-manufactured lasers often have built-in targetting mechanisms which supplement those of the vessel they are attached to. Any laser with a +1 or +2 Targetting designation may use this as a die modifier to the task to hit.

Double mount lasers roll only once for hit determination with a +1 modifier. If they hit their target, they roll once on the hit location table. High energy weapons may have the designation AxB. A is the number of times rolled on the hit location table and B is the number of hits achieved per location. For example, a 10x2 laser rolls ten hits (each can be affected by screens) on the hit location table, and each hit does two points of damage. Note, however, that the 10x2 laser above only needs one hit determination roll (either they all hit or they all miss). A weapon designated as being x2 does double damage.

**Dividing Fire:** A multiple shot laser (that is, one with more than one roll on the hit location table) may divide those hits among more than one vessel prior to firing. Each vessel fired upon must have a hit determination roll made in order to receive damage.

**Detonation Lasers:** During the commit detonation phase, any detonation type lasers must either commit or remain intact. This is done in the same manner as active sensor committment, described in detection above. Once committed, the laser must fire immediately. Once fired, the detonation laser is destroyed and removed from play.

**Hit Determination:** Hit determination is a task for the gunner.

To hit a target. Routine. Gunnery. Instant.

*Referee:* also apply these DMs. If the ship's targeting computer has a modifier, apply it. If the weapon itself has a targeting modifier, apply it as well. Last, if the range is one hex, there is an automatic −2. Lasers may not fire at more than one hex range.

**Hit Determination for Remote Piloted Lasers:** Roll 7+ on a ten-sided die with the same modifiers possible as listed directly above.

## SCREENS

If there are screens on the ship, they will be given a value of 1 to 10 in the ship's description. This value is the screen value at the beginning of each player turn in which the screens are operative—their effective value may change as they absorb hits.

Once a hit has been achieved on a ship with screens, the hit must be confirmed against the screens. For each hit, roll one ten-sided die. If the number rolled is less than or equal to the screen value, the screens absorb the energy. If the roll is greater than the screen value, the hit is achieved on the ship itself.

Each hit (in a player turn) on the screens reduces its effectiveness by one. For instance, once screens rated at three have taken a hit, they only rate two against subsequent hits that player turn. The most hits that that ship can hope to absorb into the sensors is three per player turn. At the beginning of the next player turn, the screens reset to their original value.

If the power plant is inoperative due to battle damage, the screens will also be out. They will be operative again at the start of the player turn following successful power plant repairs. The use of screens increases the passive signature of the screened ship by the value of the screens with a maximum of ten. Screens may be tuned to any value less than or equal to their given value at the start of each player turn.

## DAMAGE

For each hit achieved on a vessel, rolls are made on the hit location table, and appropriate number of points are marked off of the target vessel's hit capacity. All hits are tallied in the appropriate section on the target's ship status sheet.

### Hit Locations

**Hull:** The hull hit capacity of each vessel is given in its description. It is a three number sequence. The first is the total number of hit points which the hull can absorb before the ship is completely destroyed. The second is 20% of that number, and the third is 50% of the same number.

Once hits totalling 20% of the hull hit capacity have been taken, the hull is breached. Until repaired below this 20% level, the masked passive signature of the vessel is increased by one. If there is no masked signature for the vessel, this has no effect.

Once hits totalling 50% have been taken, the hull is seriously breached. The masked passive signature is ignored in favor of the normal passive signature until sufficient repairs have been made to reduce the hit total below 50%.

**Power Plant:** The power plant hit capacity is given as two numbers. The first is the total hits that can be absorbed before the power plant is completely destroyed. The second is 20% of this number.

Once hits totalling 20% of the power plant hit capacity have been taken, the power plant is inoperative. The ship may not move or fire weapons until repaired.

**Crew:** One crew member, determined at random, is killed. If this is a remote pilot or gunner, those devices cannot function until the position is replaced. Once all pilots and navigators on board have been killed, the ship may not move.

**Sensors:** A sensor hit indicates that all ship's sensors, passive and active, have been rendered inoperable. No detection may be undertaken until they are repaired.

**Computer:** The ship's computers have been damaged. No firing or moving until they are repaired.

**Remote Station:** One remote station is destroyed, determined at random. That remote object may not move, fire, or detect until the station is repaired.

**Targeting:** The ship's targetting computers have been damaged. There is an automatic −2 modifier to the hit determination task of all weapons fired from that vessel until repaired.

**Continuing Damage:** This indicates that some sort of continuing damage is underway (electrical damage, fires in atmosphere necessary areas, etc.). Continuous damage is marked on the ship, and they are cumulative. For each continuous damage marker on a ship during the damage control phase, roll once on the hit location chart and apply one damage point to that area.

## REPAIRING DAMAGE

Hits can be repaired during the damage control segment. Each available engineer can put his talents to use on one specific task per segment, attempting to repair damage which has been done up to that time.

To repair hull hits. Difficult. Drive engineering.

To repair power plant hits. Routine. Drive engineering.

*Referee*: For repair of both hull hits and power plant hits apply DMs for exceptional electrical (electrical 5+) or mechanical (mechanical 5+) skill.

To repair computer, targetting, continuing, remote, and sensor hits. Difficult. Electroncs.

*Referee:* For repair of computer, targetting, continuing, remote, and sensor hits, apply DMs for exceptional (5+) drive engineering and/or mechanical skills.

If repairs would make a difference to some ship condition, that effect takes place immediately. For instance, repairing sufficient hull hits to close a serious breach brings the problem to only that of a breach.

## REMOTE OBJECTS

Remote objects are all those unmanned vessels which are controlled from a mother ship. Missiles and sensor drones are typical remote objects. Note that fighters and other manned items are not remote objects, though both can be launched from the mother ship at the very beginning of the mother ship's movement.

Controlling the remote object is the job of the remote operator on the mother ship. While controlled, the remote object can do anything that any other ship can do—it can detect other ships, commit sensors or detonation lasers, fire its weapons, and move.

**Remote Detonation Missiles:** Remote detonation missiles are quite common in modern space combat. They are a means of delivering a high burst of energy at the target without endangering the mother vessel.

**First Fire:** Once a detonation missile has committed, the target has a chance to fire at it before it goes off. This is a task for each gunner making the attempt.

To detonate a missile before it fires. Difficult. Gunnery.

If successful, the gunner may then fire his weapons at the detonation missile in an attempt to knock it out of action before it goes off. If failed, the gunner's weapons must still fire at the detonation missile, but will only hit it if it doesn't go off.

If sufficient hull hits are achieved to destroy the missile, then the missile detonates but does no harm. If not, each hit achieved on the missile is counted as a negative modifier to each hit determination roll.

## HINTS ON TACTICS

Remote objects are very important. Use them as much as possible to detect and fire upon enemy vessels. Ships are too costly to be risked on the front lines, so let your fighters and missiles do that fighting for you whenever possible. Fly around with your remote objects deployed if possible. This puts plenty of black globes on the map at the start of the battle, confusing your opponent as much as possible.

Also, only use your active sensors when you are either, a) reasonably certain of achieving a valuable detection or, b) ready to detonate or about to be destroyed. Otherwise you become visible to everyone in the battle, and that could be the last thing you do.

Don't use your screens until later in the battle. Otherwise you will be very easy to detect. It's better to remain a black globe in the enemy's eyes for as long as possible.

## MODELLING SUGGESTIONS

**Traveller: 2300** space combat is designed for use with miniatures, though any system of markers and a hex grid will suffice. However, miniatures will lend a bit of added realism and color to your game, and should not be ruled out.

The models and globes shown in the accompanying photographs were all constructed in about an hour only with materials easily obtained for less than $10. The black globes are ping-pong balls mounted on golf tees and wooden bases, held together with wood modeling glue and spray-painted flat black. The ships are pieces of white golf tee mounted the same way. Missiles and sensor drones are also pieces of golf tee, cut to smaller sizes and mounted differently for distinction.

The hex grid is also easy to come by. Several companies create iron-on hex grids to be put on sheets. They range in size from one to several inches per hex (we recommend two inch hexes). At this size, a reasonable battle can be played out on a typical tabletop. Grids can be obtained from

Rafm Company, Incorporated,
19 Concession Street,
Cambridge, Ontario, Canada, N1R 2G6.

**Starship Hit Location**

| *Roll* | *Result* |
|---|---|
| 1-4 | Hull |
| 5-6 | Power Plant |
| 7-8 | Crew |
| 9-10 | Special |

**Special Hit Location**

| *Roll* | *Result* |
|---|---|
| 1-2 | Sensors |
| 3-4 | Computer |
| 5-6 | Continuing |
| 7-8 | Remote Station |
| 9-10 | Targeting |

# Ship Listings

Ship listings give all the information needed to operate a ship and to use it in space combat. The format is given in the following order.

First, there is a descriptive passage, giving general details about the ship, its design, its history, and other items of interest.

**Streamlining:** Either none, or "as space plane" or "as shuttle." These refer to the launch and reentry characteristics of the ship, in terms of its closest equivalents. See the Interface section for details.

**Sensor Package:** The sensors built into the ship are listed as described in Starship Use.

**Work Stations:** All the work stations, both on and off the bridge, are listed by their function.

**Additional Crew Recommendations:** Other crew positions may be called for; they are listed here.

**General Information:** *Warp Efficiency:* In light years per day. *Plant:* Megawatts output and type of power plant. *Fuel:* Mass of fuel. Type of fuel follows from plant type given above. *Range:* In light years before discharge of stutter drive must take place. *Mass:* Total mass of ship in tons. *Cargo Capacity:* Given in cubic meters. Cargo mass must be considered in warp efficiency. *Comfort:* A modifier to such tasks as hiring new personnel, taking on passengers, and so forth. *Emergency Power:* If there is an emergency power system, its type and duration in hours is given here. *Total Life Support:* This is the total number of human beings which can be accommodated by the atmospheric and food generating life support. Passengers beyond this number can only be taken on in emergency situations. *Solar Array:* The total area in square meters of any solar array are given, plus the total time required to breakdown the total fuel supply in days.

**Ship Status Sheet Information:** *Movement:* In hexes, unloaded. *Screens:* The value of screens, if any. *Passive Signature, Active Signature, Passive Sensors,* and *Active Sensors:* All single numbers, the meaning of which is given in Space Combat. *Hull Hit Capacity* and *Power Plant Hit Capacity:* Sequences of numbers also explained under Space Combat. *Crew Complement:* The total number of crew actually operating the ship. This is not necessarily the number of people on board. *Weapons:* Any weapons carried will be named and described here. *Remote Stations:* The number of remote stations on the ship will be given here.

## Anjou Class Cargo Vessel

The Anjou class was the mainstay of the Sol-Serurier run during the 2270's and 80's. Designed originally by L'Tage, Ltd of Paris, the Anjou class is the result of two predecessors, the ExC-1 and ExC-2. The original contract called for a design which would be capable of hauling an internal 25,000 cubic meters of material at nominal speeds between the worlds of the Serurier cluster. The Anjou class did just that, and the original order of thirty-four vessels has grown over time into a family of nearly six hundred ships.

The contract for the power plant went to Hyde Dynamics of the United States, as a part of the Shared Technology package of the Jones-Bouvier summit of 2267. The American firm provided a powerful, compact 3 MW plant turbine, easily maintained from only a few access points (vital to the design of the engineering section of the rest of the ship). The stutter warp unit itself was an off-the-shelf French design, typical of all French craft of that era.

The hull is a basic cylinder 100 meters long and approximately 20 meters in diameter. Virtually all of the interior space is formed into cargo holds, though a large portion of the ship is set aside as a spin habitat for the possible 24 personnel on board. The ship does not benefit from streamlining, and is not manufactured with any ship's vehicle or bays for such, but many models still in use today have a shuttle or cutter dock attached.

There were no weapons installed on the Anjou class when they were being produced (the last came off the line approximately 20 years ago). However, the government of New Melbourne is known to employ several as revenue cutters, and have been mounted with shields, several lasers, and an escape pod.

As a cargo ship in the present world of trade and commerce, the Anjou class is definitely outclassed by newer, more sophisticated models. However, due to the large numbers produced and the ready serviceability of the design, Anjou class ships are often purchased and refitted for a variety of purposes. They are a cheap, abundant resource to draw upon when constructing new starships is either physically or economically impossible.

*Streamlining:* None.

*Sensor Package:* Navigational radar, Deep system scan.

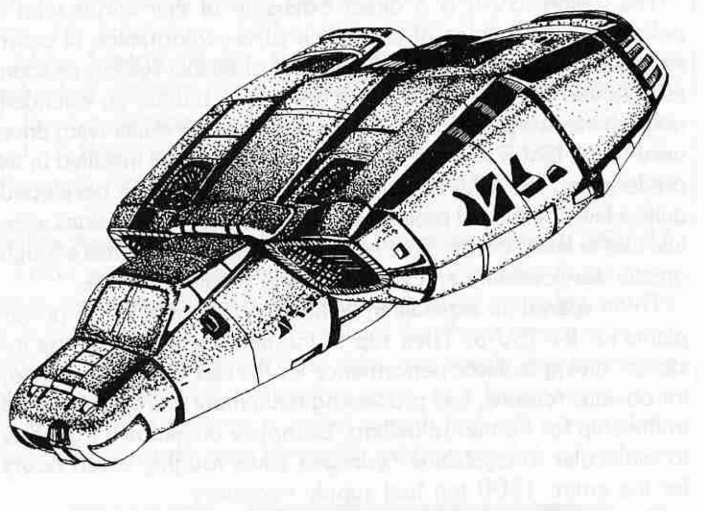
*Work Stations:*

*Off-Bridge:* 2 Engineering.

*Bridge:* 1 Command, 1 Navigation, 1 Communication, 2 Engineering, 1 Computer.

*Additional Crew Recommendations:* None.

**General Information**: *Warp Efficiency:* 2.386 (unloaded), *Plant:* 3 MW MHD Turbine, *Fuel:* 300 tons, *Range:* 7.7, *Mass:* 639 tons (unloaded), *Cargo Capacity:* 25066 cubic meters, *Comfort:* +1, *Emergency Power:* Battery, 150 hours, *Total Life Sup-*



*port:* 25, *Solar Array:* None.

**Ship Status Sheet Information**: *Movement:* 5 hexes (unloaded), *Screens:* None, *Passive Signature:* 5, *Active Signature:* 7, *Passive Sensors:* 0, *Active Sensors:* 5, *Hull Hit Capacity:* 30/6/15, *Power Plant Hit Capacity:* 10/2, *Crew Complement:* 10, *Weapons:* None, *Remote Stations:* None.

**Desarge 8680**

Introduced in 2275, the Desarge class have virtually taken over the luxury passenger market along the Sol-Alpha Centauri-Beta Canum Venaticorum route. The original specifications for the 8680 were drawn up by the eccentric founder of General Service Transport, author and architect Julius Bourge. GST originally purchased six of the vessels (the fleet has since been expanded to twenty-three) which run regular passenger service to all colony worlds along the frontier. These ships are the famed Tall Ship Fleet of GST; their flagships are an institution in their own right.

The Tall Ships are designed around a relatively small but powerful fusion reactor, designed by TerraFuse, a subsidiary of Hyde Dynamics (though not at the time of the original contracts). Considering the ambitious design and luxurious accommodations, a fusion plant was seen as the only acceptable option. Anything less would have required an enormous fuel load, which might interrupt regular service without warning.

The actual staterooms of the Tall Ship class are designed to handle the entire complement and passengers totalling 534 persons. The ship's crew, including stewards, runs at about 100, and many of the other suites are taken up by entertainers or company officials, so the ship can hope to take on in the neighborhood of 400 passengers per flight. Each stateroom or suite provides a generous amount of room, classic furnishings (some Tall Ships boast that no two staterooms are furnished alike), and superb cuisine, which alone would draw the upper crust of passenger service.

However, the Tall Ships are much more than simple comfort and luxury.

Each Tall Ship is built with a casino deck, designed and furnished in a unique style for each vessel. One is made up to resemble an American casino of the twentieth century, one like an ancient Egyptian palace, one like Tangiers in the 1920s. Live entertainment of a variety of sorts can be found here or in one of the two night clubs featured on each vessel.

For the passengers there are also two gymnasiums for their enjoyment. Social events are planned and generally adhered to (costume parties, official dinners in honor of distinguished passengers, and dances), plus an in-the-round holographic theatre. Tall Ship passages are highly sought after by those wanting more than just to travel the distance. There are faster ships, but none more entertaining than the Tall Ships.

In the 2280's and 90's, the Tall Ships gained another reputation as being a neutral meeting ground for diplomats and intelligence agents of all nations. This lent itself well to the overall feel of each vessel, as rumored intrigue added to the mystique of each ship. These ships are, in fact, the chosen method of travel for both the corporate and government elite. Many rich patrons spend months, if not years, living on the Tall Ships, moving from one vessel to another on an extended vacation of debauchery and conspicuous consumption.

Desarge is rumored to be constructing what it is calling the Tall Ship II class. The prototype is under construction in orbit around Titan in the Sol system under extremely tight security. However, industry gossip reveals that this ship is at least three times the size of the Tall Ship 8680 class, and that the prototype is within months of completion.

*Streamlining:* None.

*Sensor Package:* Navigational Radar, Gravitational Scan.

*Work Stations:*

*Off-Bridge:* 26 Engineering, 18 Steward, 11 Medical.

*Bridge:* 1 Command, 2 Navigational, 2 Communications, 4 Computer, 4 Engineering.

*Additional Crew Recommendations:* None.

**General Information:** *Warp Efficiency:* 2.412 (unloaded), *Plant:* 180 MW Fusion, *Fuel:* NA, *Range:* 7.7, *Mass:* 37,103 tons (unloaded), *Cargo Capacity:* 20,000 cubic meters, *Comfort:* +3, *Emergency Power:* Battery, 150 hours. *Total Life Support:* 750, *Solar Array:* None.

**Ship Status Sheet Information**: *Movement:* 5 hexes (unloaded), *Screens:* None, *Passive Signature:* 9, *Active Signature:* 7, *Passive Sensors:* 0, *Active Sensors:* 5, *Hull Hit Capacity:* 400/80/200, *Power Plant Hit Capacity:* 120/24, *Crew Complement:* 94, *Weapons:* None, *Remote Stations:* None.

**York Class Colonization Vessel**

The York class was designed and built by the government of Great Britain in the period from 2220-2240 as part of the national colonization effort of that era. Now, most of a century later, the York class has fallen out of the British scheme of things, and they are being sold at bargain prices to countries beginning their own large scale colonization programs, such as Brazil and Argentina.

At the time of construction, fusion power plants were available, but they were enormous and quite costly. Additionally, Great Britain was far from the cutting edge of fusion power plant technology; since this was a national effort, power would have to be derived from more readily available, very British fission reactors. The original vessel, the *York*, was laid down in far orbit around Wellington Orbit Station in 2221; it was completed four years later.

The government plan was to provide the country with a vessel which could be used by the British public and British industry to get to their colony-suitable worlds at Henry's Star and 61 Ursae Majoris. (61 Ursae Majoris has since become an international planet, though there is still a large percentage of the population which can trace its immediate family to a berth on a York class vessel.)

At first sluggish, the British effort of the mid-century was a great success. The York class, with its ability to transport approximately 200 pioneering families with all their possessions at once, was the king pin of the operation. In fact, Prime Minister Edgewood said of the York class that it was "one of the central pieces of equipment which has led us to our present extraterrestrial society." (Great Britain was the first nation to have half of its loyal population base living away from Terra proper; this event took place in 2298.)

Modern times have done little to change the design characteristics of the York class. Those purchased by Argentina for their colonization program on Montana have been virtually unchanged from the original specifications. There are berths for 900 persons beyond the crew, plus 80 cubic meters for each in personal storage. There are thirteen vessels still in existence; five are owned by the Argentinians, three by the Brazilians, one is on lease to Trilon Corporation, one serves as a power plant and warehouse at Vega Far Station 5, and three are in far orbit around Mars awaiting final orders to be scrapped.

*Streamlining:* None.

*Sensor Package:* Gravitational Scan.

*Work Stations:*

*Off-bridge:* 54 Engineering, 20 Medical, 20 Steward.

*Bridge:* 1 Command, 1 Navigational, 1 Communication, 2 Computer, 2 Engineering.

*Additional Crew Recommendations:* 33 Security.

**General Information**: *Warp Efficiency:* 2.416 (unloaded; 1.601 with common load), *Plant:* 75 MW Fission, *Fuel:* NA, *Range:* 7.7, *Mass:* 15392 tons (unloaded; 52892 with common load), *Cargo Capacity:* 75,000 cubic meters, *Comfort:* −1, *Emergency Power:* Battery, 150 hours, *Total Life Support:* 1460, *Solar Array:* None.

**Ship Status Sheet Information:** *Movement:* 5 hexes (unloaded; 3 hexes with common load), *Screens:* None, *Passive Signature:* 9, *Active Signature:* 7, *Passive Sensors:* 0, *Active Sensors:* 5, *Hull Hit Capacity:* 156/32/78, *Power Plant Hit Capacity:* 100/20, *Crew Complement:* 108, *Weapons:* none, *Remote Stations:* None.

### Trilon and Associates Initial Survey Vessel, ISV-5

Trilon Industries has always been in the forefront of both ship design and corporate exploration around the Sol-Beta Canum Venaticorum trade route. After their initial survey and colonization of Xi Ursae Majoris (2250), and their ability to make the planet nearly Trilon exclusive, efforts have been redoubled to be the first on the scene of all potentially habitable worlds within their sphere of influence.

The Trilon ISV-5 is a direct extension of that corporation's policies—the obtaining of fast, quick survey information in order to make their contact with a potentially profitable system as soon as possible. The ISV-5 is a rather fast vessel, but has an extended range stutter warp capability. The prototype of the stutter warp drive used in the ISV-5 was originally manufactured and installed in its predecessor, the ISV-4. Unfortunately, the prototype developed quite a few operational problems, and indeed several missions were lost due to faulty design. The newer version, however, has a much greater serviceability and an acceptable breakdown rate.

Trilon spared no expense in getting the best of its MHD power plants for the ISV-5. Their top of the line small turbine was installed, giving fantastic performance for the size of the plant. Also, for obvious reasons, fuel processing equipment has been installed in the ship for frontier refuelling. Complete breakdown from raw to molecular to crystalline hydrogen takes roughly seven hours for the entire 1500 ton fuel supply necessary.

Ship sensors include fairly advanced navigational and system survey equipment. Since the task of the ship is to map out the system, noting points of interest for later inspection by more specialized vessels, further sensor equipment was deemed unnecessary. Also, there are no means for getting the crew members on or off-planet.

A fairly advanced vessel, the ISV-5 has only been in production for ten years. There are hundreds in use in all corners of human space, including a shipment of thirty copies delivered to the American Space Force at Ellis.

*Streamlining:* None.

*Sensor Package:* Deep system scan, navigational radar, minimal cartographic sensors.

*Work Stations:*

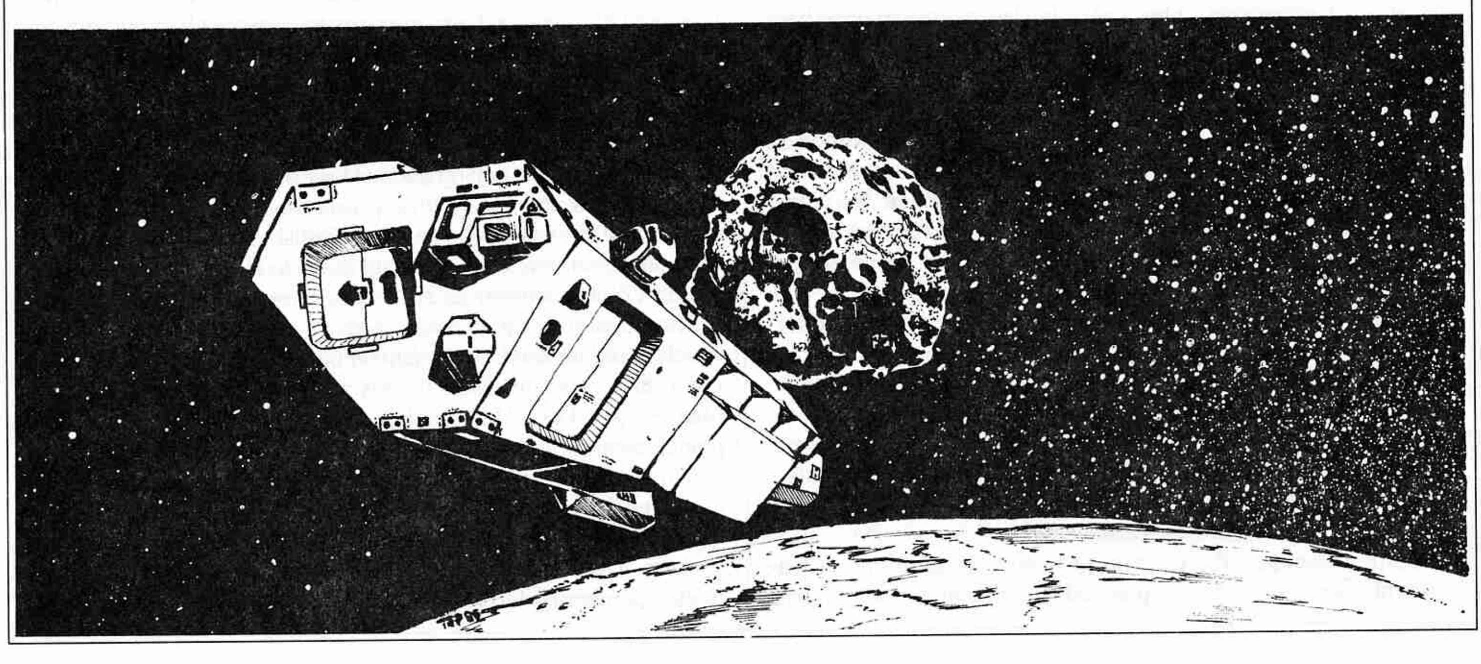
*Off-Bridge:* 2 Engineering.

*Bridge:* 1 Command, 1 Navigation, 1 Engineering, and 1 Computer.

*Additional Crew Recommendations:* None.

*Note:* The command figure on company vessels is generally an employee with a high security clearance for corporate intelligence. The reduce bridge crew also requires that some crewmembers double as a communications operator.

**General Information**: *Warp Efficiency:* 2.773 (unloaded), *Plant:* 5 MW MHD Turbine, *Fuel:* 500 tons, *Range:* 8.9, *Mass:*



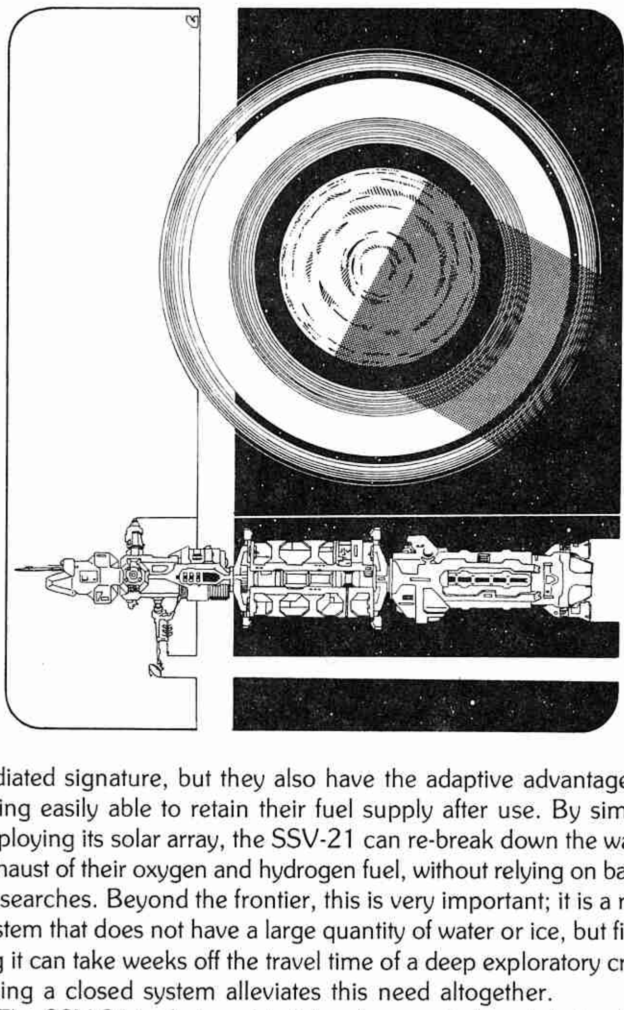
679 tons (unloaded), *Cargo Capacity:* 52.5 cubic meters, *Comfort:* 0, *Emergency Power:* Battery, 100 hours, *Total Life Support:* 16, *Solar Array:* 500 square meters, 3.5 days.

**Ship Status Sheet Information:** *Movement:* 6 hexes (unloaded), *Screens:* None, *Passive Signature:* 6, *Active Signature:* 7, *Passive Sensors:* 5, *Active Sensors:* 10, *Hull Hit Capacity:* 4/1/2, *Power Plant Hit Capacity:* 10/2, *Crew Complement:* 8, *Weapons:* None. *Remote Stations:* None.

### Trilon Assoc C-System Special Services Vessel, SSV-21

Trilon also has need for more sophisticated vessels for such things as contacting new life forms and doing extended surveys of living worlds. Their chief vehicles for these missions is the SSV-21, a highly rated craft for its class, and sought after by anyone whiching to do fringe exploratory work on a larger scale.

The SSV-21 relies on a closed system fuel cell power plant. Fuel cells are usually used for smaller military vessels for their lower



radiated signature, but they also have the adaptive advantage of being easily able to retain their fuel supply after use. By simply deploying its solar array, the SSV-21 can re-break down the water exhaust of their oxygen and hydrogen fuel, without relying on bases or searches. Beyond the frontier, this is very important; it is a rare system that does not have a large quantity of water or ice, but finding it can take weeks off the travel time of a deep exploratory craft. Using a closed system alleviates this need altogether.

The SSV-21 is designed to take along up to twenty trained individuals for deep investigative surveys. They have been provided with quarters, a conference area, and a laboratory featuring such things as work stations for their needs and two quite good linguistics computers to help crack any new languages that come up.

The SSV-21 also features two space planes which can perform interface operations (the ship itself is not streamlined, and relies on these two craft for all interface requirements). These space planes each mass 120 tons and displace 200 cubic meters. They can carry 15 people and up to 11 tons of cargo, provided it fits into 22 cubic meters. They are VTOL craft for rough terrain landing, and are of rather rugged design to withstand the rigors of several months of continuous use out of reach of repair facilities.

*Streamlining:* None. Interface vehicles attached.

*Sensor Package:* Navigational radar, deep system scan, advanced cartographic sensors.

*Work Stations:*

*Off-bridge:* 3 Engineering, 1 Medical.

*Bridge:* 1 Command, 1 Navigational, 1 Communications, 1 Computer, 1 Engineering, 1 Sensor.

*Additional Crew Recommendations:* Up to twenty specialists in contact, investigation and computer work. Two space plane pilots may also be taken on.

**General Information**: *Warp Efficiency:* 2.076 (unloaded), *Plant:* 4 MW Fuel Cell, *Fuel:* 400 tons, enclosed system, *Range:* 7.7, *Mass:* 1295 tons (unloaded), *Cargo Capacity:* 2360 cubic meters, *Comfort:* 0, *Emergency Power:* Battery, 250 hours, *Total Life Support:* 56, *Solar Array:* 800 square meters, 1.75 days.

**Ship Status Sheet Information**: *Movement:* 4 hexes (unloaded), *Screens:* None, *Passive Signature:* 3, *Active Signature:* 9, *Passive Sensors:* 0, *Active Sensors:* None, *Hull Hit Capacity:* 10/2/5, *Power Plant Hit Capacity:* 16/4, *Crew Complement:* 24, *Weapons:* None, *Remote Stations:* None.

### Fast Missile Carrier

American Space Forces are on the cutting edge of large warship design, and they have developed their Fast Missile Carrier to be the finest military craft in space.

Fusion powered, the Fast Missile Carrier has terrific performance at warp efficiency 4.068. The warp unit itself is a completely new design built by American Space Force engineers within the last five years. Most of the mass of the ship is centered in the fusion plant in order to take advantage of every bit of energy for greater speed. The American Fast Missile Carrier is perhaps the fastest ship in service today, but its overwhelming cost to firepower ratio makes its use prohibitive.

There are five remote stations to control up to ten deployed missiles. The most common missile for the Fast Missile Carrier is the Hyde Definite Kill Device. There are also five remote sensor drones, also of Hyde manufacture, issued as standard equipment.

Armament is variable. Most Fast Missile Carriers mount high output lasers in single mounts. However, as with all military craft, these weapons are often changed in favor of others according to the preference of the captain or gunner. There are a total of ten weapons mounts and gunner work stations on the Fast Missile Carrier.

Stealth characteristics for the Fast Missile Carrier are quite good, according to industry observers. Apparently the Americans are converting to a body style pioneered by the French in the 2280's for their newer craft.

There are between ten and twenty Fast Missile Carriers in service at this time (American Space Force security and disinformation is quite good—the actual number of craft in service is difficult to pinpoint). However, considering its performance and effectiveness, this design should continue for some time in order to fill what was a considerable hole in their table of organization.

*Streamlining*: None.

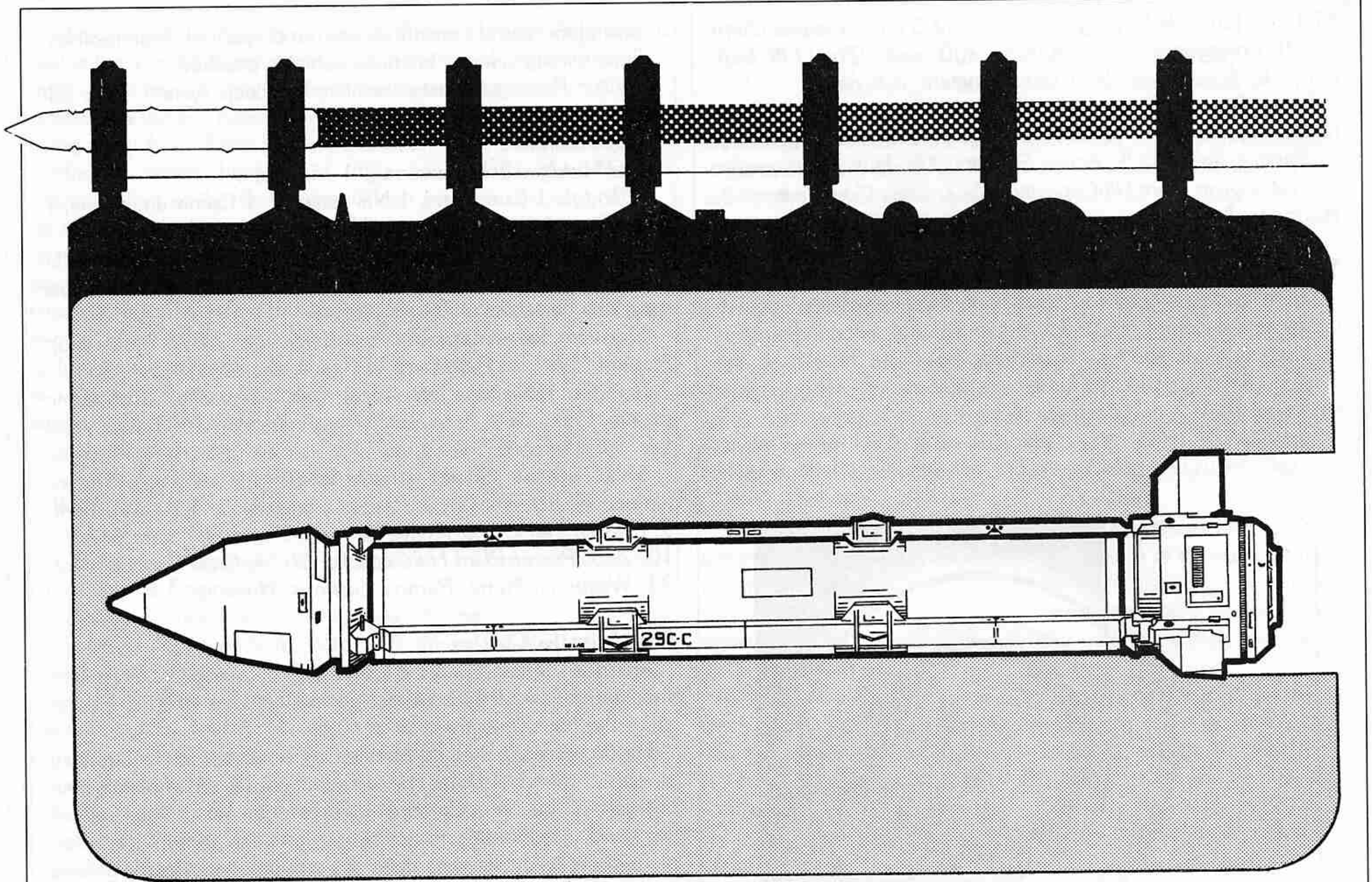
*Sensor Package*: Deep system scan, standard life sensors.

*Work Stations*:

*Off-bridge*: 23 Engineering, 5 Remote, 10 Gunnery, 2 Medical.

*Bridge*: 1 Command, 2 Navigation, 2 Communications, 3 Computer, 3 Engineering, 1 Sensor.

*Additional Crew Recommendations:* 20 Security personnel.




**General Information**: *Warp Efficiency:* 4.068 (unloaded), *Plant:* 150 MW Fusion, *Fuel:* NA, *Range:* 7.7, *Mass:* 6443 tons, *Cargo Capacity:* 600 cubic meters, *Comfort:* 0, *Emergency Power:* Battery, 90 hours, *Total Life Support:* 150, *Solar Array:* 3750 square meters (used only for additional emergency power).

**Ship Status Sheet Information**: *Movement:* 8 hexes (unloaded), *Screens:* None, *Passive Signature:* 3, *Active Signature:* 1, *Passive Sensors:* 10, *Active Sensors:* 15, *Hull Hit Capacity:* 15/3/8, *Power Plant Hit Capacity:* 100/20, *Crew Complement:* 74, *Weapons:* 10 High Output Hyde Lasers, x2, *Remote Stations:* 5.

**Hyde Dynamic One-Mission Definite-Kill Missile.**

Displacing only 2½ tons, the latest Hyde Dynamics missile is among the smallest high energy missiles on the market today. A very small power plant and stutter warp unit drives the entire unit at warp efficiency 1.908 for an entire day of defensive preparedness operations. Fueled by simple crystalline hydrogen, the missile can draw upon the fuel reserves of the mother ship indefinately.

The main weapon is a specially developed one-shot, nuclear detonation laser mounted in the nose. The laser has one burst, approximately equivalent to twenty bursts at close range from a typical near defense laser system. This much punch is certain to do massive damage to any but the most heavily armored ships.

An advanced sensor package makes the Hyde Dynamic missile an asset as a remote sensor drone, as well. The package also includes an active sensor device which can be used by the missile prior to detonation, in order to retrieve all the information possible from its vantage point.

*Streamlining:* None.
*Sensor Package:* Navigational sensors.
*Work Stations:* None.

**General Information:** *Warp Efficiency:* 3.304, *Plant:* .07 MW Fuel Cell, *Fuel:* 1 ton, *Range:* 7.7, *Mass:* 5.620 tons, *Displacement:* 6.77 cubic meters, *Cargo Capacity:* None, *Emergency Power:* None, *Solar Array:* None.

**Ship Status Sheet Information**: *Movement:* 7 hexes, *Screens:* None, *Passive Signature:* 1, *Active Signature:* 1, *Active Sensors:* 5, *Passive Sensors:* 8, *Hull Hit Capacity:* 4/1/2, *Power Plant Hit Capacity:* 1/1/1, *Weapons:* one Detonation Laser, 10x2.

**French Ritage Missile**

The French Ritage missile was the standard design of all French military craft up until the introduction of its successor, the Ritage 2, three years ago. Now, in large quantities, Ritage missiles are being sold off to local governments and other powers wishing to purchase cheap arms from the French Union.

The Ritage is not a detonation missile. Instead, the Ritage mounts a single particle weapon for close-in fighting. French doctrine has been against the use of high-cost detonation missiles since the 2270's, but is now returning to that school of thought.

The Ritage is a short performance missile, having only enough fuel on board to keep the fuel cell plant operating for twelve hours. However, due to their small size and ease of construction, each missile is quite cheap, and several could be deployed at any time to form a protective screen of sensors and weapons around a valuable ship in a potentially hostile situation.

The price given for the Ritage missile is that reported by the

French military upon original purchase. However, modern prices for Ritages run approximately 25-50% of this price as more and more examples are dumped onto the market.

*Streamlining:* None.

*Sensor Package:* Military sensors only.

**General Information**: *Warp Efficiency:* 2.861, *Plant:* .03 MW Fuel Cell, *Fuel:* 0.214 tons, *Range:* 7, *Mass:* 3.106 tons. *Displacement:* 3.82 cubic meters.

**Ship Status Sheet Information**: *Movement:* 6 hexes, *Screens:* None, *Passive Signature:* 1, *Active Signature:* 1, *Passive Sensors:* 5, *Active Sensors:* None, *Hull Hit Capacity:* 1/1/1, *Power Plant Hit Capacity:* 1/1/1, *Crew:* 0, *Weapons:* one French Mid-output Particle Beam Weapon, x1, *Remote Stations:* None.

### Aquitaine Corporation Remote Sensor Drone

The remote sensor station has become a particularly useful piece of equipment for hostile space missions against the Kafers. The Aquitaine is a typical example of such a device.

There is no power plant to speak of; the device itself runs off batteries. Once deployed in an advanced position, the drone is left off until such time as it is needed. Due to its small size and lack of power plant, the remote sensor drone is particularly hard to spot, even though no special stealth procedures have been taken.

Without a stutterwarp to drive it, in the context of any space battle the device is completely immobile. Placing remote sensor drones in advance of combat can assist in detecting enemy vessels. However, this advanced placement is not always possible. One tactic used by pilots against Kafer adversaries is to deploy a sensor drone and then keep it between them and any "black globes" they may be aware of. While hiding this way, the ship's missiles and other remote objects can do the dirty, dangerous work and leave the mother vessel in relative safety.

The Aquitaine Corporation remote sensor drone is typical of such drones built by all serious space-faring nations in human space.

*Streamlining:* None.

*Sensor Package:* Military sensors only.

**General Information**: *Fuel:* Batteries, good for 40 hours of continuous operation, *Mass:* 0.67 tons, *Displacement:* 0.44 cubic meters.

**Ship Status Sheet Information**: *Movement:* 0 hexes, *Screens:* None, *Passive Signature:* 1, *Active Signature:* 1, *Passive Sensors:* 10, *Active Sensors:* 15, *Hull Hit Capacity:* 1/1/1, *Power Plant Hit Capacity:* 1/1/1, *Crew:* 0, *Weapons:* None, *Remote Stations:* None.

### Hyde Dynamics Model X-2296 Fighter

In keeping with its commitment to military excellence, Hyde Dynamics completely rethought and redesigned its fighter development program in the early 2290's. Their emphasis was on the removal of old ideas in favor of the quest for and implementation of the latest technology and innovation. (However, this seems to have been a marketing ploy aimed at securing the lucrative Beta Hydri defense contracts so hotly contested at that time. The use of new ideas has not leaked into other areas of Hyde design, such as their traditional missile, sensor, and hull construction divisions.)

The first, and so far only, result of this restructuring has been the X-2296 fighter. It is indeed a unique design, though critics claim that many of the changes were made for changes sake, and not for the overall improvement of performance. However, in its own right, the X-2296 fighter holds its own against any comparably priced fighter craft in human space.

Specifically, the Hyde X-2296 is a one-man fighter craft, with extensive targeting and computer enhancement. The cockpit has been designed with a great deal of voice and/or eyesight directed mechanisms, all keyed to the pilot/helmet/computer link-up.

Hull, power plant, and stutterwarp design were completely reworked, though the end result was less than spectacular. The final warp efficiency of the craft is 1.489—impressive, but hardly worth the years and millions poured into the project. Synthetic hull design copies French boron composites of the 2280's, and does a good job protecting and masking the ship.

In the final analysis, the X-2296 is a good fighter. However, in light of overall speculation and the eventual drop in price of the spacecraft after introduction, it is certain the Hyde has taken it on the chin on this design, and several positions in their fighter design team will be subject to change in the near future.

*Streamlining:* As space plane.

*Sensor Package:* Navigational radar, minimal life sensors.

*Work Stations:*

*Bridge:* 1 Command.

*Additional Crew Recommendations:* Impossible.

**General Information:** *Warp Efficiency:* 2.824, *Plant:* .1 MW Fuel Cell, *Fuel:* 2.85 tons, *Range:* 7.7, *Mass:* 12.85 tons, *Cargo Capacity:* None, *Comfort:* 0, *Emergency Power:* Battery, 20 hours, *Total Life Support:* 1, *Solar Array:* 100 square meters, 0.7 days.

**Ship Status Sheet Information:** *Movement:* 6 hexes, *Screens:* None, *Passive Signature:* 1 (1), *Active Signature:* 4, *Passive Sensors:* 10, *Active Sensors:* 15, *Hull Hit Capacity:* 4/1/2, *Power Plant Hit Capacity:* 1/1, *Crew complement:* 1, *Weapons:* One High Output Hyde Laser, x2, Targeting +1, *Remote Stations:* None.

## INTERFACE VEHICLES

Interface refers to that space which needs to be overcome between the surface of a world and orbits around it. Since this usually requires moving within a significant gravity well and through an atmosphere of some sort, a special type of vehicle is required.

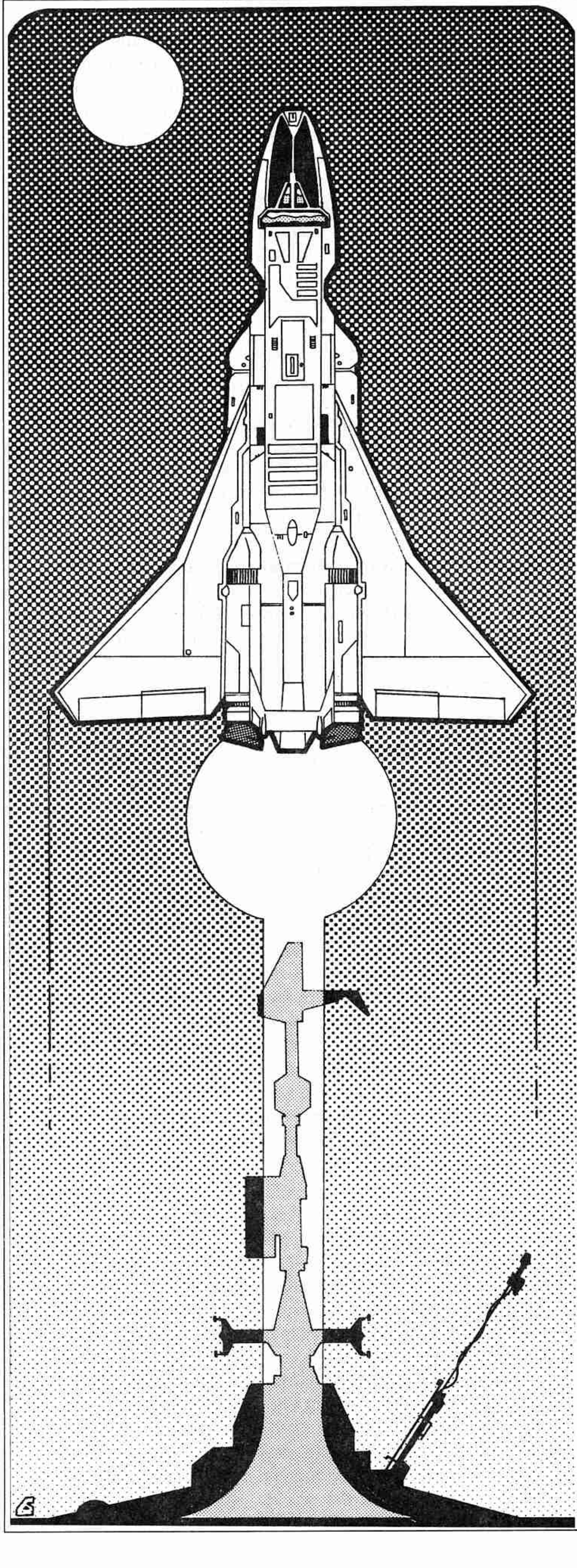
**Streamlining:** Most interstellar craft are not streamlined, and are therefore not interface capable. These ships rely on interface craft to deliver or load their cargo or passengers, and are indeed completely dependent on interface craft for all physical contact with the surface of a world with atmosphere. If properly powered, however, using reaction thrusters, a non-streamlined ship can land on the surfaces of worlds where there is no atmosphere present.

Streamlined ships are designed with some sort of airfoil, to give the ship lift when within an atmosphere. Streamlined spacecraft take off and land in the same manner as space planes or shuttles. The similarity to one of these two types of interface vehicles is given in the ship's description. When attempting to land or take off from a planetary surface, consult the appropriate section below for travel times and procedures.

### Beanstalks

A beanstalk is an extremely advanced technological device which, as its name implies, is a linear stretch of material reaching from the surface of a world straight up to orbit. Elevators on or within the beanstalk allow the transport of cargo in either direction with the simple use of electrical energy, easily created by a number of means.

The chief drawback to a beanstalk is the required materials technology. A substance strong enough to support such a mammoth structure has only recently been developed. Also, the engineering problems of such a device have been extremely difficult to overcome. However, the end result is nearly effortless interface transportation for that world.



There are two beanstalks in existence in human space. The first was created by the French on Beta Canum Venaticorum, where, due to lower gravity and shorter days, the materials technology did not have to be so great. The second is a beanstalk on Earth, pioneered by the French, but financed by nearly every nation on the planet. The Earth beanstalk is, without a doubt, the greatest technological and engineering achievement of mankind to date.

Beanstalk travel times are approximately two hours in either direction (orbit to surface or surface to orbit).

### Catapults

On a lower technological level than a beanstalk is the catapult or linear accelerator. Such accelerators are quite popular for moving materials from a surface to orbit (only). There were several catapults erected on Earth prior to the discovery of the stutterwarp, and they are still quite efficient as a method of placing cargos in orbit around a planet.

A catapult is usually designed to throw a specifically designed package, usually streamlined, into orbit. Different loads can be placed into these packages, and the energy put into the acceleration is adjusted to account for the overall mass of the object.

Catapults are used most heavily on agricultural and mineral-rich worlds. They are not open for human or live animal transport, and can only be used to get up. Once a package is taken to orbit and is unloaded, it is usually returned to the surface as a dead glider.

Catapult trip time is almost instantaneous; the entire journey takes only a few minutes.

### Dead Gliders

A dead glider is any sort of unpowered re-entry vehicle. Dead gliders are quite often disposable, or at least collapsible for ease of transport back to orbit by means of some other interface vehicle. Dead gliders can only be used to get from orbit to surface, and then only on a world with an atmosphere.

Dead gliders take advantage of the world's gravity to power it toward the surface. The streamlined airfoil design of the glider gives it and its payload lift against the atmosphere, allowing it to simply glide to the surface under no power of its own.

Dead glider flights require virtually no energy input. However, returning the glider to orbit for reuse requires some other interface vehicle, and the cost of such operations reflects this fact. Dead glider landings take approximately three hours from orbit to surface.

### Space Planes

Space planes are aerodynamic aircraft capable of flight directly into orbit around a world. They generally operate on a jet/ramjet/scramjet combination engine, propelling the craft from a horizontal or vertical takeoff, through the atmosphere and beyond to orbit.

Space planes are the most luxurious form of interface transport, in either direction, other than a beanstalk. They are usually employed in passenger service, but many larger models have been produced which carry cargo as well. Regular flights from the surface to orbital stations on nearly any human colony world are available, usually with many flights per day.

A space plane flight to orbit takes around two hours. A return trip takes the same amount of time.

### Shuttles

Shuttles are still in use on many worlds for their chief means of cargo interface transport. A shuttle relies on a great amount of supplemental drives and engines to powerthe horizontal launch of the main craft. On the return trip, the shuttle uses a dead glider method, landing at some predetermined port.

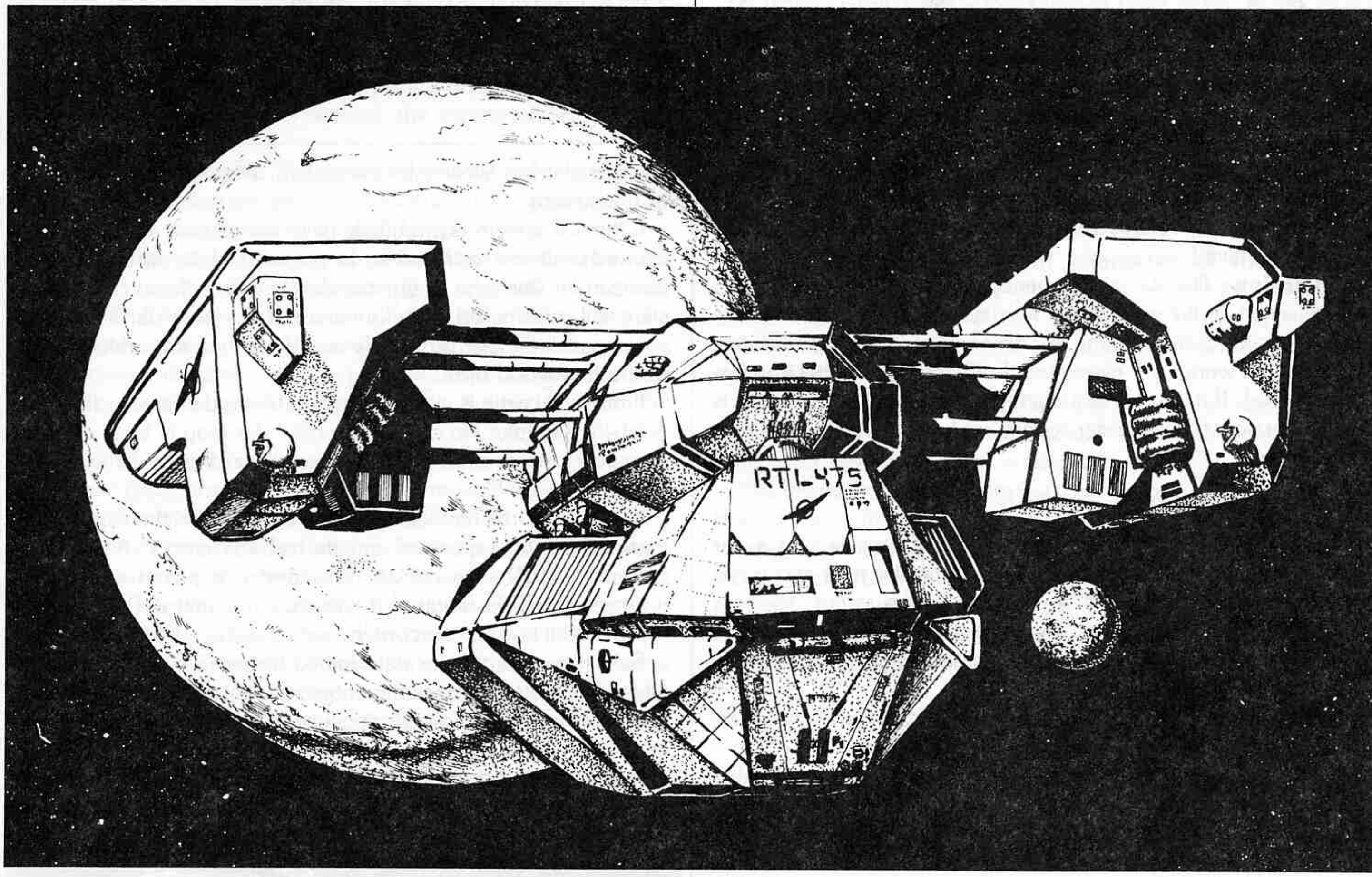
A shuttle has a greater cargo capacity than most space planes, and the surface to orbit flight is rather uncomfortable (high acceleration straight out of the gravity well). Also, the expended engines during a surface to orbit flight take time to refuel and reuse, making shuttle flights somewhat more expensive than an accelerator. However, many items cannot take the hyper-acceleration involved in a slingshot ride without sustaining damage, and a shuttle provides a viable alternative.

Shuttle flights to orbit take on the order of one hour. Return trips are similar to dead gliders, and take three hours to complete.

**Availability of Interface Transportation:** World descriptions will say what type of interface transport is available. However, it is safe to assume that any human colony world has both a shuttle and space plane service running regularly between the surface and any orbital facilities. Other types of transport, such as accelerator and dead gliders, will probably also be available, but these are not the methods of choice for most purposes.

Outposts will generally rely on streamlined spacecraft for their interface service. At best an outpost will have a limited number of space planes or shuttles in operation, making only specific runs when called for; they do not have regular transport.

Earth and Beta Canum both have beanstalks. Use of these is limited only by availability of time. Often these are booked up weeks in advance for both cargo and passenger service.



# World Generation

Adventures that take place in star systems require a basic knowledge of what that star system contains. In preparation for an adventure, the referee must determine the details of the star systems involved.

**Overview:** The star system generation procedure begins with the selection of the central star in a system and determines the characteristics of the star and its companions, if any. Orbital data for the star's worlds are generated. For each world, physical data is generated. If the world is a colony, social data for the world is also generated. Once the star system has been generated, the data is recorded.

## STAR SELECTION

The referee begins star system generation by selecting a star from the near star map and then consulting the near star list to determine what information is available for the star.

The near star list provides spectral type, size, and magnitude. The list also indicates if the star has any companions, which should be noted.

**Companion Star Orbits:** For each companion star, determine its orbit from the companion star orbit table.

Companion stars can interfere with the orbits of planets. Stable planetary orbits must have a radius of less than one-third or more than 3 times the distance between the star and each of its companions.

## ORBIT INFORMATION

Knowing the basic data for the stars in the system, it is possible to compute orbital data for worlds in the system.

**The Presence of Planets:** Stars of spectral type O, B, and A do not form planets; they are too young for the planets to have coalesced around the stars.

Such stars may have some small planetoids in random orbits. Throw 1D6 for the number of planetoids (called chunks) present. Throw 1D10 plus (1D10 x 0.1) for the orbital radius of each in au.

**Orbital Zones:** The life zone (the region with life supporting temperatures) is found on the orbital zone table, which shows the optimum life zone orbital distance, as well as the inner and outer limits of the life zone.

**World Orbits:** Star systems are generated outward from the closest orbit to the star. The radius of each orbit and the world core in the orbit is determined. The values for successive orbital radii are dependent on previous orbits.

Consult the allowed orbits table and determine the maximum number of orbits allowed for the system. Throw once for each star in the system.

If the star system is a multiple (with companion stars) then the allowed orbits are restricted by the presence of the other stars. The companion star orbit radii table details where those companion stars will orbit based on information in the near star list.

Consult the initial orbit table and determine the orbital radius of the first world orbit.

If the initial orbit is close enough to be inside the star, the orbit is labelled empty. No star on the near star map is large enough to encompass an orbit at 0.1 au; a stellar radius of 20 would be necessary.

If the initial orbit has a temperature of 2,000°K then any planet there would be vaporized and the orbit is empty. A star with luminosity 130 is necessary to vaporize a planet at 0.1 au; luminosity 520 is required to vaporize a planet at 0.2 au.

If the orbit is empty, record the radius of the orbit for reference.

Subsequent orbits are determined from the subsequent orbit table. The table produces a number which is multiplied times the radius of the previous orbit to produce a new orbital radius. Record each new orbital radius until all allowed orbits are found.

If, during the course of orbit determination, two consecutive empty orbits are produced, then orbit determination is completed regardless of the number of allowed orbits previously determined.

## WORLD DATA

World data must be generated for each world in an orbit around the star.

**World Core Type:** Determine the core type for the world. Worlds may have rocky or icy cores.

**World Size:** Consult the world size table to determine the throw required for world diameter and then make that throw and record the world diameter.

**World Density:** The density of the matter that forms a world is determined from the world density table. Using the table, determine the world density.

**World Mass:** World mass can be read from the world mass table using world size and density. Mass is given in earth masses.

Surface Gravity: The gravity table shows the gravity in Gs for the world based on diameter and density. Gs can be converted to escape velocity by multiplying by 11.2 (the escape velocity at 1 G is 11.2 kilometers per second; the escape velocity at 2 G is 22.4 kps).

**World Atmosphere:** The atmosphere component table shows the minimum molecular weight of the atmospheric gases retained by a world of specific diameter and density.

Note the diameter and density of the world and find the minimum molecular weight of atmospheric gases retained. Using that number, find the label for the world's atmospheric type and the specific gas with that molecular weight (or higher). The atmosphere will contain the gases listed on the atmosphere gas list with molecular weights equal to, or greater than, the number from the table.

Molecular weight is an indication of the mass of specific atmospheric gases; the higher the mass, the more likely that a world's gravity will retain the gas in the atmosphere.

Atmospheres are classified by type depending on the minimum molecular weight of the gases retained. The atmosphere type table shows the specific label attached to atmospheres based on minimum molecular weight retained.

**Atmospheric Pressure:** Atmospheric pressure is proportional to surface gravity. The atmospheric pressure table gives the average atmospheric pressure on a world surface. The atmospheric pressure (condensed) table provides roughly the same information.

**World Type:** It is possible to designate world type based on atmosphere type, world core type, and orbital zone. Consult the world type table and determine the world type.

If the world type is Garden, then further classification is necessary to determine where the world is in the time sequence of garden planets. Pregarden planets appear early in the life cycle of a star and its system, and soon transform themselves into another phase of the cycle, becoming either glacier planets or garden planets. Very old garden planets become postgarden planets. Throw 1D10 and apply the DM shown for stellar type. Record the result.

The world type determines many of the characteristics of the world. Consult the world characteristics chart to determine what they are and record them.

**Water Presence:** Consult the water presence table to determine if there is water available on the world.

**Average Temperature:** Consult the average temperature table to determine the average temperature for the world. This value may vary across the world surface, but the average temperature provides an indication of temperature levels on the world.

**Atmospheric Oxygen:** Free oxygen is present only on glacier and garden worlds. Consult the atmospheric oxygen table to determine the percentage of oxygen in the atmosphere.

Multiply the oxygen percentage times the atmospheric pressure (previously determined) to find the oxygen pressure in the atmosphere.

## SOCIAL DATA

Most worlds are inhospitable to life, and they can be expected to have no more than a few small outposts, scientific stations, or mines. Habitable worlds, however, will have more extensive settlement and development.

**Inhospitable Worlds:** Consult the inhospitable world table to determine the installations to be expected on the world.

**Hospitable Worlds:** Hospitable worlds soon become colonies. Earth has produced seventeen colony worlds in star systems beyond Sol.

A colony world can be described in great detail by indicating its age, population, and settlement character.

**Determine the age of the colony:** This data may be found by consulting published material, by using the colony age table, or by arbitrarily determining the value.

**Determine the colony population:** First decide if the colony was the object of heavy colonization, median colonization, or light colonization. Using age as a guide, determine the current population level.

**Determine the settlement character of the colony:** Character is based primarily on age and indicates the degree of capital improvements that have been made in the colony. The referee will have to make a decision as to the settlement character in some cases.

**Capital Improvements:** Total the points provided by settlement character for the colony and add to that one point for each million (or fraction thereof) colonists.

The referee may then determine what capital improvements have been made to the colony by expending points to purchase items from the interface systems, orbital facilities, and surface facilities tables. Every colony must have an interface system and an orbital terminal. All points must be spent.

The items acquired should be described in the commentary about the colony.

## SPECTRAL TYPE

| *Type* | *Color* |
|---|---|
| O | Blue |
| B | Blue |
| A | Blue |
| F | White |
| G | Yellow |
| K | Orange |
| M | Red |

## STELLAR SIZE

| *Type* | *Label* |
|---|---|
| Ia | Brightest Supergiants |
| Ib | Weaker Supergiants |
| II | Bright Giants |
| III | Normal Giants |
| IV | Subgiants |
| V | Main Sequence Stars |
| VI | Sub Dwarfs |
| VII | White Dwarfs |

## MAGNITUDE TO LUMINOSITY CONVERSION TABLE

| *Absolute Magnitude* | *Luminosity* |
|---|---|
| 15 | .000083 |
| 14 | .00021 |
| 13 | .00052 |
| 12 | .0013 |
| 11 | .0033 |
| 10 | .0083 |
| 9 | .021 |
| 8 | .052 |
| 7 | .132 |
| 6 | .33 |
| 5 | .83 |
| 4 | 2.09 |
| 3 | 5.25 |
| 2 | 13 |
| 1 | 33 |
| 0 | 83 |
| −1 | 209 |
| −2 | 525 |
| −3 | 1320 |

Luminosity for fractional magnitudes can be approximated by interpolation.

## UNITS

Stellar radius, mass, and luminosity are all expressed in Sols, where 1 = Sol.

Effective temperature is in °K.

## RANDOM PLANETOIDS

Star types O, B, and A do not naturally have planets. They may have captured planetoids (chunks) in random orbits.

Throw 1D6 for the number of chunks.

For each chunk, throw 1D10+(1D10×.1) for the orbital radius in au.

## STELLAR RADIUS CHART

| *Spectral Class* | *Size* *Ia* | *Ib* | *II* | *III* | *IV* | *V* | *VI* |
|---|---|---|---|---|---|---|---|
| B0 | 52 | 30 | 22 | 16 | 13 | 10 | — |
| B5 | 75 | 35 | 20 | 10 | 5.3 | 4.4 | — |
| A0 | 135 | 50 | 18 | 6.2 | 4.5 | 3.2 | — |
| A5 | 149 | 55 | 14 | 4.6 | 2.7 | 1.8 | — |
| F0 | 174 | 59 | 16 | 4.7 | 2.7 | 1.7 | — |
| F5 | 204 | 60 | 18 | 5.2 | 2.6 | 1.4 | 1.14 |
| G0 | 298 | 84 | 25 | 7.1 | 2.5 | 1.03 | 1.02 |
| G5 | 454 | 128 | 37 | 11 | 2.8 | .91 | .55 |
| K0 | 654 | 216 | 54 | 16 | 3.3 | .90 | .40 |
| K5 | 1010 | 392 | 124 | 42 | — | .56 | .30 |
| M0 | 1467 | 857 | 237 | 63 | — | .54 | .26 |
| M5 | 3020 | 2073 | 712 | 228 | — | .35 | .10 |
| M9 | 3499 | 2876 | 931 | 360 | — | .20 | .05 |

## STELLAR MASS CHART

| *Spectral Class* | *Size* *Ia* | *Ib* | *II* | *III* | *IV* | *V* | *VI* |
|---|---|---|---|---|---|---|---|
| B0 | 60 | 50 | 30 | 25 | 20 | 18 | — |
| B5 | 30 | 25 | 20 | 15 | 10 | 6.5 | — |
| A0 | 18 | 16 | 14 | 12 | 6 | 3.2 | — |
| A5 | 15 | 13 | 11 | 9 | 4 | 2.1 | — |
| F0 | 13 | 12 | 10 | 8 | 2.5 | 1.7 | — |
| F5 | 12 | 10 | 8.1 | 5 | 2 | 1.3 | .8 |
| G0 | 12 | 10 | 8.1 | 2.5 | 1.75 | 1.04 | .6 |
| G5 | 13 | 12 | 10 | 3.2 | 2 | .94 | .52 |
| K0 | 14 | 13 | 11 | 4 | 2.3 | .82 | .43 |
| K5 | 18 | 16 | 14 | 5 | — | .57 | .33 |
| M0 | 20 | 16 | 14 | 6.3 | — | .48 | .15 |
| M5 | 25 | 20 | 16 | 7.4 | — | .33 | .10 |
| M9 | 30 | 25 | 18 | 9.2 | — | .21 | .05 |

## STELLAR LUMINOSITY CHART

| *Spectral Class* | *Size* *Ia* | *Ib* | *II* | *III* | *IV* | *V* | *VI* |
|---|---|---|---|---|---|---|---|
| B0 | 560,000 | 270,000 | 170,000 | 107,000 | 81,000 | 56,000 | — |
| B5 | 204,000 | 46,700 | 18,600 | 6,700 | 2,000 | 1,400 | — |
| A0 | 107,000 | 15,000 | 2,200 | 280 | 156 | 90 | — |
| A5 | 81,000 | 11,700 | 850 | 90 | 37 | 16 | — |
| F0 | 61,000 | 7,400 | 600 | 53 | 19 | 8.1 | — |
| F5 | 51,000 | 5,100 | 510 | 43 | 12 | 3.5 | .97 |
| G0 | 67,000 | 6,100 | 560 | 50 | 6.5 | 1.21 | .32 |
| G5 | 89,000 | 8,100 | 740 | 75 | 4.9 | .67 | .186 |
| K0 | 97,000 | 11,700 | 890 | 95 | 4.67 | .42 | .117 |
| K5 | 107,000 | 20,400 | 2,450 | 320 | — | .08 | .025 |
| M0 | 117,000 | 46,000 | 4,600 | 470 | — | .04 | .011 |
| M5 | 129,000 | 89,000 | 14,900 | 2,280 | — | .007 | .002 |
| M9 | 141,000 | 117,000 | 16,200 | 2,690 | — | .001 | .00006 |

## STELLAR EFFECTIVE TEMPERATURES CHART

| *Spectral Class* | *Size* *Ia* | *Ib* | *II* | *III* | *IV* | *V* | *VI* |
|---|---|---|---|---|---|---|---|
| B0 | 22,000 | 24,000 | 25,000 | 26,000 | 27,000 | 28,000 | — |
| B5 | 14,200 | 14,500 | 15,100 | 15,200 | 15,400 | 15,500 | — |
| A0 | 9,000 | 9,100 | 9,300 | 9,500 | 9,700 | 9,900 | — |
| A5 | 8,000 | 8,100 | 8,200 | 8,300 | 8,400 | 8,500 | — |
| F0 | 6,900 | 7,000 | 7,100 | 7,200 | 7,300 | 7,400 | — |
| F5 | 6,100 | 6,300 | 6,400 | 6,500 | 6,600 | 6,700 | 6,800 |
| G0 | 5,400 | 5,600 | 5,700 | 5,800 | 5,900 | 6,000 | 6,100 |
| G5 | 4,700 | 4,850 | 5,000 | 5,100 | 5,200 | 5,500 | 5,600 |
| K0 | 4,000 | 4,100 | 4,300 | 4,500 | 4,700 | 4,900 | 5,000 |
| K5 | 3,300 | 3,500 | 3,650 | 3,800 | — | 4,100 | 4,200 |
| M0 | 2,800 | 2,900 | 3,100 | 3,400 | — | 3,500 | 3,600 |
| M5 | 2,000 | 2,200 | 2,400 | 2,650 | — | 2,800 | 2,900 |
| M9 | 1,900 | 2,000 | 2,100 | 2,200 | — | 2,300 | 2,400 |

## COMPANION STAR ORBIT RADII

**Spectroscopic Binary:** Orbit is 1D10 times au. Spectroscopic binaries are identified as SB in the *Near Star List*.

**Unseen Companion:** Orbit is 1D100 au. Unseen companions are identified as UC in the *Near Star List*.

**Different Coordinates:** Orbit is the square root of

$$(X_1\text{-}X_2)^2 + (Y_1\text{-}Y_2)^2 + (Z_1\text{-}Z_2)^2$$

times 6,000 au.

Use this method for companion stars (in the *Near Star List*) which have different XYZ coordinates. $X_1$ is the X coordinate of the first star; $X_2$ is the X coordinate of the second star. By finding the square root of the sum of the differences in X, Y, and Z coordinates, it is possible to determine the distance separating the stars; multiply by 6,000 to convert au to light years.

**Others:** Orbit is 1D10 au.

**Restrictions:** Stable orbits must have a radius less than 1/3, or greater than 3 times the distance between companions.

## UNTENABLE ORBITS

Planets are not tenable (they cannot exist) if their star produces a temperature of 2000 °K or more at their orbit.

This table shows the minimum stellar luminosity which creates a temperature of 2000 °K at the orbital distance shown.

| *Untenable Orbit* | *Luminosity* |
|---|---|
| .1 au | 130 |
| .2 au | 520 |
| .3 au | 1170 |
| .4 au | 2090 |
| .5 au | 3270 |

## ALLOWED ORBITS

| *Star Type* | *Quantity* |
|---|---|
| O | 1D6 (chunks only) |
| B | 1D6 (chunks only) |
| A | 1D6 (chunks only) |
| F | 1D10 |
| G | 3D6 |
| K | 2D6 |
| M | 1D6 |

When generating orbits, stop after rolling two consecutive empty orbits, regardless of the result on this table. White dwarfs (size VII or 7) have no allowed orbits.

## TIDAL LOCKING

Planets of stars with a mass of less than .7 are tidally locked to the star if in the life or inner zones. Tidally locked worlds in the life zone may have small pockets of habitable terrain in the twilight zone between total day and total night.

## LIFE ZONES

| *Luminosity* | *Inner Limit* | *Optimum Distance* | *Outer Limit* |
|---|---|---|---|
| .3 | .40 | .55 | .79 |
| .4 | .46 | .63 | .92 |
| .5 | .51 | .71 | 1.03 |
| .6 | .56 | .77 | 1.12 |
| .7 | .61 | .84 | 1.21 |
| .8 | .65 | .89 | 1.30 |
| .9 | .69 | .95 | 1.38 |
| 1.0 | .72 | 1.00 | 1.45 |
| 1.1 | .76 | 1.05 | 1.52 |
| 1.2 | .79 | 1.10 | 1.59 |
| 1.3 | .83 | 1.14 | 1.65 |
| 1.4 | .86 | 1.18 | 1.72 |
| 1.5 | .89 | 1.22 | 1.76 |
| 1.6 | .92 | 1.26 | 1.83 |
| 1.7 | .94 | 1.30 | 1.89 |
| 1.8 | .97 | 1.34 | 1.95 |
| 1.9 | 1.00 | 1.39 | 2.00 |
| 2.0 | 1.02 | 1.41 | 2.05 |
| 2.1 | 1.05 | 1.45 | 2.10 |
| 2.2 | 1.07 | 1.48 | 2.15 |
| 2.3 | 1.10 | 1.52 | 2.20 |
| 2.4 | 1.12 | 1.55 | 2.25 |
| 2.5 | 1.14 | 1.58 | 2.29 |
| 2.6 | 1.17 | 1.61 | 2.34 |
| 2.7 | 1.19 | 1.64 | 2.38 |
| 2.8 | 1.21 | 1.67 | 2.43 |
| 2.9 | 1.23 | 1.70 | 2.47 |
| 3.0 | 1.25 | 1.73 | 2.51 |
| 3.1 | 1.27 | 1.76 | 2.55 |
| 3.2 | 1.30 | 1.79 | 2.59 |
| 3.3 | 1.32 | 1.82 | 2.63 |
| 3.4 | 1.33 | 1.84 | 2.67 |
| 3.5 | 1.35 | 1.87 | 2.71 |
| 3.6 | 1.37 | 1.90 | 2.75 |
| 3.7 | 1.39 | 1.92 | 2.79 |
| 3.8 | 1.41 | 1.95 | 2.83 |
| 3.9 | 1.43 | 1.97 | 2.86 |
| 4.0 | 1.45 | 2.00 | 2.90 |
| 4.1 | 1.47 | 2.02 | 2.94 |
| 4.2 | 1.48 | 2.05 | 2.97 |
| 4.3 | 1.50 | 2.07 | 3.01 |
| 4.4 | 1.52 | 2.10 | 3.04 |
| 4.5 | 1.54 | 2.12 | 3.08 |
| 4.6 | 1.55 | 2.14 | 3.11 |
| 4.7 | 1.57 | 2.17 | 3.14 |
| 4.8 | 1.59 | 2.19 | 3.18 |
| 4.9 | 1.60 | 2.21 | 3.21 |
| 5.0 | 1.62 | 2.24 | 3.24 |
| 5.1 | 1.64 | 2.26 | 3.26 |
| 5.2 | 1.65 | 2.28 | 3.31 |
| 5.3 | 1.67 | 2.30 | 3.34 |
| 5.4 | 1.68 | 2.32 | 3.37 |
| 5.5 | 1.70 | 2.35 | 3.40 |
| 5.6 | 1.71 | 2.37 | 3.43 |
| 5.7 | 1.73 | 2.39 | 3.46 |
| 5.8 | 1.74 | 2.41 | 3.49 |
| 5.9 | 1.76 | 2.43 | 3.52 |
| 6.0 | 1.77 | 2.45 | 3.55 |
| 6.2 | 1.80 | 2.49 | 3.61 |
| 6.4 | 1.83 | 2.53 | 3.67 |

## INITIAL ORBIT

| *1D10* | *Orbit Radius* |
|---|---|
| 0 | Empty Orbit |
| 1 | .1 au |
| 2 | .2 au |
| 3 | .3 au |
| 4 | .4 au |
| 5 | .5 au |
| 6 | .6 au |
| 7 | .7 au |
| 8 | .8 au |
| 9 | .9 au |

If empty orbit, roll again for its radius. If orbit radius places it inside the star or produces a temperature above 2000 °K, then the orbit is empty.

Luminosity 130 would vaporize a world at .1 au; luminosity 520 would vaporize a world at .2 au.

## SUBSEQUENT ORBITS

| *1D10* | *Multiplier* |
|---|---|
| 0 | Empty Orbit |
| 1 | 1.3 |
| 2 | 1.4 |
| 3 | 1.5 |
| 4 | 1.6 |
| 5 | 1.7 |
| 6 | 1.8 |
| 7 | 1.9 |
| 8 | 2.0 |
| 9 | 2.1 |

Multiply the previous orbit by the multiplier to determine subsequent orbit radius.

If empty orbit, roll again for the radius of its orbit.

## OUTER LIFE ZONES

| *Luminosity* | *Inner Limit* | *Optimum Distance* | *Outer Limit* |
|---|---|---|---|
| 6.6 | 1.86 | 2.57 | 3.73 |
| 6.8 | 1.89 | 2.61 | 3.78 |
| 7.0 | 1.92 | 2.65 | 3.84 |
| 7.2 | 1.94 | 2.68 | 3.89 |
| 7.4 | 1.97 | 2.72 | 3.94 |
| 7.6 | 2.00 | 2.76 | 4.00 |
| 7.8 | 2.02 | 2.79 | 4.05 |
| 8.0 | 2.05 | 2.83 | 4.10 |
| 8.2 | 2.07 | 2.86 | 4.15 |
| 8.4 | 2.10 | 2.90 | 4.20 |
| 8.6 | 2.12 | 2.93 | 4.25 |
| 8.8 | 2.15 | 2.97 | 4.30 |
| 9.0 | 2.17 | 3.00 | 4.35 |
| 9.5 | 2.23 | 3.08 | 4.45 |
| 9.9 | 2.28 | 3.15 | 4.56 |

Life Zone Formula:

$$D = KL^{.5}$$

K is a constant which is different for each distance. At the inner limit, K = 0.72; at optimum distance, K = 1.0; at the outer limit, K = 1.45.

## WORLD CORE

| 1D6 | Inner Zone | Life Zone | Outer Zone |
|---|---|---|---|
| 1 | Rocky | Rocky | Rocky |
| 2 | Rocky | Rocky | Rocky |
| 3 | Rocky | Rocky | Icy |
| 4 | Rocky | Rocky | Icy |
| 5 | Rocky | Rocky | Icy |
| 6 | Rocky | Rocky | Icy |

## WORLD DIAMETER

| 1D6 | Rocky Core | Icy Core |
|---|---|---|
| 1 | 1D6 × 1,000 | 1D6 × 1,000 |
| 2 | 1D6 × 1,000 | 1D6 × 1,000 |
| 3 | 2D6 × 1,000 | 1D6 × 1,000 |
| 4 | 3D6 × 1,000 | 2D6 × 1,000 |
| 5 | 4D6 × 1,000 | 2D6 × 1,000 |
| 6 | 5D6 × 1,000 | 3D6 × 1,000 |

This table provides world diameter in kilometers. Circumference at the equator equals 3.14 times this amount.

## WORLD DENSITY

| 1D10 | Density of Rocky Core | 1D6 | Density of Icy Core |
|---|---|---|---|
| 0 | .4 | 1 | .1 |
| 1 | .5 | 2 | .2 |
| 2 | .6 | 3 | .3 |
| 3 | .7 | 4 | .4 |
| 4 | .8 | 5 | .5 |
| 5 | .9 | 6 | .6 |
| 6 | 1.0 | | |
| 7 | 1.1 | | |
| 8 | 1.2 | | |
| 9 | 1.3 | | |

Density is in Earths (Earth=1).

## EQUIVALENT DENSITIES

| *Material* | *g/cc* | *Earths* |
|---|---|---|
| Water | 1.0 | .18 |
| Ice | .9 | .16 |
| Carbon | 2.3 | .41 |
| Rock | 3.5 | .65 |
| Iron | 7.9 | 1.43 |
| Gold | 19.3 | 3.50 |

| *Body* | *g/cc* | *Earths* |
|---|---|---|
| Sun | 1.0 | .18 |
| Mercury (Rock Ball) | 5.4 | .98 |
| Venus (Hot House) | 5.2 | .94 |
| Earth (Garden) | 5.5 | 1.00 |
| Luna (Rock Ball) | 3.3 | .60 |
| Mars (Desert) | 3.9 | .71 |
| Jupiter (Gas Giant) | 1.3 | .23 |
| Saturn (Gas Giant) | .7 | .13 |
| Uranus (Gas Giant) | 1.6 | .29 |
| Neptune (Gas Giant) | 1.7 | .30 |
| Pluto (Ice Ball) | 1.0 | .18 |

## ATMOSPHERIC TYPES

| Minimum Molecular Weight Retained | Atmosphere Type |
|---|---|
| 1+ | Massive |
| 5+ | Dense |
| 20+ | Standard |
| 40+ | Thin |
| 80+ | Very Thin |
| 120+ | Vacuum |

## ATMOSPHERIC PRESSURE (CONDENSED TABLE)

| Surface Gravity (Gs) | Atmospheric Pressure (Atms) |
|---|---|
| .1 | .1 |
| .2 | .2 |
| .3 | .3 |
| .4 | .4 |
| .5 | .5 |
| .6 | .6 |
| .7 | .7 |
| .8 | .8 |
| .9 | .9 |
| 1.0 | 1.0 |

Atmospheric pressure is roughly equivalent to Gs. Humans require a minimum pressure of .2 atm.

## MOLECULAR WEIGHTS OF COMMON ATMOSPHERIC GASES

| *Constituent* | *Molecular Weight* |
|---|---|
| Molecular Hydrogen ($H_2$) | 2.0 |
| Helium (He) | 4.0 |
| Methane ($CH_4$) | 16.0 |
| Ammonia ($NH_3$) | 17.0 |
| Water Vapor ($H_2O$) | 18.0 |
| Neon (Ne) | 20.2 |
| Molecular Nitrogen ($N_2$) | 28.0 |
| Carbon Monoxide (CO) | 28.0 |
| Nitric Oxide (NO) | 30.0 |
| Molecular Oxygen ($O_2$) | 32.0 |
| Hydrogen Sulfide ($H_2S$) | 34.1 |
| Argon (Ar) | 39.9 |
| Carbon Dioxide ($CO_2$) | 44.0 |
| Nitrous Oxide ($N_2O$) | 44.0 |
| Nitrogen Dioxide ($NO_2$) | 46.0 |
| Ozone ($O_3$) | 48.0 |
| Sulfur Dioxide ($SO_2$) | 64.1 |
| Sulfur Trioxide ($SO_3$) | 80.1 |
| Krypton (Kr) | 83.8 |
| Xenon (Xe) | 131.3 |

## ATMOSPHERIC COMPOSITION

A world atmosphere will have a gas shown on the molecular weights of common atmospheric gases table if the gas's molecular weight is equal to or greater than the value shown on the atmospheric type table for the world's atmosphere.

## WORLDS

There are eleven broad types of worlds possible; they are:

**Rock:** A plain rock ball with no appreciable atmosphere. Most planets begin with a rocky core; if the total mass is below a certain limit, the planet cannot retain an atmosphere and becomes a plain rock ball. *Example:* Mercury.

**Ice Ball:** A plain ball of frozen gases. Ice balls occur only in the outer zone of a system. *Example:* Pluto.

**Gas Giant:** A large planet with an atmosphere primarily of hydrogen and helium. Gas giants occur when a planet accumulates a mass greater than four Earths; thereafter, gas continues to accumulate. *Example:* Jupiter.

**Hot House:** A planet with a large greenhouse-effect atmosphere. The initial planetary accumulation produces an atmosphere with a large amount of $CO_2$; the world retained too much heat and cannot generate life. *Example:* Venus.

**Glacier:** A planet with a heavy overburden of ice. If, for various reasons, the water content of a world becomes locked up in the ice caps, the world albedo increases, and heat from the star is reflected directly back into space; with less heat being retained, the icecaps expand. Ultimately, all water on the world is locked up in icecaps which cover much of the world's surface.

**Pre-Garden:** Given the right circumstances, a planet in the life zone will have the prerequisites for life. Given sufficient time, life will evolve on the world, shifting the atmosphere from methane and water vapor to nitrogen and oxygen. *Example:* Earth eons ago.

**Garden:** A world with a hospitable environment, an oxygen atmosphere, and locally evolved life. *Example:* Earth.

**Post-Garden:** A world which has a history of life, but which has since developed a high greenhouse effect. Post-garden planets are similar to hot houses, but they have a different history. *Example:* Earth eons from now.

**Desert:** The world has an atmosphere, but has never developed liquid water. *Example:* Mars.

**Failed Core:** A world which accumulated an atmosphere during the formation of the star system, but which never accumulated enough mass to become a gas giant.

**Chunk:** A small airless world less than 1,000 kilometers in diameter. *Example:* Ceres.

## WORLD MASS

| Diameter 1,000 km | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | 1.0 | 1.1 | 1.2 | 1.3 | 1.4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Density (Earths) | |
| 1 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0004 | .0005 | .0005 |
| 2 | .0003 | .0007 | .001 | .001 | .002 | .002 | .002 | .003 | .003 | .003 | .004 | .004 | .004 | .005 |
| 3 | .001 | .002 | .003 | .005 | .006 | .007 | .008 | .010 | .011 | .012 | .014 | .015 | .016 | .017 |
| 4 | .003 | .006 | .009 | .012 | .015 | .018 | .021 | .024 | .027 | .030 | .033 | .036 | .039 | .042 |
| 5 | .005 | .011 | .017 | .023 | .029 | .035 | .041 | .047 | .053 | .059 | .065 | .071 | .077 | .083 |
| 6 | .010 | .020 | .030 | .041 | .051 | .061 | .072 | .082 | .092 | .10 | .11 | .12 | .13 | .14 |
| 7 | .016 | .032 | .049 | .065 | .081 | .098 | .11 | .13 | .14 | .16 | .17 | .19 | .21 | .22 |
| 8 | .024 | .048 | .073 | .097 | .12 | .14 | .17 | .19 | .21 | .24 | .26 | .29 | .31 | .34 |
| 9 | .034 | .069 | .10 | .13 | .17 | .20 | .24 | .27 | .31 | .34 | .38 | .41 | .45 | .48 |
| 10 | .047 | .095 | .14 | .19 | .23 | .28 | .33 | .38 | .42 | .47 | .52 | .57 | .61 | .66 |
| 11 | .063 | .12 | .19 | .25 | .31 | .38 | .44 | .50 | .57 | .63 | .69 | .76 | .82 | .88 |
| 12 | .082 | .16 | .24 | .32 | .41 | .49 | .57 | .65 | .74 | .82 | .90 | .98 | 1.07 | 1.15 |
| 13 | .10 | .20 | .31 | .41 | .52 | .62 | .73 | .83 | .94 | 1.04 | 1.15 | 1.25 | 1.36 | 1.46 |
| 14 | .13 | .26 | .39 | .52 | .65 | .78 | .91 | 1.04 | 1.17 | 1.30 | 1.43 | 1.57 | 1.70 | 1.83 |
| 15 | .16 | .32 | .48 | .64 | .80 | .96 | 1.12 | 1.28 | 1.44 | 1.60 | 1.77 | 1.93 | 2.09 | 2.25 |
| 16 | .19 | .39 | .58 | .78 | .97 | 1.17 | 1.36 | 1.56 | 1.75 | 1.95 | 2.14 | 2.34 | 2.53 | 2.73 |
| 17 | .23 | .46 | .70 | .93 | 1.17 | 1.40 | 1.64 | 1.87 | 2.10 | 2.34 | 2.57 | 2.81 | 3.40 | 3.28 |
| 18 | .27 | .55 | .83 | 1.11 | 1.39 | 1.66 | 1.94 | 2.22 | 2.50 | 2.78 | 3.05 | 3.33 | 3.61 | 3.89 |
| 19 | .32 | .65 | .98 | 1.30 | 1.63 | 1.96 | 2.28 | 2.61 | 2.94 | 3.27 | 3.59 | 3.92 | 4.25 | 4.57 |
| 20 | .38 | .76 | 1.14 | 1.52 | 1.90 | 2.28 | 2.67 | 3.05 | 3.43 | 3.81 | 4.19 | 4.57 | 4.96 | 5.34 |
| 21 | .44 | .88 | 1.32 | 1.76 | 2.20 | 2.65 | 3.09 | 3.53 | 3.97 | 4.41 | 4.85 | 5.30 | 5.74 | 6.18 |
| 22 | .50 | 1.01 | 1.52 | 2.03 | 2.53 | 3.04 | 3.55 | 4.06 | 4.57 | 5.07 | 5.58 | 6.09 | 6.60 | 7.10 |
| 23 | .58 | 1.16 | 1.74 | 2.32 | 2.90 | 3.48 | 4.06 | 4.64 | 5.22 | 5.80 | 6.38 | 6.96 | 7.54 | 8.12 |
| 24 | .65 | 1.31 | 1.97 | 2.63 | 3.29 | 3.95 | 4.61 | 5.27 | 5.93 | 6.59 | 7.25 | 7.91 | 8.57 | 9.23 |
| 25 | .74 | 1.49 | 2.23 | 2.98 | 3.72 | 4.47 | 5.21 | 5.96 | 6.70 | 7.45 | 8.19 | 8.94 | 9.68 | 10.00 |
| 26 | .83 | 1.67 | 2.51 | 3.35 | 4.19 | 5.02 | 5.86 | 6.70 | 7.54 | 8.38 | 9.22 | 10.05 | 10.89 | 11.73 |
| 27 | .93 | 1.87 | 2.81 | 3.75 | 4.69 | 5.63 | 6.57 | 7.50 | 8.44 | 9.38 | 10.32 | 11.26 | 12.20 | 13.14 |
| 28 | 1.04 | 2.09 | 3.14 | 4.18 | 5.23 | 6.28 | 7.32 | 8.37 | 9.42 | 10.46 | 11.51 | 12.56 | 13.61 | 14.65 |
| 29 | 1.16 | 2.32 | 3.48 | 4.65 | 5.81 | 6.97 | 8.14 | 9.30 | 10.46 | 11.63 | 12.79 | 13.95 | 15.12 | 16.28 |
| 30 | 1.28 | 2.57 | 3.86 | 5.15 | 6.43 | 7.72 | 9.01 | 10.30 | 11.58 | 12.87 | 14.16 | 15.45 | 16.74 | 18.02 |

## WORLD GRAVITY

| Diameter 1,000 km | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | 1.0 | 1.1 | 1.2 | 1.3 | 1.4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Density (Earths) | |
| 1 | .024 | .035 | .043 | .049 | .055 | .060 | .065 | .070 | .074 | .078 | .082 | .086 | .089 | .093 |
| 2 | .049 | .070 | .086 | .099 | .111 | .121 | .131 | .140 | .149 | .157 | .165 | .172 | .179 | .186 |
| 3 | .074 | .105 | .129 | .149 | .167 | .182 | .197 | .211 | .224 | .236 | .247 | .258 | .269 | .279 |
| 4 | .099 | .140 | .172 | .199 | .222 | .243 | .263 | .281 | .298 | .314 | .330 | .345 | .359 | .372 |
| 5 | .124 | .176 | .215 | .248 | .278 | .304 | .329 | .352 | .373 | .393 | .412 | .431 | .448 | .465 |
| 6 | .149 | .211 | .258 | .298 | .334 | .365 | .395 | .422 | .448 | .472 | .495 | .517 | .538 | .558 |
| 7 | .174 | .246 | .301 | .348 | .389 | .426 | .461 | .492 | .522 | .551 | .578 | .603 | .628 | .652 |
| 8 | .192 | .281 | .345 | .398 | .445 | .487 | .527 | .563 | .597 | .629 | .660 | .690 | .718 | .745 |
| 9 | .224 | .316 | .388 | .448 | .501 | .548 | .592 | .633 | .672 | .708 | .743 | .776 | .807 | .838 |
| 10 | .248 | .352 | .431 | .497 | .556 | .609 | .658 | .704 | .746 | .787 | .825 | .862 | .897 | .931 |
| 11 | .273 | .387 | .474 | .547 | .612 | .670 | .724 | .774 | .821 | .866 | .908 | .948 | .987 | 1.024 |
| 12 | .298 | .422 | .517 | .597 | .668 | .731 | .790 | .845 | .896 | .944 | .991 | 1.035 | 1.077 | 1.117 |
| 13 | .323 | .457 | .560 | .647 | .723 | .792 | .856 | .915 | .971 | 1.023 | 1.073 | 1.121 | 1.167 | 1.211 |
| 14 | .348 | .492 | .603 | .697 | .779 | .853 | .922 | .985 | 1.045 | 1.102 | 1.156 | 1.207 | 1.256 | 1.304 |
| 15 | .373 | .528 | .646 | .746 | .835 | .914 | .988 | 1.056 | 1.120 | 1.181 | 1.238 | 1.293 | 1.346 | 1.397 |
| 16 | .398 | .563 | .690 | .796 | .890 | .975 | 1.054 | 1.126 | 1.195 | 1.259 | 1.321 | 1.380 | 1.436 | 1.490 |
| 17 | .423 | .598 | .733 | .846 | .946 | 1.036 | 1.119 | 1.197 | 1.269 | 1.338 | 1.403 | 1.466 | 1.526 | 1.583 |
| 18 | .448 | .633 | .776 | .896 | 1.002 | 1.097 | 1.185 | 1.267 | 1.344 | 1.417 | 1.486 | 1.552 | 1.615 | 1.676 |
| 19 | .473 | .669 | .819 | .946 | 1.057 | 1.158 | 1.251 | 1.338 | 1.419 | 1.496 | 1.569 | 1.638 | 1.705 | 1.770 |
| 20 | .497 | .704 | .862 | .995 | 1.113 | 1.219 | 1.317 | 1.408 | 1.493 | 1.574 | 1.651 | 1.725 | 1.795 | 1.863 |
| 21 | .522 | .739 | .905 | 1.045 | 1.169 | 1.280 | 1.383 | 1.478 | 1.568 | 1.653 | 1.734 | 1.811 | 1.885 | 1.956 |
| 22 | .547 | .774 | .948 | 1.095 | 1.224 | 1.341 | 1.449 | 1.549 | 1.643 | 1.732 | 1.816 | 1.897 | 1.975 | 2.049 |
| 23 | .572 | .809 | .991 | 1.145 | 1.280 | 1.402 | 1.515 | 1.619 | 1.718 | 1.811 | 1.899 | 1.983 | 2.064 | 2.142 |
| 24 | .597 | .845 | 1.035 | 1.195 | 1.336 | 1.463 | 1.581 | 1.690 | 1.792 | 1.889 | 1.982 | 2.070 | 2.154 | 2.235 |
| 25 | .622 | .880 | 1.078 | 1.244 | 1.391 | 1.524 | 1.646 | 1.760 | 1.867 | 1.968 | 2.064 | 2.156 | 2.244 | 2.329 |
| 26 | .647 | .915 | 1.121 | 1.294 | 1.447 | 1.585 | 1.712 | 1.831 | 1.942 | 1.047 | 2.147 | 2.242 | 2.334 | 2.422 |
| 27 | .672 | .950 | 1.164 | 1.344 | 1.503 | 1.646 | 1.778 | 1.901 | 2.016 | 2.125 | 2.229 | 2.328 | 2.423 | 2.515 |
| 28 | .697 | .985 | 1.207 | 1.394 | 1.558 | 1.707 | 1.844 | 1.971 | 2.091 | 2.204 | 2.312 | 2.415 | 2.513 | 2.608 |
| 29 | .722 | 1.021 | 1.250 | 1.444 | 1.614 | 1.768 | 1.910 | 2.042 | 2.166 | 2.283 | 2.394 | 2.501 | 2.603 | 2.701 |
| 30 | .746 | 1.056 | 1.293 | 1.493 | 1.670 | 1.829 | 1.976 | 2.112 | 2.240 | 2.362 | 2.477 | 2.587 | 2.693 | 2.794 |

## MINIMUM MOLECULAR WEIGHT RETAINED

| Diameter 1,000 km | Density (Earths) .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | 1.0 | 1.1 | 1.2 | 1.3 | 1.4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 299 | 299 | 299 | 299 | 299 | 299 | 299 | 299 | 299 | 299 | 299 | 299 | 299 | 299 |
| 2 | 299 | 299 | 299 | 299 | 299 | 299 | 299 | 299 | 299 | 287 | 262 | 240 | 220 | 205 |
| 3 | 299 | 299 | 299 | 299 | 256 | 212 | 181 | 160 | 142 | 127 | 116 | 106 | 97 | 90 |
| 4 | 299 | 299 | 237 | 178 | 143 | 118 | 101 | 89 | 79 | 71 | 64 | 59 | 54 | 50 |
| 5 | 299 | 227 | 152 | 114 | 91 | 76 | 65 | 56 | 50 | 45 | 41 | 38 | 35 | 32 |
| 6 | 299 | 158 | 105 | 79 | 63 | 52 | 45 | 39 | 35 | 31 | 28 | 26 | 24 | 22 |
| 7 | 232 | 116 | 77 | 58 | 46 | 38 | 33 | 29 | 25 | 23 | 21 | 19 | 17 | 16 |
| 8 | 178 | 89 | 59 | 44 | 35 | 29 | 25 | 22 | 19 | 17 | 16 | 14 | 13 | 12 |
| 9 | 141 | 70 | 46 | 35 | 28 | 23 | 20 | 17 | 15 | 14 | 12 | 11 | 10 | 10 |
| 10 | 114 | 56 | 38 | 28 | 22 | 18 | 16 | 14 | 12 | 11 | 10 | 9 | 8 | 8 |
| 11 | 94 | 47 | 31 | 23 | 18 | 15 | 13 | 11 | 10 | 9 | 8 | 7 | 7 | 6 |
| 12 | 79 | 39 | 26 | 19 | 15 | 13 | 11 | 9 | 8 | 7 | 7 | 6 | 6 | 5 |
| 13 | 67 | 33 | 22 | 16 | 13 | 11 | 9 | 8 | 7 | 6 | 6 | 5 | 5 | 4 |
| 14 | 58 | 29 | 19 | 14 | 11 | 9 | 8 | 7 | 6 | 5 | 5 | 4 | 4 | 4 |
| 15 | 50 | 25 | 16 | 12 | 10 | 8 | 7 | 6 | 5 | 5 | 4 | 4 | 3 | 3 |
| 16 | 44 | 22 | 14 | 11 | 8 | 7 | 6 | 5 | 4 | 4 | 4 | 3 | 3 | 3 |
| 17 | 39 | 19 | 13 | 9 | 7 | 6 | 5 | 4 | 4 | 3 | 3 | 3 | 3 | 2 |
| 18 | 35 | 17 | 11 | 8 | 7 | 5 | 5 | 4 | 3 | 3 | 3 | 2 | 2 | 2 |
| 19 | 31 | 15 | 10 | 7 | 6 | 5 | 4 | 3 | 3 | 3 | 2 | 2 | 2 | 2 |
| 20 | 28 | 14 | 9 | 7 | 5 | 4 | 4 | 3 | 3 | 3 | 2 | 2 | 2 | 2 |
| 21 | 25 | 12 | 8 | 6 | 5 | 4 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 |
| 22 | 23 | 11 | 7 | 5 | 4 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 |
| 23 | 21 | 10 | 7 | 5 | 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 |
| 24 | 19 | 9 | 6 | 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| 25 | 18 | 9 | 6 | 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| 26 | 16 | 8 | 5 | 4 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| 27 | 15 | 7 | 5 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 28 | 14 | 7 | 4 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 29 | 13 | 6 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 30 | 12 | 6 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |

## ATMOSPHERIC PRESSURE (Atm x 1,000)

| Diameter 1,000 km | Density (Earths) .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | 1.0 | 1.1 | 1.2 | 1.3 | 1.4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 23 | 34 | 41 | 47 | 54 | 59 | 63 | 68 | 72 | 76 | 80 | 83 | 87 | 90 |
| 2 | 47 | 68 | 83 | 96 | 108 | 118 | 128 | 136 | 145 | 153 | 160 | 168 | 175 | 181 |
| 3 | 72 | 102 | 125 | 145 | 163 | 178 | 192 | 205 | 218 | 230 | 241 | 252 | 262 | 273 |
| 4 | 96 | 136 | 168 | 194 | 217 | 238 | 257 | 274 | 291 | 307 | 321 | 336 | 350 | 363 |
| 5 | 121 | 171 | 210 | 242 | 271 | 297 | 321 | 343 | 364 | 383 | 403 | 421 | 438 | 454 |
| 6 | 145 | 205 | 252 | 291 | 326 | 356 | 385 | 412 | 437 | 461 | 483 | 505 | 526 | 546 |
| 7 | 170 | 240 | 294 | 340 | 380 | 417 | 450 | 481 | 510 | 538 | 564 | 589 | 613 | 636 |
| 8 | 194 | 274 | 336 | 389 | 434 | 476 | 514 | 550 | 583 | 615 | 644 | 673 | 701 | 727 |
| 9 | 218 | 308 | 378 | 437 | 489 | 535 | 579 | 618 | 656 | 691 | 726 | 758 | 788 | 819 |
| 10 | 242 | 343 | 421 | 486 | 543 | 595 | 643 | 687 | 729 | 768 | 806 | 842 | 876 | 910 |
| 11 | 267 | 377 | 463 | 534 | 597 | 655 | 707 | 756 | 802 | 846 | 887 | 926 | 965 | 1000 |
| 12 | 291 | 412 | 505 | 583 | 652 | 714 | 772 | 825 | 875 | 923 | 967 | 1011 | 1052 | 1092 |
| 13 | 315 | 446 | 547 | 632 | 706 | 774 | 836 | 894 | 948 | 1000 | 1048 | 1095 | 1140 | 1183 |
| 14 | 340 | 481 | 589 | 680 | 761 | 834 | 900 | 963 | 1021 | 1076 | 1129 | 1179 | 1227 | 1273 |
| 15 | 364 | 515 | 631 | 729 | 815 | 893 | 965 | 1032 | 1094 | 1153 | 1210 | 1264 | 1315 | 1365 |
| 16 | 389 | 550 | 673 | 778 | 869 | 952 | 1029 | 1101 | 1167 | 1231 | 1290 | 1348 | 1403 | 1456 |
| 17 | 413 | 584 | 716 | 827 | 924 | 1013 | 1094 | 1169 | 1240 | 1308 | 1371 | 1432 | 1491 | 1547 |
| 18 | 437 | 618 | 758 | 875 | 979 | 1072 | 1158 | 1238 | 1313 | 1384 | 1452 | 1516 | 1578 | 1638 |
| 19 | 461 | 653 | 800 | 924 | 1033 | 1131 | 1222 | 1307 | 1386 | 1461 | 1533 | 1601 | 1666 | 1729 |
| 20 | 486 | 687 | 842 | 972 | 1088 | 1191 | 1287 | 1376 | 1459 | 1538 | 1613 | 1685 | 1754 | 1820 |
| 21 | 510 | 722 | 884 | 1021 | 1142 | 1251 | 1351 | 1445 | 1532 | 1615 | 1694 | 1769 | 1842 | 1911 |
| 22 | 534 | 756 | 926 | 1070 | 1196 | 1310 | 1416 | 1513 | 1605 | 1692 | 1774 | 1854 | 1930 | 2002 |
| 23 | 559 | 791 | 968 | 1118 | 1251 | 1370 | 1480 | 1582 | 1678 | 1769 | 1856 | 1938 | 2017 | 2093 |
| 24 | 583 | 825 | 1011 | 1167 | 1305 | 1430 | 1544 | 1651 | 1751 | 1846 | 1936 | 2022 | 2105 | 2184 |
| 25 | 608 | 859 | 1053 | 1216 | 1359 | 1489 | 1609 | 1719 | 1824 | 1923 | 2017 | 2107 | 2192 | 2275 |
| 26 | 632 | 894 | 1095 | 1265 | 1414 | 1549 | 1673 | 1788 | 1897 | 2000 | 2097 | 2191 | 2280 | 2367 |
| 27 | 656 | 928 | 1137 | 1313 | 1468 | 1609 | 1738 | 1857 | 1970 | 2077 | 2178 | 2275 | 2368 | 2458 |
| 28 | 680 | 963 | 1179 | 1362 | 1523 | 1668 | 1801 | 1926 | 2043 | 2154 | 2259 | 2359 | 2456 | 2548 |
| 29 | 705 | 997 | 1221 | 1410 | 1577 | 1728 | 1866 | 1995 | 2116 | 2231 | 2340 | 2444 | 2543 | 2640 |
| 30 | 729 | 1032 | 1264 | 1459 | 1631 | 1787 | 1931 | 2064 | 2189 | 2308 | 2420 | 2528 | 2631 | 2731 |

## WORLD TYPES

| *Atmosphere Type* | *Inner Zone Rocky* | *Life Zone Rocky* | *Outer Zone Rocky* | *Outer Zone Icy* |
|---|---|---|---|---|
| Vacuum | Rock | Rock | Rock | Ice Ball |
| Very Thin | Rock | Rock | Rock | Ice Ball |
| Thin | Desert | Desert | Desert | Failed Core |
| Standard | Hot House | Desert | Failed Core | Failed Core |
| Dense | Hot House | Garden | Failed Core | Failed Core |
| Massive | Gas Giant | Gas Giant | Gas Giant | Gas Giant |
| Chunk | Chunk | Chunk | Chunk | — |

**Note:** Consult the garden worlds table to determine the nature of the garden world.

## WATER

| *World Type* | *Inner Zone* | *Life Zone* | *Outer Zone* |
|---|---|---|---|
| Rock | Rare Ice | Rare Ice | Rare Ice |
| Ice Ball | — | — | Plentiful |
| Desert | No | Rare Ice | Rare Ice |
| Hot House | No | — | — |
| Failed Core | | | Ice Sheets |
| Gas Giant | Crystals | Crystals | Crystals |
| Glacier | — | Ice Sheets | — |
| Garden | — | Oceans | — |
| Pre-Garden | — | Oceans | — |
| Post-Garden | — | No | — |
| Chunk | Rare Ice | Rare Ice | Rare Ice |

**Surface Coverage:** *No:* None. *Rare Ice:* Ice less than 1%. *Plentiful:* 1D6×10%. *Crystals:* 1% ice crystals floating in atmosphere. *Oceans:* (2D6−2)×10%. *Ice Sheets:* (2D6−2)×10%.

## AVERAGE TEMPERATURES

| *World Type* | *Inner Zone* | *Life Zone* | *Outer Zone* |
|---|---|---|---|
| Rock | Hot-VHot | Temperate | Cold-VCold |
| Ice Ball | — | — | Cold-VCold |
| Desert | Hot-VHot | Cold-Hot | Cold-VCold |
| Hot House | VHot | Hot-VHot | — |
| Failed Core | — | — | Cold-VCold |
| Gas Giant | — | — | — |
| Pre-Garden | — | Temperate | — |
| Glacier | — | Cold | — |
| Garden | — | Temperate | — |
| Post-Garden | — | Hot | — |
| Chunk | Hot-VHot | Cold-Hot | Cold-VCold |

**Ranges (in °K):** *VHot (Very Hot):* 60° or more. *Hot:* 30° to 60°. *Temperate:* 0° to 30°. *Cold:* −30° to 0°. *VCold (Very Cold):* −30° or less.

## SATELLITES

Use the following procedure for the generation of satellites of planets.

1. **Satellite Presence:** For each planet (except gas giants), the number of satellites is 1D6−3. For each gas giant, the number of satellites is 2D6. A result of 0 or less indicates no satellites.

2. **Satellite Core:** Throw on the world core table to determine if the satellite core is icy or rocky.

3. **Satellite Size:** Throw 1D10−4 for satellite size. If the satellite diameter is greater than the parent world diameter, halve it (more than once, if necessary) until the satellite diameter is less than the world diameter. If satellite diameter is 0, it is a chunk (even if icy core) with diameter of 1D10 times 100 kilometers. If diameter is less than 0 (and satellite orbit is close), then it is a ring.

## GARDEN WORLDS

| *1D10* | *World Type* |
|---|---|
| 0 | Pre-Garden |
| 1 | Glacier |
| 2 | Glacier |
| 3 | Glacier |
| 4 | Garden |
| 5 | Garden |
| 6 | Garden |
| 7 | Garden |
| 8 | Post-Garden |
| 9 | Post-Garden |
| 10 | Post-Garden |

**DMs:** Star type F, −1; G, 0; K, +1; M, +3.

## OXYGEN PRESSURE

Multiply % oxygen by atmospheric pressure for oxygen pressure in atms.

**Human Acceptable Oxygen Levels:** 0.40 atm maximum; 0.05 atm minimum. Beyond these limits, humans require supplements or protective devices.

## ATMOSPHERIC OXYGEN

| *% Water* | *% Oxygen* |
|---|---|
| 0 | 5 |
| 10 | 10 |
| 20 | 12 |
| 30 | 14 |
| 40 | 16 |
| 50 | 18 |
| 60 | 19 |
| 70 | 20 |
| 80 | 22 |
| 90 | 24 |
| 100 | 26 |

Life in oceans produces oxygen. Use this table to determine the oxygen level present in the atmosphere of garden and glacier worlds (other world types do not have free oxygen in their atmospheres).

**Ice Coverage:** Treat the surface coverage of ice as 1/3 its actual percentage when using this table. Round down to match a value on the table.

## GRAVITY TO ESCAPE VELOCITY CONVERSION

Multiply gravity in G's by 11.2 to determine escape velocity in kilometers per second.

## SATELLITE ORBITS

| *1D10* | *Orbit Type* | *Close* | *Far* | *Extreme* |
|---|---|---|---|---|
| 0 | Close | 1 | 15 | 70 |
| 1 | Close | 2 | 20 | 80 |
| 2 | Close | 3 | 25 | 90 |
| 3 | Far | 4 | 30 | 100 |
| 4 | Far | 5 | 35 | 110 |
| 5 | Far | 6 | 40 | 120 |
| 6 | Extreme | 7 | 45 | 130 |
| 7 | Extreme | 8 | 50 | 140 |
| 8 | Extreme | 9 | 55 | 150 |
| 9 | Extreme | 10 | 60 | 160 |

Rings are always in close orbit.

4. **Satellite Orbits:** Place satellites into orbits using the satellite orbits table. Throw 1D10 for the orbit type, and then throw on the correct orbit type column. Orbit radii are given in planetary diameters of the parent planet (thus, an orbital result of 30 for the satellite of a world of 12,000 kilometers diameter produces an orbital radius of 360,000 kilometers). More than one satellite may occupy the same orbital radius.

5. **Satellite Density:** Throw on the density table.

*Additional Satellite Information.* Using the above information, it is possible to determine more details about satellites using the world generation procedures. These details include: mass, surface gravity, escape velocity, atmosphere type, world type, water presence, average temperature, and oxygen levels.

## STAR SYSTEM CHECK LIST

1. Select Star from *Near Star Map.*
 A. Determine data from *Near Star List.*
  1) Spectral Type and Size.
  2) Magnitude.
  3) XYZ Coordinates.
 B. Determine data from charts.
  1) Radius (Stellar Radius Chart).
  2) Mass (Stellar Mass Chart).
  3) Luminosity (Stellar Luminosity Chart).
   a. Alternative: Convert Magnitude to Luminosity.
  4) Effective Temperature (Stellar Effective Temperature Chart).
2. Orbital Information.
 A. Locate Companion Star Orbits (Stellar Companion Radii Table).
 B. Orbit Restrictions.
  1) Companion Restrictions (Companion Restrictions Note).
  2) Untenable Orbits (Untenable Orbit Table).
  3) Orbital Zones (Orbital Zone Table).
 C. Existing Orbits.
  1) Allowed Orbits (Allowed Orbits Table).
  2) Innermost Orbit (Initial Orbit Table).
  3) Subsequent Orbits (Subsequent Orbits Table).
3. World Data.
 A. Basic Data.
  1) World Core Type (World Core Table).
  2) World Size (World Size Table).
  3) World Density (World Density Table).
 B. Computed Data.
  1) Mass (World Mass Table).
  2) Surface Gravity (World Gravity Table).
  3) Escape Velocity (Gravity to Escape Velocity Conversion Table).
 C. Atmosphere Data.
  1) Minimum Retained Molecular Weight (Retained Molecular Weight Table).
  2) Atmospheric Pressure (Atmospheric Pressure Table and Atmospheric Pressure—Condensed—Table).
 D. World Type Data.
  1) World Type (World Type Table and Garden World Table).
  2) Water Presence (Water Table).
  3) Average Temperature (Average Temperature Table).
  4) Atmospheric Oxygen Levels (Atmospheric Oxygen Table).
 E. Social Data.
  1) Colony Age (Colony Age Table).
  2) Colony Population (Colony Population Table).
  3) Settlement Character (Settlement Character Table).
  4) Colony Facilities.
   a. Points Available.
   b. Interface Systems.
   c. Orbital Facilities.
   d. Surface Facilities.

## COLONY POPULATION

| *Age (Years)* | *Colonization Effort (in thousands)* Heavy | Light | Median |
|---|---|---|---|
| 0 | 100 | 10 | 50 |
| 10 | 400 | 44 | 194 |
| 20 | 900 | 96 | 407 |
| 30 | 1,700 | 172 | 723 |
| 40 | 2,500 | 285 | 1,119 |
| 50 | 3,700 | 452 | 1,882 |
| 60 | 5,500 | 700 | 2,905 |
| 70 | 8,000 | 1,066 | 4,421 |
| 80 | 12,000 | 1,600 | 6,664 |
| 90 | 18,000 | 2,411 | 9,985 |
| 100 | 26,000 | 3,500 | 14,900 |

**Heavy Colonization:** Assumes 100,000 colonists, 25,000 immigration for 30 years, and 4% growth rate.

**Light Colonization:** Assumes 10,000 initial, 2,500 immigration constant to date, and 4% growth rate.

**Median Colonization:** Assumes 50,000 colonists, 10,000 immigration constant to date, and 4% growth rate for first 50 years, 2% thereafter.

## COLONY AGE

| *1D6* | *Age Determiner* |
|---|---|
| 1 | 10+3D10 |
| 2 | 20+4D10 |
| 3 | 30+4D10 |
| 4 | 40+4D10 |
| 5 | 50+4D10 |
| 6 | 60+4D10 |

## SETTLEMENT CHARACTER

| *Type* | *Typical Age* | *Points* |
|---|---|---|
| Initial | 1- 20 | 10 |
| Frontier | 20- 40 | 15 |
| Developing | 40- 60 | 20 |
| Expanding | 60-100 | 30 |
| Mature | 80-140 | 40 |
| Declining | 60+ | 30 |

Points available for improvements to a colony are derived from this table, plus 1 point per 1,000,000 population.

## POSSIBLE LOCAL BASES

Military
Scientific
Foundation
Naval
Outpost

Representatives of all five types will be present; a base of each of these types is present on 8+ (1D10).

## INTERFACE SYSTEMS

| *Description* | *Point Cost* |
|---|---|
| Orbital Catapult | 5 |
| Scram Aircraft | 3 |
| Rocket Planes | 2 |
| Rockets | 1 |

## ORBITAL FACILITIES

| *Description* | *Point Cost* |
|---|---|
| Solar Power Satellite | 10 |
| Orbital Factory | 3 |
| Defense Installation | 1 |
| Terminal (one required) | 2 |

## SURFACE FACILITIES

| *Description* | *Point Cost* |
|---|---|
| Fusion Power Plant | 4 |
| Power Transmission Net (per hex) | 1 |
| Heavy Industry | 5 |
| Rail Net (per hex) | 1 |
| Air Film Net (per hex) | 2 |
| Maglev Net (per hex) | 3 |
| Hydrogen Road Net (per hex) | 1 |
| University | 4 |
| Mining (per hex) | 1 |
| Farming (per hex) | 1 |

## DETAILS

There can be more than one colony on a world (but only one per nationality). Each colony develops separately, but colonies may elect to share some facilities.

Typical colonies develop territory in contiguous hexes; all developed hexes must be connected by a transport net of some type.

## INHOSPITABLE WORLD INSTALLATIONS

| *World* | *Very Hot* | *Hot* | *Temperate* | *Cold* | *Very Cold* |
|---|---|---|---|---|---|
| Rock | Mine 2 | Mine 1 | Mine 3 | Mine 2 | Mine 1 |
| Ice Ball | — | — | — | Mine | Mine 0 |
| Desert | Mine 1 | Mine 1 | Mine 2 | Mine 1 | Mine 0 |
| Hot House | Research 0 | Research 1 | — | — | — |
| Failed Core | — | — | — | Research 1 | Research 0 |
| Gas Giant | — | — | — | — | — |
| Pre-Garden | — | — | Mine 2 | — | — |
| Garden | — | — | Research | — | — |
| Glacier | — | — | Mine 2 | — | — |
| Post-Garden | — | Research 1 | — | — | — |
| Chunk | Mine 1 | Mine 1 | Mine 1 | Mine 1 | Mine 1 |

Installations are either mines (commercial or for profit) or research bases (academic or not-for-profit).

Throw the number after the type or less to determine if the installation is present on the world.