GURPS Fourth Edition

# SPACESHIPS

by David L. Pulver

Steve Jackson Games

GURPS® Fourth Edition

# SPACESHIPS™


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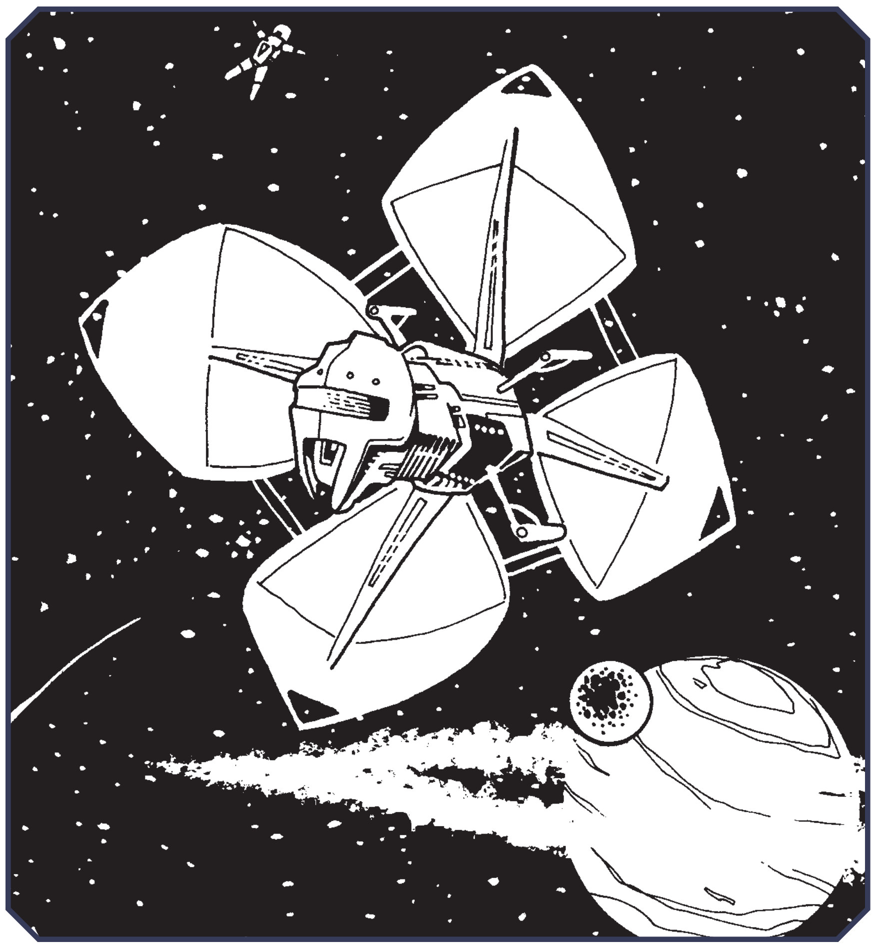


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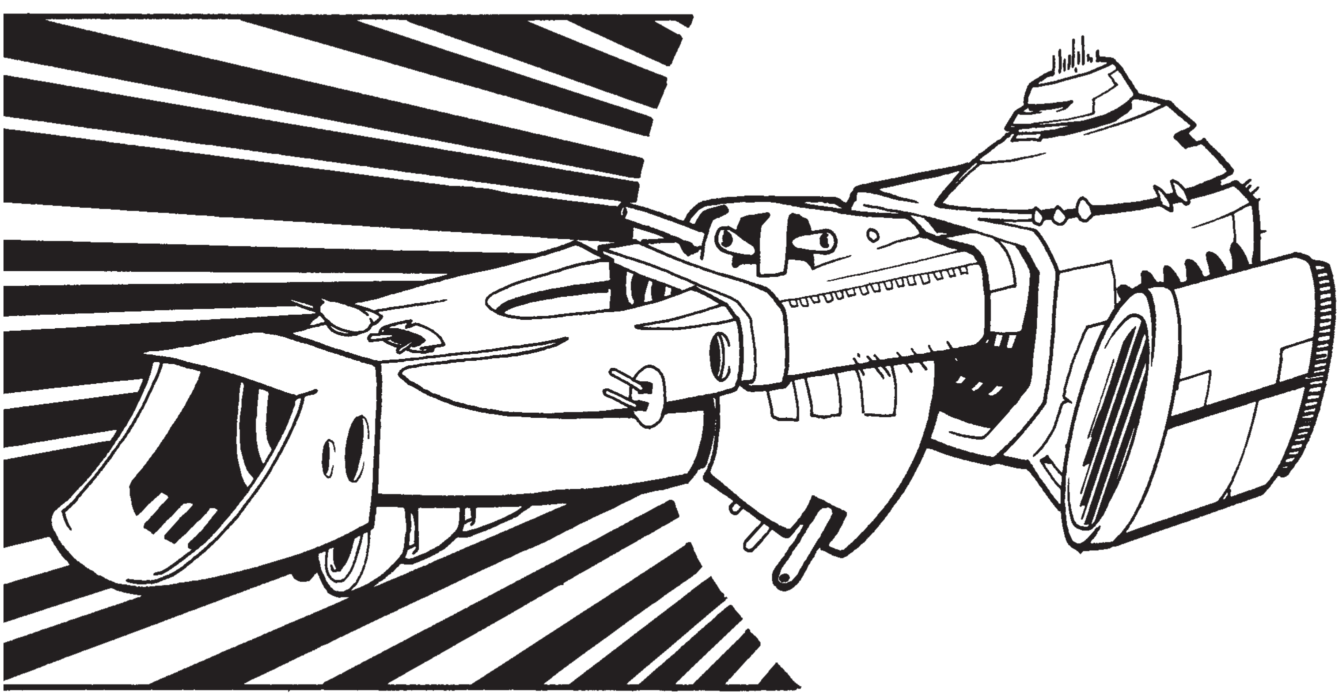


# Introduction

This book describes how spacecraft are designed and explains what the systems built into them do. Several examples of spacecraft from different tech levels are also provided, along with rules for space flight and a basic space combat system.

Why a new system for describing spacecraft? ***GURPS*** has had several spaceship creation systems, but they were intended for gamers who wanted to spend hours building a single ship. If you enjoy that level of detail, ***GURPS Vehicle Design System*** and ***GURPS Traveller: Interstellar Wars*** are recommended. This system is more abstract, but it's also faster. The design rules are tightly integrated into the mechanics for space combat, simplifying procedures for character actions, power allocation, and hit location.

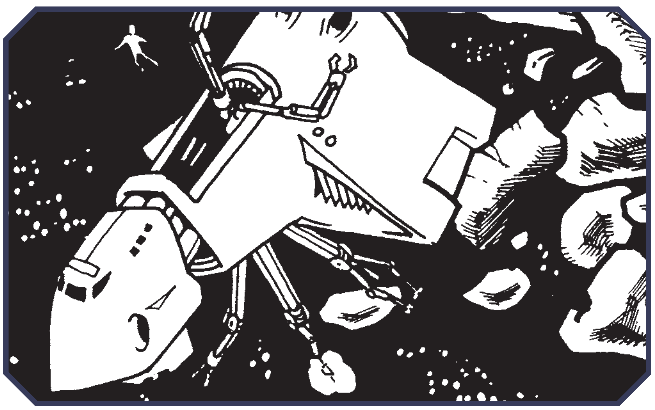
## About The Series

***GURPS Spaceships*** is the core book in the ***GURPS Spaceships*** series, a series of 32-page volumes that will supplement ***GURPS Space*** campaigns by providing ready-to-use spacecraft descriptions and rules for space travel, combat, and operations. The series will include ***Traders, Liners, and Transports***; ***Warships and Space Pirates; Fighters, Carriers, and Mecha; Exploration and Colony Spacecraft; Mining and Industrial Spacecraft; Strange and Alien Spacecraft***; and ***Sentient Spacecraft.***

Each volume provides spacecraft descriptions and supplementary rules. For example, trade and passengers are covered in ***Traders, Liners, and Transports,*** and hex-grid combat is covered in ***Warships and Space Pirates.***

## Publication History

***GURPS Spaceships*** includes revised and expanded versions of the space travel rules that first appeared in ***GURPS Space*** (by William Barton and Steve Jackson) and the ship combat rules that David Pulver added to ***GURPS Space 3rd Edition***.



## About the Author

David L. Pulver is a freelance writer and game designer based in Victoria, British Columbia. He is the co-author of the ***GURPS Basic Set 4th Edition*** and author of ***Transhuman Space*** and numerous other roleplaying games and supplements.

## About *GURPS*

Steve Jackson Games is committed to full support of ***GURPS*** players. Our address is SJ Games, P.O. Box 18957, Austin, TX 78760. Please include a self-addressed, stamped envelope (SASE) any time you write us! We can also be reached by e-mail: **info@sjgames.com**. Resources include:

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*Bibliographies*. Many of our books have extensive bibliographies, and we're putting them online – with links to let you buy the books that interest you! Go to the book's web page and look for the "Bibliography" link.

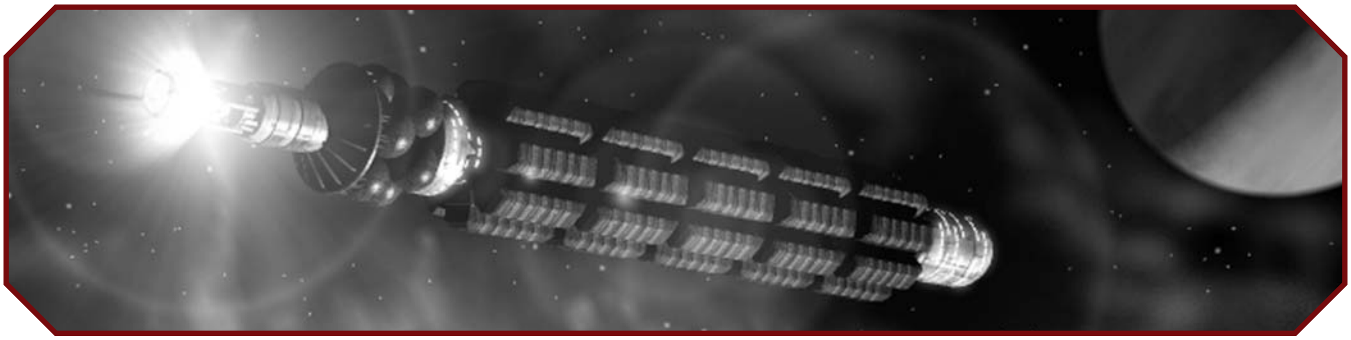
Rules and statistics in this book are specifically for the ***GURPS Basic Set,*** *Fourth Edition*. Page references that begin with B refer to that book, not this one.

# Chapter One

# Spacecraft

*In the vast cavern of Vehicle Assembly Bay Two, the great ship was taking form. Her great alloy skeleton was surrounded by a swarm of hundreds of technicians and robots that floated about her, hard at work. Today they were installing the main engines: the fusion torch for normal space travel, and the Ashtekar-Thorn hyperdrive so she could leap between the stars. The habitats and workshops for the 306 crewmembers would follow, cocooned in a shell of hyperdense armor – all wrapped around the spinal particle cannon that gave the ship her dreadful purpose.*

*– Maya Bright,* ***Inner Systems Gazette****, 2434 A.D.*



## Spacecraft Statistics

Spacecraft detailed in the ***GURPS Spaceships*** line use a common format for statistics. The description begins with the ship's name and TL. This is followed by a description of the spacecraft's intended mission, how it may be used, the spacecraft's hull type, systems, design features, crew, and statistics.

Throughout these rules, the terms "spacecraft" and "vessel" are used interchangeably.

### *Hull and Systems*

Spacecraft hulls are rated in terms of their mass in short tons (2,000 lbs. per ton), their Size Modifier, and their longest dimension. A hull is further defined as either *streamlined* (an aerodynamic shape) or *unstreamlined*.

Spacecraft hulls are divided into three sections: the *front hull*, the *central hull*, and the *rear hull*. Each represents one-third of the spacecraft's total mass (not volume). This need not be taken too literally: the actual shape may be more complex, e.g., "the front hull section" could include forward-facing parts of the vessel that are actually part of multiple different sub-hulls, pods, or wings.

The front, center, and rear hulls each contain six hull systems numbered [1] to [6]. In addition, two of the three hull sections contain deep-buried systems designated [core]. Each system is a major component. The numbers are used for hit location rolls (see p. 61), while the core systems are similar to the vitals location of a human. Each spacecraft has 20 *systems*, each 5% of the total mass.

### Scaling Statistics

To improve playability, some statistics in spacecraft description have been scaled differently from those in the ***GURPS Basic Set***.

*sACC:* The space Accuracy statistic combines the weapon's Acc bonus, the range penalty for firing at typical ranges, and a bonus for aimed fire over several turns with the aid of active targeting systems and targeting programs.

*Acceleration:* This is always measured in gravities, abbreviated G. To convert to a Move in yards per second per second, multiply it by 10.

*Delta-V:* This "top speed" is measured in miles per second, abbreviated mps. To convert to a Top Speed in yards per second, multiply by 1,800.

d-Damage: This is decade-scale damage, i.e., 1 point is 10 points of damage. For an explanation of decade-scale see Scaling Damage (p. B470).

*dDR:* Space-scale DR is decade-scale damage resistance.

*dST/HP:* Spaceship ST/HP values are also decade-scale.

System types are given in italics, e.g. *fusion rocket* [1], or a spread of numbers for identical systems, e.g., "*three cargo holds* [4-6]." Core systems are designated [core], e.g., "*tactical bridge* [core]."

Systems whose number or core designation are marked with an exclamation point are high-energy systems (p. 9) that must be allocated power (one Power Point per system) to operate, e.g., *stardrive* [1!]. If a spread is designated, e.g., *stardrive engine* [1-3!], each separate system requires a Power Point.

Individual system entries are followed by a statement of its capabilities, such as a rocket's acceleration, a cargo hold's capacity, or a habitat's number and type of cabins, e.g., "fusion rocket [1] with 1G acceleration." Refer to System Descriptions (p. 9) for detailed explanations of what each system does.

Most spacecraft also include a computer network rated for its Complexity (see p. B472). This is distributed throughout the vessel – see Computer Networks (p. 44).

### Crew

Crews are suggestions only. They are listed below the spacecraft description. On large vessels, systems with workspaces containing technicians are noted with an asterisk.

### Statistics Table

A spacecraft's key performance statistics are summarized in standard ***GURPS*** vehicle format (p. B463) modified as detailed below:

*dST/HP:* The Strength/Hit Point statistic in decade scale.

*Hnd/SR:* The spacecraft's Handling and Stability Rating.

*HT:* The spacecraft's Health.

*Move:* These two numbers are acceleration in G (Earth gravities) followed by delta-V in miles per second (mps). A + sign is added if the vessel is an upper stage of a multi-stage vehicle. Delta-V (see p. B467) is the maximum change in velocity a spacecraft can perform without running out of reaction mass; each acceleration or deceleration "costs" a fraction of the delta-V reserve. Space sails and reactionless drive vessels replace delta-V with the notation "c" (an abbreviation for the speed of light) to indicate they can reach near-light velocity. Light or magnetic sails just list their acceleration in G.

*LWt.:* The typical loaded weight in tons under Earth gravity, i.e., loaded mass.

*Load:* This is the maximum load in tons the spacecraft carries, and is the sum of the rated capacities of all payload systems (cargo holds, hangar bay, etc.).

SM: This is the spacecraft's Size Modifier.

*Occ:* The occupancy rating gives the number of people the spacecraft supports, derived from its chosen systems. For vessels with short-term accommodations (e.g., seats) occupancy is split into crew + passengers followed by the suffix "SV" to show they have limited life support (Sealed and Vacuum Support) for 24 hours. Vessels with long-term accommodations (e.g., cabins) just list the number of people they can provide ongoing full life support for, followed by the suffix "ASV."

*dDR:* The decade-scale Damage Resistance of the front hull/central hull/rear hull armor. If identical, only one is listed.

Range: Used only for spacecraft with FTL drives: this is its FTL rating.

*Cost:* The dollar cost of a new spacecraft in millions ($M), billions ($B), or trillions ($T).

Footnotes cover exceptions (e.g., force screens that add to armor).

# Examples

The system presented in this book can describe many different types of spacecraft. A few examples are shown below; more appear in future books in this series.

## *Star Flower*-class Tramp Freighter (TL11^)

*"My first billet was chief engineer on the **Rose of Rigel**. The captain was a smuggler and a slaver – for some reason this class of ship tends to attract an unsavory element."*

*– Captain Zeke Morrigan*

This is a fast tramp freighter designed for operations in frontier regions with primitive port facilities. Its reactionless drive gives it enough thrust to blast off from a planetary surface, or elude custom patrols or pirates. It has an SM+8 streamlined hull. It masses 1,000 tons and is 75 yards long.

### Systems Table

| ***Front Hull*** | ***System*** |
|---|---|
| [1] | Metallic laminate armor (dDR 7). |
| [2] | Cargo hold (50 tons capacity). |
| [3] | Cargo hold (50 tons capacity). |
| [4] | Cargo hold (50 tons capacity). |
| [5] | Cargo hold (50 tons capacity). |
| [6] | Enhanced array (comm/sensory Level 10) |
| [core] | Control room (four control stations; Complexity 9 computer network). |

| ***Central Hull*** | ***System*** |
|---|---|
| [1] | Metallic laminate armor (dDR 7). |
| [2] | Habitat (six cabins; intended for passengers). |
| [3] | Habitat (four cabins, two-bed sickbay; intended for crew). |
| [4] | Cargo hold (50 tons capacity). |
| [5] | Cargo hold (50 tons capacity). |
| [6!] | Tertiary battery (1 turret, 10 MJ laser; 43.5 tons of cargo). |

| ***Rear Hull*** | ***System*** |
|---|---|
| [1] | Metallic laminate armor (dDR 7). |
| [2!] | Standard reactionless drive engine (1G acceleration). |
| [3!] | Standard reactionless drive engine (1G acceleration). |
| [4!] | Stardrive engine (FTL-1). |
| [5!] | Stardrive engine (FTL-1). |
| [6] | Engine room (1 workspace). |
| [core] | Fusion reactor (provides two Power Points). |

The spacecraft has artificial gravity. Usual crew are four control crew (captain/navigator, pilot, chief engineer, and comm/sensor operator), an engine room technician, a steward (to look after passengers), and a medic. The sensor operator usually serves as a gunner when necessary.

## *Spacecraft Table*

| TL | Spacecraft | dST/HP | Hnd/SR | HT | Move | LWt. | Load | SM | Occ | dDR | Range | Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *PILOTING/TL11 (AEROSPACE, HIGH-PERFORMANCE SPACECRAFT)* | | | | | | | | | | | | |
| 11^ | Star Flower-class Freighter | 70 | -1/5 | 13 | 2G/c | 1,000 | 301 | +8 | 20ASV | 7 | 2× | $44.5M |

Top air speed is 3,500 mph.

# MIDNIGHT SUN-CLASS ORBITAL SHUTTLE (TL9)

*"First time I went into space was aboard one of these relics, before they got the beanstalk up. 3G acceleration is not fun when you're five years old."*

*– Maya Bright*

This is a two-stage spacecraft designed to lift a shuttle and crew from an Earth-gravity world into high orbit. It consists of a 300-ton booster stage including one 100-ton upper stage (see Upper Stage, p. 26).

### *Midnight Sun and Booster Stage*

This the complete "stack" of both vehicles, treated as an SM+7 300-ton hull. It counts as streamlined because the top stage is streamlined. The first stage falls away after accelerating the rocket to a delta-V of 2.6 mps.

## *Systems Table*

| Front Hull | System |
|---|---|
| [1-6] | A 100-ton upper stage (see below). |
| ***Central Hull*** | ***System*** |
| [1-6, core] | Fuel tanks (105 tons of rocket fuel)*. |
| ***Rear Hull*** | ***System*** |
| [1] | Chemical rocket engine (3G acceleration). |
| [2-6, core] | Fuel tanks (90 tons of rocket fuel)*. |

* The combined rocket fuel provides a total of 2.6 mps delta-V.

### *Second Stage – Midnight Sun Orbiter*

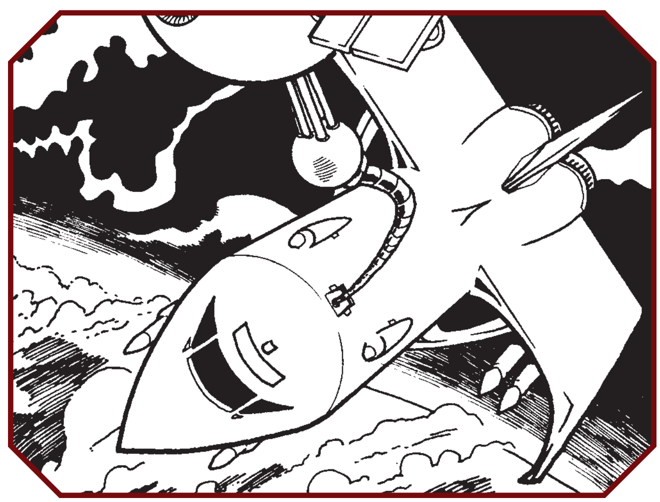
The first stage burns out and falls away after accelerating the rocket to a delta-V of 2.6 mps; the winged second stage's engine then takes over, adding 3.4 mps for a total of 6 mps, enough to reach low orbit (losing some of its fuel tanks as it does so, since 10 expendable tanks were installed). The upper stage is a space vehicle built on an SM+6 100-ton streamlined hull.

## *Systems Table*

| Front Hull | System |
|---|---|
| [1] | Light alloy armor (dDR 2). |
| [2] | Control room (two control stations; Complexity 5 computer network; base array, comm/sensor Level 4). |
| [3-4] | Passenger seats (12 seats). |
| [5-6] | Cargo hold (10 tons capacity). |
| ***Central Hull*** | ***System*** |
| [1] | Light alloy armor (dDR 2). |
| [2-6, core] | Expendable fuel tanks (30 tons of rocket fuel).* |
| ***Rear Hull*** | ***System*** |
| [1] | Chemical rocket engine (3G acceleration). |
| [2-6, core] | Expendable fuel tanks (30 tons of rocket fuel).* |

* The combined rocket fuel provides a total of 3.4 mps delta-V.

The upper stage has the winged design feature. Crew consists of a pilot and co-pilot.



## *Spacecraft Table*

| TL | Spacecraft | dST/HP | Hnd/SR | HT | Move | LWt. | Load | SM | Occ | dDR | Range | Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *PILOTING/TL9 (AEROSPACE, HIGH-PERFORMANCE SPACECRAFT)* | | | | | | | | | | | | |
| 9 | Midnight Sun booster-orbiter | 50 | -1/5 | 12 | 3G/2.6 mps | 300 | 11.6 | +7 | 10SV | – | 2/2/0 | $3.66M |
| 9 | Midnight Sun orbiter only | 30 | 0/4 | 12 | 3G/+3.4 mps | 100 | 11.4 | +6 | 2+12SV | – | 2/2/0 | $1.61M |

Air speed is 4,300 mph; orbiter's air Handling/SR is +4/5.

# Chapter Two
# Spacecraft Systems

This chapter provides rules to design and modify spacecraft, and a catalog of systems to build them with.

## Design

These rules can be used to assign statistics to spacecraft that range from 30 tons to 3,000,000 tons mass and which are built at TL7 to TL12.

To create a spacecraft, first choose the TL, and consider the spacecraft's mission. Who's building it and why? Is it a station, an interplanetary ship, or a starship? A merchantman or a warship?

Decide how large the ship is by choosing a hull size modifier from SM+5 to SM+15, and whether the hull is streamlined or unstreamlined; see *Spacecraft Hulls* (p. 9).

A spacecraft hull has three hull sections – *front*, *central*, and *rear* – into which are placed 20 *systems*. Each system is a set of components representing 5% of the ship's total loaded mass. Choose any combination of systems from those listed under *System Descriptions* (p. 9). A spacecraft can have multiple examples of the same system. The choices should fit the setting, which can determine which space drives are available and which superscience technologies exist.

The front, central, and rear hull sections must each contain six systems; number these systems [1] to [6]. Two additional systems, buried deep inside the spacecraft's hull, are designated [core] and may be placed in any two different hull sections. Record system statistics, such as the tons of cargo in a hold or engine acceleration, as they are selected.

Spacecraft can have various optional *design features* (p. 29) and *design switches* (p. 31). These don't count toward the 20 systems.

Refer to *Finalizing the Spacecraft* (p. 34) to determine how these choices affect the spacecraft's statistics.

*Example*: We decide to create a TL10 armed merchant ship. We give it an SM+8 unstreamlined hull (so the ship masses 1,000 tons). We then select the six systems for each hull section and two core systems, placing one core system in the front and one in the rear, and making these choices:

The front hull will have *steel armor* [1] to protect the vessel. The crew and passengers live in two *habitats* [2-3] with six cabins each. There are three *cargo holds* [4-6] each with 50 tons capacity. The vessel is controlled from a *control room* [core] with four control stations and a Complexity 8 computer network.

The central hull will be devoted to six *cargo holds* [1-6] with 50 tons capacity each. (We decided not to bother with armor, to give an open "container ship" feel.)

The rear hull will have *steel armor* [1], another *cargo hold* [2] with 50 tons capacity, an *engine room* [3], a *hangar bay* [4] with 30 tons capacity, a *hot reactionless drive* [5!] with 2G acceleration, a *stardrive engine* [6!] with hyperdrive, and a *fusion reactor* [core] with two Power Points. Systems with an ! require power. We refer to the individual computer network and system descriptions to find out the total cost of the spacecraft. We then examine the design features and design switches section, and decide that the spacecraft has the artificial gravity (p. 29) feature.

Last of all we finalize the design, add up costs, and record the spacecraft's statistics.

# Spacecraft Hulls

A hull is rated for its Size Modifier (SM), which determines the spacecraft's mass, dST/HP, dimensions, and the base Handling and Stability Rating.

A spacecraft hull must be streamlined or unstreamlined.

*Unstreamlined*: This is a spherical, cylindrical, cubical, or humanoid hull, or a complex collection of spheres, saucers, cylinders, booms, and pods. It is designed for space operations; it might be able to fly with enough thrust, but has poor aerodynamics.

*Streamlined:* A streamlined hull's shape may be a wedge, lifting body, cone, disk, teardrop, bullet, or needle-like shape. It is optimized for high atmospheric speed. A streamlined spacecraft must have at least one Armor system for its front hull or central hull (if a multi-stage design, only the uppermost section need be armored). All of its armor will have lower DR than an unstreamlined hull, due to the greater surface area.

The hull's SM determines its other characteristics:

## Hull Size Table

| SM | Loaded Mass | Length | dST/HP | Hnd/SR |
|---|---|---|---|---|
| SM+5 | 30 tons | 15 yards (45 ft) | 20 | 0/4 |
| SM+6 | 100 tons | 20 yards (60 ft) | 30 | 0/4 |
| SM+7 | 300 tons | 30 yards (90 ft) | 50 | -1/5 |
| SM+8 | 1,000 tons | 50 yards (150 ft) | 70 | -1/5 |
| SM+9 | 3,000 tons | 70 yards (200 ft) | 100 | -1/5 |
| SM+10 | 10,000 tons | 100 yards (300 ft) | 150 | -2/5 |
| SM+11 | 30,000 tons | 150 yards (450 ft) | 200 | -2/5 |
| SM+12 | 100,000 tons | 200 yards (600 ft) | 300 | -2/5 |
| SM+13 | 300,000 tons | 300 yards (900 ft) | 500 | -3/5 |
| SM+14 | 1,000,000 tons | 500 yards (1,500 ft) | 700 | -3/5 |
| SM+15 | 3,000,000 tons | 700 yards (2,000 ft) | 1,000 | -3/5 |

*Loaded Mass:* The approximate loaded mass of the spacecraft in tons. To keep this system simple, mass values follow a 1-3-10 progression that conforms with SM.

*Length:* An average for a typical unstreamlined cylindrical spacecraft, or for many complex shapes like saucer-boom-and-pod designs. Length is only an approximation; feel free to vary it. Streamlined vessels may be up to twice as long. Stubby cylinders, teardrops, saucers, and other more complex shapes average about 50%-75% of this length. A sphere will be less than half this length.

*dST/HP:* This is the spacecraft's *decade-scale* ST and basic HP value.

*Hnd/SR:* The base Handling and Stability Rating of a spacecraft of that size.

A hull has no cost – that depends on the armor or other systems added to it.

### Scaling Up Spacecraft

The spacecraft tables are built around SM+5 to SM+15 spacecraft. However, the GM may permit larger spacecraft. All tables follow a logical progression, and GMs should feel free to extrapolate larger sizes and statistics if desired.

If emulating real or fictional spacecraft whose mass falls between the values listed, just pick whichever hull size is closest to the known mass or dimensions.

# System Descriptions

Numerous systems may be built into spacecraft. The cost, and many other statistics, vary according to the spacecraft's hull SM, as indicated in the tables in this section.

## TL

The suggested TL the system is available at. Most spacecraft are built using systems from a variety of TLs. All superscience systems (TL^) are optional and their TL is only a suggestion. Some items are referred to as "limited superscience." They don't egregiously violate physical laws, but they do push past the edge of realistic engineering capabilities.

These rules offer a wide variety of superscience technologies, some of which can be overwhelming effective if not countered by other superscience! For example, take care to balance weapon damage with DR to avoid ships that are invulnerable or die instantly.

## Location and Other Restrictions

Some systems can only go be placed in certain hull section locations.

[any] means the system can go anywhere.

[hull] means it can go in any of the 18 hull locations, but cannot be a core system.

[rear] means it can only go in the rear hull and may not be a core system.

[front] means it can only go in the front hull and may not be a core system.

## Dollar Cost and Other Statistics

Most systems have a specified cost that increases with Size Modifier, as shown in the system's table. Many systems have other statistics, such as the capacity of a cargo hold or the acceleration of a maneuver drive. Where large numbers are used, the abbreviations K for thousand, M for million, B for billion, and T for trillion are used, e.g., a dollar cost of 30M is $30 million dollars.

## High-Energy Systems and Power Points

Certain systems are "high-energy systems" that require a great deal of power. These are indicated with an exclamation point next to their location, e.g., [!]. Each high-energy system operated simultaneously must be assigned one *Power Point* to power it. Power Points are produced by power systems, such as fission power plants. You can design the vessel with enough Power Points to operate every high-energy system that needs to run simultaneously, or install less power, which forces the crew to carefully decide what systems they want powered up at any given time. (Excess power is useful for redundancy in case of damage.)

Spacecraft *without* high-energy systems do not require Power Points. It's assumed that built-in auxiliary power supplies or energy banks factored into the systems are sufficient.

### Workspaces

Many systems (especially on larger spacecraft) have a specified number of "workspaces." This determines how many technicians are required to man and maintain that system. Thus, if a system specifies three workspaces, it is normally manned by three crew, who are busy inside that system performing various routine duties, such as monitoring panels or performing maintenance. Workspaces include duty stations for the technicians and workshops that fulfill equipment requirements for these techs to maintain and repair that type of system (or all shipboard systems, for engine rooms). The Automation (p. 29) design feature can reduce or eliminate workspace requirements.

### Repair Skill

Systems that can be disabled or destroyed list the skill required to repair them. This is also the skill that crew will need for routine maintenance. Mechanic (Vehicle Type) means the required specialization is the same as the Piloting skill.

## Free Equipment

Along with their 20 systems, all spacecraft get the following equipment.

*Airlocks* for entering the vessel. A spacecraft can be assumed to have (SM-4) airlocks, with each airlock capable of admitting (SM-4) persons per cycle.

*Auxiliary Power* systems that power all systems not requiring Power Points.

*Landing Gear* in the form of retractable runners or landing legs if the spacecraft is either streamlined or capable of 0.1G or greater acceleration, or retractable wheels if the spacecraft is winged.

*Routine equipment* for safety, e.g., lights, fire extinguishers, pressure doors, etc. If SM+7 or larger, numerous ducts, corridors, and passageways. If large enough (usually SM+9) elevators, turbo-lifts, or other internal rapid-transit systems connecting all crewed or inhabited systems and cargo or hangar areas.

## Additional Equipment

GMs with ***Ultra-Tech***, ***High-Tech***, or other ***GURPS*** catalog books may install extra equipment from these books into Cargo or Habitat systems. Large items use up space based on their mass in tons.

### Armor Systems

Armor systems are rated for the decade-scale DR (dDR) that they provide to the hull section they are installed in. Thus, armor on the front hull protects the front of the spacecraft, armor on the central hull protects the central hull (the sides), and armor on the rear hull protects the back. To fully armor a spacecraft, add armor systems to the front, central, and rear hull.

The dDR of armor systems also varies depending on whether the ship is streamlined or not: two values are listed for each armor system, US (unstreamlined) or SL (streamlined). The lower dDR for streamlined vessels represents the same mass of armor spread over a greater surface area.

A streamlined spacecraft must be given at least one armor system on its front or central hull.

Multiple armor systems ("layers") can protect the same hull section; the dDR of all armor systems on a given hull section are cumulative. Where important (e.g., in the case of semi-ablative or hardened armor), armor layers from outer to innermost protect in the order they are numbered. Civilian craft built for deep space operations often omit armor on some sections to conserve mass. If a hull section is entirely unarmored, it is dDR 0.

(When not using decade-scale damage, e.g., in personal combat, the thin non-structural walls of a dDR 0 unarmored hull section can be assumed to have DR 2 if streamlined or DR 3 if unstreamlined.)

## Armor, Ice (TL0) [hull]

This is armor made from frozen water. It may be used to represent spacecraft built from hollowed-out comets or Kuiper Belt objects, although ice is sometimes added atop other armor as cheap shielding for space stations. Ice armor systems provide *semi-ablative* dDR (p. B47) that protects the hull section it is installed in. Ice armor is not available for SM+5 to SM+7 hulls, nor for streamlined hulls. Cost is negligible.

### Ice Armor Table

| SM | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|
| US dDR | 1 | 2 | 2 | 3 | 5 | 7 | 10 | 15 |

*Repair Skill*: Armoury (Vehicle Armor) at -4 for unfamiliarity, unless ice armor is commonly used.

## Armor, Stone (TL0) [hull]

This is rock armor for vessels that are hollowed-out asteroids, or covered with a layer of rock or slag. Stone dDR is *semi-ablative* (p. B47). It is unavailable for SM+5-6 hulls, or for streamlined hulls. Cost is negligible.

### Stone Armor Table

| SM | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|
| US dDR | 1 | 2 | 2 | 3 | 5 | 7 | 10 | 15 | 20 |

*Repair Skill*: Masonry.

## Armor, Steel (TL7) [hull]

This is armor made of high-quality steel plate. It is common due to its low cost.

### Steel Armor Table

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| US dDR | 1 | 2 | 3 | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 |
| SL dDR | no | 1 | 2 | 3 | 5 | 7 | 10 | 15 | 20 | 30 | 50 |
| Cost ($) | 6K | 20K | 60K | 200K | 600K | 2M | 6M | 20M | 60M | 200M | 600M |

*Repair Skill*: Armoury (Vehicle Armor).

## Armor, Light Alloy (TL7) [hull]

This is armor made of aerospace-grade aluminum or titanium alloys.

### Light Alloy Armor Table

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| US dDR | 2 | 3 | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 |
| SL dDR | 1 | 2 | 3 | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 |
| Cost ($) | 15K | 50K | 150K | 500K | 1.5M | 5M | 15M | 50M | 150M | 500M | 1.5B |

*Repair Skill*: Armoury (Vehicle Armor).

## Armor, Metallic Laminate (TL8) [hull]

This is titanium, aluminum, beryllium, or ultra-hard steel alloy further reinforced by the addition of carbon fibers, ceramic fibers, or intermetallic laminates.

### *Metallic Laminate Armor Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| US dDR | 3 | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 | 150 |
| SL dDR | 2 | 3 | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 |
| Cost ($) | 30K | 100K | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B |

*Repair Skill*: Armoury (Vehicle Armor).

## Armor, Advanced Metallic Laminate (TL9) [hull]

This is armor similar to metallic laminate, but the alloy is reinforced through the addition of super-strong carbon nanotubes, boron nanotubes, or diamond whiskers.

### *Advanced Metallic Laminate Armor Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| US dDR | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 | 150 | 200 |
| SL dDR | 3 | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 | 150 |
| Cost ($) | 60K | 200K | 600K | 2M | 6M | 20M | 60M | 200M | 600M | 2B | 6B |

*Repair Skill*: Armoury (Vehicle Armor).

## Armor, Nanocomposite (TL10) [hull]

This armor uses ultra-strength carbon or boron nanotube-reinforced polymers. It can also represent biotech hulls far stronger than the organic hull covered below.

### *Nanocomposite Armor Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| US dDR | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 | 150 | 200 | 300 |
| SL dDR | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 | 150 | 200 |
| Cost ($) | 150K | 500K | 1.5M | 5M | 15M | 50M | 150M | 500M | 1.5B | 5B | 15B |

*Repair Skill*: Armoury (Vehicle Armor).

## Armor, Organic (TL10) [hull]

This is low-cost armor made of advanced biotech materials (space-adapted wood or living tissue, living bioplastic, etc.) Use this for spacecraft with living or high-biotech wood hulls. DR is halved (round down) against burning or corrosion damage. TL11 if engineered or manufactured rather than found (e.g., the body or wood of a space life form).

### *Organic Armor Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| US dDR | 2 | 3 | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 |
| SL dDR | 1 | 2 | 3 | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 |
| Cost ($) | 10K | 30K | 100K | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B |

*Repair Skill*: Carpentry, Biotechnology (Tissue Engineering), or even Veterinary.

## Armor, Diamondoid (TL11) [hull]

This armor system uses super-hard nano-fabricated materials such as diamondoid, ultra-hard fullerites, or cubic boron nitride. Can also represent exotic superscience "crystal" armors

### *Diamondoid Armor Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| US dDR | 10 | 15 | 20 | 30 | 50 | 70 | 100 | 150 | 200 | 300 | 500 |
| SL dDR | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 | 150 | 200 | 300 |
| Cost ($) | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B | 30B |

*Repair Skill*: Armoury (Vehicle Armor).

## Armor, Exotic Laminate (TL12) [hull]

Tougher armor than diamondoid, usually a complex laminate of ultra-hard materials and high-density exotic matter.

### *Exotic Laminate Armor Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| US dDR | 15 | 20 | 30 | 50 | 70 | 100 | 150 | 200 | 300 | 500 | 700 |
| SL dDR | 10 | 15 | 20 | 30 | 50 | 70 | 100 | 150 | 200 | 300 | 500 |
| Cost ($) | 600K | 2M | 6M | 20M | 60M | 200M | 600M | 2B | 6B | 20B | 60B |

*Repair Skill*: Armoury (Vehicle Armor).

## Cargo Hold [any]

This is ordinary cargo space. Each system is rated for tons of cargo capacity. The design table shows the capacity of cargo space. Cost is negligible.

### *Cargo Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tons | 1.5 | 5 | 15 | 50 | 150 | 500 | 1.5k | 5k | 15k | 50k | 150k |

*Repair Skill*: Mechanic (Vehicle Type).

### *Options*

Special options are available by sacrificing some cargo capacity.

*Refrigerated:* Refrigerated cargo space adds an extra $0.5K per ton.

*Shielded:* Concealed and scan-shielded cargo space. Each ton of cargo capacity sacrificed provides 0.5 tons of shielded cargo capacity and costs $4K.

## Cloaking Device (TL^) [any!]

This is a superscience, energy-intensive stealth system that makes the vessel invisible to vision and to active and passive imaging sensors. The vessel can be detected if it fires weapons or uses a reaction drive. A spacecraft using a cloaking device is -10 to be detected by sensors. During space combat, cloaking devices are activated when power is allocated to them.

### *Cloaking Device Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost($) | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B | 30B | 100B |

*Repair Skill:* Electronics Repair (EW).

## Contragravity Lifter (TL^) [any!]

Many contragravity systems are treated as reactionless drives. This system works differently: it selectively nullifies some or all of the pull of gravity on the spacecraft, but does not actually provide any acceleration. A spacecraft with contragravity lifters can land on, or take off from, a world regardless of its gravity. The lifter will cancel up to 10G, enough to take off from all normal or gas giant planets.

### Contragravity Lifter Table

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost($) | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B | 30B |

*Repair Skill:* Mechanic (Contragravity).

## Control Room (TL7) [any]

All spacecraft capable of maneuvering require a control room; multi-stage spacecraft only need this in the uppermost stage. Although the system includes the actual control room and computer systems, most of the mass and cost, especially on large spacecraft, is devoted to systems distributed about the vessel's hull: a basic comm/sensor array for navigation, and the attitude thrusters or gyros used to alter facing.

The control room's basic array is embedded into the hull, providing a communications and sensor suite with a rated comm/sensor array level shown on the table below (see *Comm/Sensor Arrays*, p. 44). Many civilian vessels use only this minimal system; for specialized systems, see *Enhanced, Multipurpose, Science, and Tactical Comm/Sensory Arrays* (p. 15).

The control room is also rated for the Complexity of its *computer network* (as per B472). The network is hardened vs. electromagnetic pulse and radiation.

The control room is further rated for the number of *control stations* installed. Each station is an acceleration couch or seat plus a multi-function console for controlling shipboard operations such as command, piloting, engineering, navigation, gunnery, sensor operation, or communications. The more control stations, the less work for any one individual. All control stations are configurable; there's no need to specify what each one does. Each control station comes with 24 hours of limited life support for the operator, so a short-range fighter, shuttle, etc. doesn't need a habitat.

You may install fewer control stations: it's possible to have an autonomous vessel with no control stations at all if the vessel is run by sapient AIs instead.

### Control Room Table

| Size Modifier | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Complexity | C6 | C7 | C7 | C8 | C8 | C9 | C9 | C10 | C10 | C11 | C11 |
| Comm/sensor | TL-6 | TL-5 | TL-4 | TL-3 | TL-2 | TL-1 | TL | TL+1 | TL+2 | TL+3 | TL+4 |
| Control Stations | 1 | 2 | 3 | 4 | 6 | 10 | 15 | 20 | 30 | 40 | 60 |
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost (dollars) | 60K | 200K | 600K | 2M | 6M | 20M | 60M | 200M | 600M | 2B | 6B |

*Complexity* is the system's computer network complexity. Modify it by -6 at TL7, -4 at TL8, -2 at TL9, +1 at TL11, +2 at TL12.

*Comm/sensor* is the system's basic comm/sensor array level calculated from its TL, e.g., an SM+7 control room at TL10 has comm/sensor 6.

*Control stations* is the typical number of control stations. You may install fewer (or none, for an autonomous bridge); each station removed saves $50K.

*Repair Skill*: Electronics Repair (Computers), Computer Programming, and Electrician.

## Defensive ECM (TL7) [any]

An array of automatic self-defense jamming antenna, decoy systems, etc. that protects the spacecraft from being hit by enemy fire. Each system gives a -2 to ranged attacks against the vessel. No more than three can be installed. It *only* applies if the defensive ECM system is of the same or higher TL as the spacecraft or missile targeting it.

### Defensive ECM Table

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B | 30B |

*Repair Skill*: Electronics Repair (EW).

## ENGINE ROOM (TL7) [ANY]

Small spacecraft (SM+5 to SM+9) whose crew wish to perform repairs and maintenance without exiting the vehicle should have an engine room system. An engine room includes room, tools, and parts sufficient to maintain and repair the craft. It isn't required on an SM+5-9 craft, but lacking one lowers HT and makes repairs harder.

An engine room comes with one control station.

An engine room should be placed in the same or adjacent hull section as the majority of the drives or power plants. SM+10 or larger spacecraft *do not* require an engine room system, since all systems that require maintenance include workspaces integral to them (manned by their listed tech crew requirement).

### *Engine Room Table*

| ***SM*** | ***+5*** | ***+6*** | ***+7*** | ***+8*** | ***+9*** | ***+10 or more*** |
|---|---|---|---|---|---|---|
| Workspaces | 1 | 1 | 1 | 1 | 2 | – |
| Cost ($) | 15K | 30K | 100K | 300K | 1M | – |

*Repair Skill*: Mechanic (Vehicle Type).

## ENHANCED, MULTIPURPOSE, SCIENCE, AND TACTICAL COMM/SENSOR ARRAYS (TL7) [HULL]

Many spacecraft have only a basic comm/sensor array (see *Control Room*), but some have more sophisticated systems. This is a large multi-function sensor and communications array. It uses an embedded phased array or rotating antenna for communicators and sensors. Installation of more than one array is rare, except for specialized space observatories or intelligence spacecraft. There are four types:

*Enhanced Array:* A larger and more capable version of the basic array that comes with a control room system.

*Science Array:* Incorporates highly sensitive instruments for use in astronomical and physics surveys, as well as the same equipment as an enhanced array.

*Tactical Array:* Has the same capabilities as an enhanced array, but adds the ability to actively jam transmissions and overcome defensive ECM.

*Multipurpose Array*: Combines science and tactical array functions.

All arrays integrate active sensors, passive sensors, and a comm suite into a single system. The array is rated for its type and comm/sensor array Level, based on SM and TL, e.g., an SM+8 spacecraft built at TL10's Level is 9. The array level is the same for all types; the only differences are their special abilities.

### *Enhanced, Science, Multipurpose, and Tactical Array Table*

| ***Size Modifier*** | ***+5*** | ***+6*** | ***+7*** | ***+8*** | ***+9*** | ***+10*** | ***+11*** | ***+12*** | ***+13*** | ***+14*** | ***+15*** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Array Level | TL-4 | TL-3 | TL-2 | TL-1 | TL | TL+1 | TL+2 | TL+3 | TL+4 | TL+5 | TL+6 |
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost (dollars) | 60K | 200K | 600K | 2M | 6M | 20M | 60M | 200M | 600M | 2B | 6B |

Cost is 1× for enhanced, 5× for tactical or science, 10× for multipurpose array.

*Repair Skill*: Electronics Repair (Communications *and* Sensors).

The comm/sensor level determines the Telescopic Vision level of the array's passive sensors. For other capabilities, see Comm/Sensor Arrays (p. 44) in Chapter 3. See *Design Switches* for various superscience upgrades.

## EXTERNAL CLAMP (TL7) [HULL]

This is a system of clamps or grapples that allows the vessel to attach itself to another spacecraft or object that the vessel has rendezvoused with. Attachment takes at least 20 seconds; the subject must be cooperative or drifting. A clamped spacecraft can be towed or pushed. To determine performance, calculate the tons of thrust. A vessel's tons of thrust are equal to its acceleration (or FTL rating) times its mass. If it pulls or pushes a vessel or other heavy object (such as an asteroid) divide by their combined mass to get the new acceleration or rating. The two vessels may also combine their acceleration or FTL ratings: add their thrust or FTL rating together before dividing by combined mass.

### *External Clamp Table*

| ***Size Modifier*** | ***+5*** | ***+6*** | ***+7*** | ***+8*** | ***+9*** | ***+10*** | ***+11*** | ***+12*** | ***+13*** | ***+14*** | ***+15*** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dollar Cost ($) | 3K | 10K | 30K | 100K | 300K | 1M | 3M | 10M | 30M | 100M | 300M |

*Repair Skill*: Mechanic (Vehicle Type).

## Factory (TL8) [any!]

This is an industrial system capable of fabricating spare parts or other goods. Use Machinist skill to operate it. The $/hr entry on the table shows the production capacity in dollars per hour worth of goods it can assemble, if provided with appropriate blueprints. Factories are unavailable for small SM+5 craft.

*Fabricator* (TL8): A high-tech machine shop. Requires component parts equal in mass and costing 40% of the good's value.

*Robofac* (TL10): As above, but faster and capable of self-operation with its own Machinist-14 skill.

*Nanofactory* (TL11): A "cornucopia" capable of manufacturing goods from raw materials (carbon, metals, etc.). Requires only an equivalent mass in raw materials.

*Replicator* (TL12^): A nuclear synthesis machine capable of transforming one element into another, and creating goods from transmutation of bulk matter. The table shows the *pounds* of goods each system can replicate per hour from an equivalent mass of bulk matter (which can be stored as cargo or fuel).

### Factory Table

| ***SM*** | ***+6*** | ***+7*** | ***+8*** | ***+9*** | ***+10*** | ***+11*** | ***+12*** | ***+13*** | ***+14*** | ***+15*** |
|---|---|---|---|---|---|---|---|---|---|---|
| $/hr | 5k | 15k | 50k | 150k | 500k | 1.5M | 5M | 15M | 150M | 500M |
| lbs./hr* | 0.5 | 1.5 | 5 | 15 | 50 | 150 | 500 | 1,500 | 5,000 | 15,000 |
| Workspaces | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 5M | 15M | 50M | 150M | 500M | 1.5B | 5B | 15B | 50B | 150B |

Multiply $/hr. by 2 for robofacs or 20 for nanofactories.
* Replicators use this statistic (instead of $/hr).
Multiply cost by 2 for robofacs, 4 for nanofactories, or 20 for replicators.

*Repair Skill*: Mechanic (Machine Tools) for Fabricator, Mechanic (Robotics) for Robofac, Mechanic (Nanomachines) for Nanofactory, Electronics Repair (MT) for Replicator.

## Force Screen (TL11^) [any!]

This system generates a protective force field around the *entire* vessel – it protects all hull sections, not just the one it is installed in. It is rated for the *semi-ablative* (p. B47) dDR that it provides. The table shows the field's dDR and the cost per (high-energy) system. Subtract force screen dDR first, then any armor dDR on the hull section struck.

A force screen regenerates 10% of its lost dDR every second, provided it is powered up. During space combat turns (which represent several seconds to several minutes) the screen is assumed to completely regenerate lost dDR each turn, but it offers reduced protection against repeated attacks *during* the turn.

A spacecraft may only have one force screen up at any one time. Screens may be light or heavy:

*Light Force Screen*: A relatively inexpensive design; use the listed dDR.

*Heavy Force Screen*: A high-power screen; it may function as a light screen, or it can *double* the dDR by using a second Power Point to reinforce the field.

The screen only provides protection while powered up. For more or less powerful screens and other options, see *Force Screen Variants* (p. 32).

### Force Screen Table

| ***Size Modifier*** | ***+5*** | ***+6*** | ***+7*** | ***+8*** | ***+9*** | ***+10*** | ***+11*** | ***+12*** | ***+13*** | ***+14*** | ***+15*** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TL11^ dDR | 20 | 30 | 50 | 75 | 100 | 150 | 250 | 350 | 500 | 750 | 1,000 |
| TL12^ dDR | 30 | 50 | 75 | 100 | 150 | 250 | 350 | 500 | 750 | 1,000 | 1,500 |
| ***Cost ($)*** | | | | | | | | | | | |
| Light screen | 500K | 1.5M | 5M | 15M | 50M | 150M | 500M | 1.5B | 5B | 15B | 50B |
| Heavy screen | 1.5M | 5M | 15M | 50M | 150M | 500M | 1.5B | 5B | 15B | 50B | 150B |
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |

*Repair Skill*: Armoury (Force Shields).

# Fuel Tank (TL7) [any]

This is a full tank of reaction mass for a reaction drive. A spacecraft with one or more reaction drive engines requires at least one fuel tank with appropriate reaction mass to supply those drives. A high technology alternative to fuel tanks for drives that use hydrogen is a Ramscoop (p. 21).

The table shows the tons of fuel stored in each fuel tank system, and the cost of each fuel tank system without fuel. See *Refueling* (p. 46) for the cost to refuel a tank.

The more fuel tanks that can supply a particular reaction drive, the greater the ship's delta-V, as indicated in each reaction drive engine description. This is the spaceship's delta-v reserve – the maximum total velocity change it can make. For example, a spacecraft that is using any number of TL9 nuclear thermal rocket engines for propulsion receives a delta-V of 0.3 mps per fuel tank. If it had four fuel tanks, its delta-v reserve would be 1.2 mps.

A reaction drive spacecraft's performance improves if it has a high ratio of fuelled to dry mass, since it gets lighter as tanks are emptied. If *six or more* fuel tanks supply a particular reaction drive multiply delta-V per tank as shown below:

## Delta-V Increase

| *Tanks* | *Delta-V* | *Tanks* | *Delta-V* |
|---|---|---|---|
| 6-8 | ×1.2 | 16 | ×2 |
| 9-12 | ×1.4 | 17 | ×2.2 |
| 13-14 | ×1.6 | 18 | ×2.5 |
| 15 | ×1.8 | 19 | ×3 |

*Example*: A ship with a chemical rocket engine with delta-V 0.15 mps per tank has 15 fuel tanks, so delta-V per tank is ×1.8: 0.27 mps per tank.

See also *Coolant Tanks* (p. 31) for other options.

## Fuel Tank Table

| *SM* | *+5* | *+6* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fuel tons | 1.5 | 5 | 15 | 50 | 150 | 500 | 1,500 | 5,000 | 15K | 50K | 150K |
| Cost ($) | 10K | 30K | 100K | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 3B |

*Repair Skill*: Mechanic (Vehicle Type).

# Habitat (TL7) [any]

Provides living quarters and extended life support for spacecraft crew during long voyages. A habitat includes a pressurized hull, radiation shielding, and a variety of standard features such as airlocks, hatches, compartmentalization, and elevators. It can contain several different types of facilities.

*Bunkroom*: Cramped accommodations with bunk beds for up to four people. Often used for enlisted crew, troops, or colonists.

*Cabin*: Quarters for one person in comfort or shared by two occupants.

*Cell or Cage*: Spartan accommodations equivalent to bunk, but with fewer amenities. Includes a barred door, electronic lock, and surveillance camera.

*Luxury Cabin*: A suite with very comfortable quarters for one or two occupants.

*Specialized Rooms*: See *Specialized Rooms for Habitats* (p. 18).

*Steerage Cargo*: Unused tonnage in a habitat is usually assigned to cargo; this is a good way to use up excess capacity. Steerage cargo is pressurized and climate-controlled, so it can be used for livestock or delicate goods.

Cabins, cells, and bunkrooms are *accommodations* that provide sleeping quarters and full life support to permit occupancy for an indefinite period. They have sanitary, galley, and dining facilities appropriate to their size and quality. For example, a habitat with 10 luxury cabins will likely have a well-appointed kitchen and sumptuous dining room; one with a single bunkroom may have a microwave oven and a mini-fridge.

Life support provides air, climate control, and water for occupants. At TL9+, any accommodations may optionally replace this with *total life support* that grows or manufactures food. Total life support doubles space required (e.g., each cabin counts as 2 cabins). Alternatively, vessels with replicator systems or one or more open spaces devoted to gardens or farms can be assumed to be able to manufacture all necessary food.

The *Habitat Table* shows the number of Cabins that a habitat system provides. Cabins may be exchanged for bunkrooms, cells, or cages at a 1:1 ratio. Luxury cabins count as two cabins; each cabin exchanged for steerage provides five tons cargo. For specialized rooms, see the boxed text. Habitats are unavailable on SM+5 craft. Crew will occupy a Control Room (p. 14) or Engine Room (p. 15) and passengers occupy Passenger Seats (p. 20).

## Habitat Table

| *Size Modifier* | *+6* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|---|
| No. of Cabins | 1 | 2 | 6 | 20 | 60 | 200 | 600 | 2,000 | 6,000 | 20,000 |
| Workspaces | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost (dollars) | 100K | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B |

*Repair skill*: Mechanic (Life Support). If a habitat has total life support, Gardening or Farming (if SM+12 or more), or at TL10+, possibly Bioengineering (Tissue Engineering) for "faux flesh" food vats. Crew assigned to maintenance also use Housekeeping skill.

## Specialized Rooms for Habitats

Habitats can include various specialized rooms. Multiple facilities can be combined to represent larger examples. The number of cabins that must be exchanged for each specialized room is shown in parenthesis.

*Briefing Room* (1): A conference room with a table and up to 10 chairs.

*Establishment* (2): A facility such as a bar, brothel, casino, gym, massage parlor, nursery, salon, classroom, or retail store. Each has standing or seating room for up to 20 patrons, usually manned by one to three staffers.

*Hibernation Chamber* (TL9) (0.25): A pod housing one person. The "sleeper" inside it is unconscious, but ages at 1/10th speed and does not require sustenance.

*Lab* (2): A scientific laboratory usable by up to two people simultaneously. Fulfills equipment requirements for a scientific skill, e.g., Chemistry, Biology, Physics, or Science!, with a +1 equipment bonus. Each lab costs an extra $1M ($10M for Physics labs, $30M for Science!). Installing 10+ identical labs qualifies as a "large lab" with +2 bonus; 100+ qualify as a "major lab" with +TL/2 to skill.

*Minifac* (1): A miniaturized version of any Factory system (p. 16) can be installed in a habitat. A minifac is 1/10 the cost and production capacity of an SM+6 factory (e.g., $0.5M and $0.5K/hr. for a fabricator minifac) and, for a robofac, only skill-13.

*Office* (1): Contains a desk and display terminal for use by one or two administrators, analysts, etc. Useful for skills such as Administration, Computer Operation, Computer Programming, Intelligence Analysis, Market Analysis, or Strategy skill tasks. A habitat with 10 or more offices devoted to the same activity can be classed as an "ops center" with +1 bonus to these tasks, or a "large ops center" with +2 bonus if 100 or more.

*Sickbay* (1): Medical facilities, e.g., a stabilized diagnostic bed, trauma maintenance, and surgery, for diagnosis and treatment of one patient at a time (First Aid for 1-4 patients). Multiple sickbays extend this, e.g., a "20-bed sickbay" is 100 tons. Fulfills equipment requirements for Diagnosis, First aid, Physician, and Surgery skill with a +2 bonus. Ten-bed or larger sickbays ("clinic") increase this to +3; 100+ beds ("hospital") give +TL/2. Any size sickbay can use *automeds* for extra $100K per bed, allowing AI computer software to treat patients.

*Teleport Projector* (TL12^) (1): A two-way matter transmitter capable of transmitting 1-2 persons or 0.2 tons cargo. Takes about 10 seconds to send or retrieve and requires an Electronics Operation (MT) skill roll to use properly (-1 per 1,000 miles range), failure meaning a near miss, critical failure disaster; add +4 if beaming between two cooperating systems. It can be controlled from the bay or a control station. See ***GURPS Ultra-Tech*** (p. UT233) for detailed rules. Costs an extra $20M. Half cost if it can only send or receive.

*Repair Skills:* If labs, add Electronics Repair (Scientific). If sickbay or hibernation chamber, Electronics Repair (Medical). If office, Electronic Repair (Computers). If teleport projector, Electronics Repair (MT). If minifac, see Factory (p. 16).

## Hangar Bay (TL7) [hull]

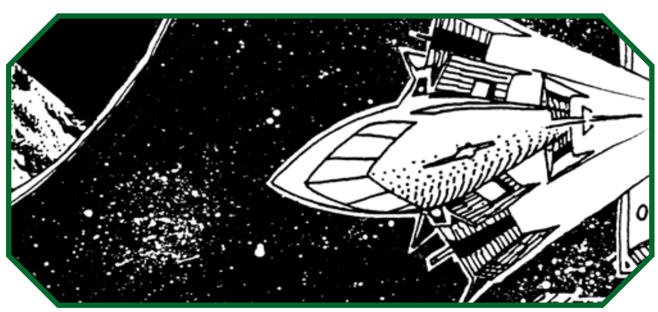
A bay capable of storing, launching, and retrieving other vehicles (spacecraft, trucks, etc.). Hangar bays can also be used for cargo, but are less mass-efficient than a cargo hold, due to the other facilities installed in the bay.

Hangar bays include airlock systems so they can be depressurized without spilling the vessel's air. A hangar bay can also be flooded and used launch watercraft or submarines.

The table shows the *capacity* of the bay in tons, which is the maximum mass of craft that can be stowed inside. This can also be used as a cargo hold for "roll-on/roll-off" cargo. *Launch rate* is the maximum tons of craft that can be released or recovered per minute. Craft heavier than this can still be launched or recovered at a slower pace, e.g., an SM+13 bay with a launch rate of 1,000 tons per minute could launch a 3,000-ton ship in 3,000/1,000 = 3 minutes.

Multiple systems placed in the same hull section may be specified as a single larger hangar of greater capacity, e.g., an SM+9 vessel may have "three Hangar Bays [3-5]" with combined 300 tons capacity. Launch rate is unchanged.

Workspace crews are assumed to be maintaining both the bay machinery *and* the vehicles inside them.



### Hangar Bay Table

| *Size Modifier* | *+5* | *+6* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Capacity (tons) | 1 | 3 | 10 | 30 | 100 | 300 | 1,000 | 3,000 | 10K | 30K | 100K |
| Launch rate | 1 | 3 | 10 | 20 | 50 | 100 | 200 | 500 | 1,000 | 2,000 | 5,000 |
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Dollar Cost ($) | 3K | 10K | 30K | 100K | 300K | 1M | 3M | 10M | 30M | 100M | 300M |

*Repair skill*: Mechanic (Vehicle Type).

## Jet Engine (TL7) [rear]

This is a turbo ramjet or scramjet engine that functions only in an atmosphere containing oxygen with at least 0.1 atmospheres pressure. Each jet engine provides 1G acceleration for calculating atmospheric speed, and consumes one fuel tank worth of jet fuel per half-hour (TL7) or hour (TL8+).

Use Piloting (Aerospace) skill to control the vessel when flying in atmosphere.

### *Jet Engine Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B | 30B |

*Repair Skill*: Mechanic (either Aerospace or Jet Engines).

## Jump Gate (TL^) [hull!]

This is one side of an artificial wormhole portal that connects to another distant jump gate, usually permitting instant FTL transit. This may be a prerequisite for, or alternative to, stardrive engines. The table shows maximum tonnage that can pass through the gate at any one time. Multiple systems installed in the same hull section may combine capacity.

### *Jump Gate Table*

| SM | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|
| Max tonnage | 100 | 300 | 1,000 | 3,000 | 10K | 30K | 100K |
| Workspaces | 1 | 1 | 3 | 10 | 30 | 100 | 300 |
| Dollar Cost ($) | 150M | 500M | 1.5B | 5B | 50B | 150B | 500B |

*Repair skill*: Electronics Repair (MT).

## Mining and Refinery (TL7) [any!]

These systems require a crew member using Mechanic (Mining) skill to supervise operations (from a control station). Failure reduces output by 10% times margin of failure.

*Mining* (TL7): A heavy-duty mining and processing system that can extract ore from rock, or convert ice or rock into a powdered residue suitable for use as mass driver reaction mass. It is rated for the tons/hour of ore it can extract or process.

*Chemical Refinery* (TL7): Different types are possible, but the most common spacecraft type processes ice or water into hydrogen and oxygen for rocket fuel or reaction mass. It is rated for the tons of fuel refined per system per hour.

### *Mining and Refinery Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tons/hr: | | | | | | | | | | | |
| If Mining | 0.15 | 0.5 | 1.5 | 5 | 15 | 50 | 150 | 500 | 1,500 | 5,000 | 15K |
| If Refinery | 0.5 | 1.5 | 5 | 15 | 50 | 150 | 500 | 1,500 | 5,000 | 15K | 50K |
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 30K | 100K | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B |

*Repair skill*: Mechanic (Mining or Refineries).

## Open Space (TL7) [any]

This system is a pressurized hall or other large, open space. It contains one or more *open areas* such as an auditorium, farm, garden, pool, theater, or zoo with room for up to 100 people to congregate. Multiple open spaces may be combined to create larger areas.

Twenty open spaces are equal to an acre of land (a football-field sized area).

Open spaces used as gardens or farms may provide food requirements for the vessel's occupants. One open space system is sufficient for the entire vessel; excess provide a surplus. The *Open Space* table shows the number of areas per system.

### *Open Space Table*

| SM | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|
| Areas | 1 | 2 | 5 | 10 | 20 | 50 | 100 | 200 |
| Techs | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 100K | 200K | 500K | 1M | 2M | 5M | 10M | 20M |

*Repair skill*: Housekeeping, or if used to grow food, Gardening or Farming.

# Passenger Seating (TL7) [Any]

This is an alternative to a habitat for a short voyage or small spacecraft. The system contains a number of airliner-style passenger seats, separated by aisles. (Two seats may be replaced by one stabilized *stretcher* for casualty evacuation.) It includes 24 hours of limited life support per passenger seat or stretcher. The table shows number of seats.

### *Passenger Seating Table*

| ***SM*** | ***+5*** | ***+6*** | ***+7*** | ***+8*** | ***+9*** | ***+10*** | ***+11*** | ***+12*** | ***+13*** | ***+14*** | ***+15*** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Seats | 2 | 6 | 20 | 60 | 200 | 600 | 2,000 | 6,000 | 20K | 60K | 200K |
| Cost ($) | 10K | 30K | 100K | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B |

*Repair skill*: Mechanic (Life Support).

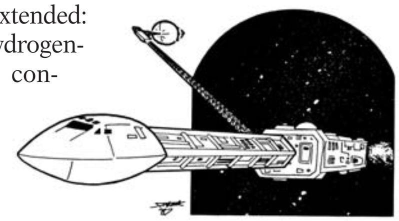
# Power Plant, Chemical Energy (TL7) [Any]

This power plant is a high-efficiency chemical energy closed-cycle power plant using hydrogen and liquid oxygen fuel (much like a chemical rocket). There are two variations:

*Fuel Cell* (TL7): Each system provides one Power Point. It can operate for three hours (TL7), six hours (TL8), 12 hours (TL9), or 24 hours (TL10+) on internal fuel.

*MHD Turbine* (TL9): An advanced high-performance closed-cycle turbine. Each system provides two Power Points for six hours (TL9), or 12 hours (TL10+) on internal fuel.

Endurance can be extended: each fuel tank of hydrogen-oxygen rocket fuel consumed by the power plant operates it for 4 × that duration.



### *Chemical Energy Power Plant Table*

| ***SM*** | ***+5*** | ***+6*** | ***+7*** | ***+8*** | ***+9*** | ***+10*** | ***+11*** | ***+12*** | ***+13*** | ***+14*** | ***+15*** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 15K | 50K | 1.5M | 5M | 15M | 50M | 150M | 500M | 1.5B | 5B | 15B |

Double cost for MHD turbine.

*Repair skill*: Mechanic (Fuel Cell or MHD Turbine).

# Power Plant, Reactor (TL8) [Any]

These may be the most common spacecraft power plant.

*Fission* (TL8): This is a high-performance nuclear fission reactor (or on very large vessels, a series of several reactors). Each system provides one Power Point. It will operate for 25 years on internal fuel at TL8, 50 at TL9, or 75 at TL10+.

*Fusion* (TL9): Uses a thermonuclear fusion reaction; each system provides two Power Points. It has internal fuel for 50 years at TL9, 200 years at TL10, 600 years at TL11, or 1,500 years at TL12. The reactor may be *de-rated* to provide only one Power Point, doubling endurance and halving cost. At TL9 fusion reactors can only be used on SM+10 or larger vessels; there is no limit at TL10+.

*Antimatter* (TL10): Uses a matter-antimatter reaction. If damaged, it may explode (see *Volatile Systems*, p. 62). Each system provides four Power Points. Internal fuel gives two years endurance (at TL10), 20 years (TL11), or 200 years (TL12) . It may be de-rated: each -1 Power Point reduces cost by 25% and adds 25% to endurance.

*Super Fusion* (TL11): An exotic fusion system (muon-catalyzed or black hole catalyzed, for example), or a design that uses force fields, gravity control, etc. to contain the reaction for better performance. Provides four Power Points for 400 years (TL11) or 1,000 years (TL12). It can be *de-rated:* each -1 Power Point reduces cost by 25% and add 25% to endurance.

*Total Conversion* (TL12^): Converts matter directly into energy with 100% efficiency. Can also represent other forms of exotic power plant (caged baby universes, etc.). It provides five Power Points with effectively unlimited endurance.

### *Reactor Table*

| ***Size Modifier*** | ***+5*** | ***+6*** | ***+7*** | ***+8*** | ***+9*** | ***+10*** | ***+11*** | ***+12*** | ***+13*** | ***+14*** | ***+15*** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| ***Cost ($)*** | | | | | | | | | | | |
| Fission reactor | 100K | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B |
| Fusion reactor | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B | 30B |
| Antimatter | 600K | 2M | 6M | 20M | 60M | 200M | 600M | 2B | 6B | 20B | 60B |
| Super Fusion | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B | 30B | 100B |
| Total Conversion | 2M | 6M | 20M | 60M | 200M | 600M | 2B | 6B | 20B | 60B | 200B |

*Repair skill*: Mechanic (Fission, Fusion, Antimatter, or Total Conversion).

## RAMSCOOP (TL10) [FRONT]

An electromagnetic scoop intended to capture interstellar hydrogen molecules for fuel and reaction mass. At 1,800 mps or more, one Ramscoop system provides unlimited reaction mass for *one* drive system: antimatter plasma rocket, antimatter plasma torch, super antimatter plasma torch, fusion rocket, fusion torch, super fusion torch, total conversion torch, or super conversion torch. Each ramscoop requires one Power Point to power up, but no power to maintain.

Exception: Ramscoops used by antimatter engines must be powered continuously by an antimatter reactor.

### *Ramscoop Table*

| *SM* | *+5* | *+6* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B | 30B | 100B | 300B |

*Repair skill*: Mechanic (Vehicle Type).

## Reaction Drive Engines

Most maneuver drive engines for spacecraft are *reaction engines*. They propel the spacecraft through normal space according to Newtonian principles, expelling mass to generate thrust. They can only operate if the spacecraft has at least one *fuel tank* (p. 17) with appropriate reaction mass. They are rated for acceleration in gravities (G) per engine, e.g., three engine systems (representing a bigger engine or engine cluster) triples acceleration.

A reaction drive-propelled spacecraft's top speed, or delta-V, does not depend on the number of engines, but rather on the type of engine and number of fuel tanks of reaction mass the spacecraft has. For example, a spacecraft propelled by one or more TL8 nuclear thermal rocket engines can achieve a maximum delta-V of 0.3 mps per fuel tank of hydrogen reaction mass available.

How much delta-V does a reaction drive spacecraft need? It depends on the mission (see Chapter Three). Some examples:

- 5.6 mps of delta-V (and 1G+ acceleration) lets a spaceship blast off from Earth into low orbit.
- 2.1 mps of delta-V lets a spaceship in Earth orbit achieve escape velocity.
- 12 mps of delta-V lets a spaceship that has achieved Earth escape velocity travel from Earth orbit to the Moon in about 11 hours, Mars orbit in about six months, or to Jupiter in about 20 months, including decelerating the vessel. (Spending more or less delta-V will proportionately affect the travel time.)
- 4,000 mps of delta-V lets a spaceship travel from our solar system to Alpha Centauri in about 400 years, including deceleration time, at about 1% of light speed.

## REACTION ENGINE, CHEMICAL AND HEDM ROCKETS (TL7) [REAR]

These maneuver drives use chemical fuels to produce high accelerations suitable for lifting off from a planet or close combat, but they burn a great deal of reaction mass and will usually run out of fuel before they can achieve a fast delta-V.

*Chemical Rocket* (TL7): This is a reaction drive that burns fuel and oxidizer, such as a mix of liquid hydrogen and liquid oxygen, to produce thrust. Each engine provides 3G acceleration. Each fuel tank of rocket fuel provides 0.15 mps delta-V. Spacecraft capable of reaching orbit are often multi-stage designs (see *Upper Stage, p.* 26).

*HEDM (High Energy Density Materials) Chemical Rocket* (TL9): Uses high-energy density materials such as metallic hydrogen or metastable helium, for fuel. Each fuel tank of HEDM fuel provides 0.5 mps delta-V, but may explode if damaged (see *Volatile Systems,* p. 62). Each engine gives 2G acceleration.

### *Chemical and HEDM Engine Table*

| *SM* | *+5* | *+6* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 60K | 200K | 600K | 2M | 6M | 20M | 60M | 200M | 600M | 2B | 6B |

1.5× cost for HEDM chemical rockets.

*Repair Skill*: Mechanic (High-Performance Spacecraft or Rockets).

## Reaction Engines, Electric (TL8) [rear!]

These low thrust maneuver drives require both electrical power and reaction mass.

*Ion Drive* (TL8): A high-impulse, low-thrust engine that ionizes a reaction mass and accelerates it as a beam of ions to produce thrust. Each ion drive engine provides 0.0005G acceleration, but is a high-energy system that requires one Power Point. Each fuel tank of ionizable reaction mass provides 3 mps delta-V. These statistics also apply to most plasma thruster systems.

*Mass Driver* (TL9): An electromagnetic accelerator that launches buckets of reaction mass at high velocity to produce thrust. Its performance is unimpressive, but it can use just about anything as reaction mass. Each fuel tank or cargo hold's worth of mass (often powdered rock!) ejected provides 0.3 mps delta-V. Each mass driver engine provides 0.01G acceleration, but is a high-energy system that requires one Power Point.

*Options*: May be *high-thrust* (double acceleration, halve delta-V).

### Reaction Engine, Electric

| *SM* | *+5* | *+6* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 100K | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B |

*Repair Skill*: Mechanic (Low-Performance Spacecraft).

## Reaction Engine, Fission (TL7) [Rear]

These maneuver drives use nuclear fission to heat reaction mass.

*Nuclear Thermal Rocket* (NTR) (TL7): This reaction engine heats a fluid as it passes through a built-in solid- or liquid-core nuclear reactor and expels it for thrust. Each NTR engine gives 0.1G acceleration (TL7), 0.2G (TL8), or 0.5G (at TL9+). Each fuel tank of hydrogen gives a delta-V of 0.3 mps (TL7-8) or 0.45 mps (TL9+).

*Nuclear Light Bulb* (TL9): An enclosed gas-core fission drive; radiation from the reactor (principally light) passes through a transparent containment vessel, to heat the fuel (hence "nuclear light bulb"). Each engine gives 0.01G acceleration (TL9) or 0.05G (TL10+). Each fuel tank of hydrogen gives a delta-V of 0.8 mps.

*Nuclear Saltwater Rocket* (TL9^): A high-performance "fission torch" rocket fuelled by water containing dissolved salts of enriched uranium in a barely sub-critical state. Released into the reaction chamber, it creates a continuous nuclear reaction directly behind the rocket, using the water as a reaction mass. Each engine gives 2G acceleration. Each fuel tank of uranium-saltwater fuel gives a delta-V of 2.5 mps. The engine and fuel may explode if damaged – see *Volatile Systems* (p. 62).

*Options*: NTR may use *water* instead of hydrogen: 3× acceleration, 1/3 delta-V.

### Fission Engine Table

| *SM* | *+5* | *+6* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 150K | 500K | 1.5M | 5M | 15M | 50M | 150M | 500M | 1.5B | 5B | 15B |

*Repair Skill*: Mechanic (Fission Engine).

## Reaction Engine, Nuclear Pulse (TL7) [Rear]

Uses pulse units (shaped nuclear bombs) surrounded by or adjacent to inert reaction mass to generate thrust.

*External Pulsed Plasma ("Orion Drive")* (TL7): Pulse units are full-size nuclear bombs that are ejected out and exploded behind the vessel. The plasma wave impacts an acceleration pusher plate, producing thrust. The rear hull section must have dDR 50 or better, or dDR 5+ plus a magnetic sail ("Mag-Orion"). Each engine produces 2G acceleration. Each fuel tank of bomb pulse units gives a delta-V of 2 mps (TL7), 3 mps (TL8), 4 mps (TL9), 8 mps (TL10+) delta-V.

*Fusion Pulse Drive* (TL9): Uses laser beams, particle beams and/or miniscule amounts of antimatter to trigger fusion micro-explosions in tiny nuclear fuel pellets in the reaction chamber. Each engine give 0.01G acceleration (TL9) or 0.05G (TL10+). Each fuel tank of fuel pellets gives a delta-V of 5 mps (TL9), 10 mps (TL10), 40 mps (TL11+).

*Advanced Fusion Pulse Drive* (TL9): A fusion pulse drive optimized for outer system or interstellar travel. Each engine give 0.005G acceleration. Each fuel tank of fuel pellets gives a delta-V of 20 mps (TL9), 100 mps (TL10), or 350 mps (TL11+).

*Super Fusion Pulse Drive* (TL11^): Uses extensive super-science (e.g., force field pusher plates and inertial dampers). Each engine give 20G acceleration at TL11 or 100G at TL12. Each tank of fuel pellets gives a delta-V of 350 MPS (at all TLs).

*Options:* Any engine may be *high thrust* (double acceleration but halve delta-V per tank).

### *Nuclear Pulse Engine Table*

| ***SM*** | ***+5*** | ***+6*** | ***+7*** | ***+8*** | ***+9*** | ***+10*** | ***+11*** | ***+12*** | ***+13*** | ***+14*** | ***+15*** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($)* | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B | 30B |

*Repair Skill*: Mechanic (Nuclear Pulse Engine).
* 2× cost for advanced fusion, 4×cost for super fusion.

# Reaction Engine, Fusion (TL9) [Rear]

These maneuver drives incorporate built-in fusion reactors, producing a hot, high-velocity exhaust.

*Fusion Rocket* (TL9): Generates a fusion reaction to heat hydrogen into plasma and expel it, adding extra cold mass for extra thrust. Each engine gives 0.005G acceleration. Each fuel tank of hydrogen gives a delta-V of 12 mps (TL9), 60 mps (TL10), 180 mps (TL11), or 450 mps (TL12). Requires minimum SM+9 at TL9; but no limit at TL10+.

*Fusion Torch* (TL10^): A limited superscience high-performance fusion rocket. Each engine gives 0.5G acceleration. Each fuel tank of hydrogen gives a delta-V of 15 mps (TL10), 45 mps (TL11), or 150 mps (TL12).

*Super Fusion Torch* (TL11^): A fusion drive derivative of the *cosmic* super fusion reactor. Each engine gives 50G acceleration. Each fuel tank of hydrogen gives a delta-V of 450 mps.

*Options:* Any engine may be *high thrust* (double acceleration but halve delta-V per tank). Any engine can also use *water* instead of hydrogen (triple acceleration, one-third delta-V).

### *Fusion Engine Table*

| ***SM*** | ***+5*** | ***+6*** | ***+7*** | ***+8*** | ***+9*** | ***+10*** | ***+11*** | ***+12*** | ***+13*** | ***+14*** | ***+15*** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($)* | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B | 30B |

*Repair Skill*: Mechanic (Fusion Engine).
* 2× cost for fusion torch; 4× cost for super fusion torch.

# Reaction Engine, Total Conversion and Antimatter

These offer generally superior performance to nuclear engines (p. 22) but antimatter fuel is costly! Most engines mix a small amount of antimatter with a greater quantity of matter. Antimatter-catalyzed fuel uses only micrograms of antimatter per ton, antimatter-boosted uses grams, and matter/antimatter uses a (hideously expensive) 1:1 mix. More advanced designs use total conversion of matter, eliminating the expensive fuel.

*Antimatter Thermal Rocket* (TL9): Annihilation of a tiny amount of antimatter directly heats a reaction mass which is expelled for thrust. Each engine gives 0.1G acceleration (TL9), 0.2G (TL10), or 0.4G (TL11+). Each fuel tank of antimatter-catalyzed hydrogen gives a delta-V of 1.8 mps.

*Antimatter Plasma Rocket* (TL10): Uses the annihilation of a modest amount of antimatter to heat reaction mass into hot plasma, which is contained in magnetic fields and expelled for thrust. Each engine gives 0.01G acceleration. Each fuel tank of antimatter-boosted hydrogen gives a delta-V of 120 mps (TL10), 360 mps (TL11+).

*Antimatter Plasma Torch* (TL10^): A high-performance limited superscience version of the antimatter plasma rocket. Each engine provides 1G acceleration. Each fuel tank of antimatter-boosted hydrogen gives a delta-V of 120 mps (TL10), 360 mps (TL11+).

*Super Antimatter Plasma Torch* (TL11^): Uses superscience technologies such as force field containment to boost performance. Each engine gives 100G acceleration. Each fuel tank of antimatter-boosted hydrogen gives a delta-V of 360 mps. Usually only used if cosmic antimatter reactors exist.

*Antimatter Pion* (TL11): Matter and antimatter are annihilated at a 1:1 ratio, and magnetic fields focus the resulting charged pions into a near-light speed exhaust. Each engine gives 0.005G acceleration. Each fuel tank of matter/antimatter fuel gives 3,400 mps of delta-V.

*Antimatter Pion Torch* (TL11^): A superscience version. Each engine gives 0.1G acceleration. Each fuel tank of matter/antimatter fuel gives 3,400 mps of delta-V.

*Total Conversion Torch* (TL12^): Similar to antimatter pion, but makes use of total conversion of matter, so it can use ordinary fuel and is more efficient. Each engine gives 1G acceleration. Each fuel tank of hydrogen (or anything else) gives a delta-V of 10,000 mps.

*Super Conversion Torch* (TL12^): An engine derived from the *cosmic* total conversion reactor. Each engine gives 50G acceleration. Each fuel tank of hydrogen (or anything else) gives a delta-V of 10,000 mps.

*Options*: Engines can be *high thrust* (5× acceleration, 1/5× delta-V per tank), and/or antimatter thermal or plasma engines can replace hydrogen with *water* (3× acceleration, 1/3 delta-V).

### *Antimatter and Total Conversion Engine Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost($)* | 150K | 500K | 1.5M | 5M | 15M | 50M | 150M | 500M | 1.5B | 5B | 15B |

* 2× cost for antimatter plasma torch or antimatter pion; 4× cost for antimatter pion torch, super antimatter plasma torch, or total conversion torch; 10× for super conversion torch.

*Repair Skill*: Mechanic (Antimatter or Total Conversion Engine).

## Reactionless Engines (TL^) [Rear!]

These maneuver drive engines allow the vessel to accelerate without using up reaction mass. Top speed is near-lightspeed ("near-*c*") (optionally much less, or variable, e.g., 0.01*c per engine*), but each engine is also a high-energy system that requires one Power Point.

*Rotary Reactionless* (TL7^): For example, a Dean Drive using oscillating rotating masses. Each engine gives 0.1G acceleration. May also go in a Central hull.

*Standard Reactionless* (TL10^): Each engine gives 0.5G acceleration at TL10 or 1G at TL11-12.

*Hot Reactionless* (TL10^): Each engine gives 1G acceleration at TL10 or 2G at TL11-12. It has a waste-heat signature equivalent to a conventional drive's exhaust.

*Super Reactionless* (TL11^): Reactionless drive with 50G acceleration at TL11 or 100G at TL12.

*Subwarp* (TL^): Each engine gives 500G acceleration. Also use this for most warp drives that can "downshift" to operate as reactionless drives. It will almost always be a pseudo-velocity drive (p. 33).

### *Reactionless Engine Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| ***Cost($)*** | | | | | | | | | | | |
| Rotary | 15K | 50K | 150K | 500K | 1.5M | 5M | 15M | 50M | 150M | 500M | 1.5B |
| Standard | 30K | 100K | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B |
| Hot | 100K | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B |
| Super | 200K | 600M | 2M | 6M | 20M | 60M | 200M | 600M | 2B | 6B | 20B |
| Subwarp | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B | 30B |

*Repair Skill*: Mechanic (Reactionless Drive).

## Reconfigurable System (TL^ or TL11) [special]

A system can be designed as a multi-function device that can alter its shape and capabilities. Transformation requires 20 seconds. Cost is the combined cost of all systems it can transform into times the number of transformations. Power consumption is that of the current configuration. This is only possible for systems that, in the GM's opinion, would logically share a large number of components or use superscience. Fuel, people, cargo, ammunition, or small craft do not appear when a system transforms. If there is no room for them, they must leave or be removed before a transformation can take place.

## Robot Arm (TL8) [hull]

This system is a hand- or gripper-equipped arm, proportionately sized to the spacecraft, that can grab and manipulate spacecraft or other objects using the vessel's ST.

A robot arm can also function as an external clamp (p. 15).

### *Robot Arm Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B | 30B |

*Repair Skill*: Mechanic (Robotics or Mecha).

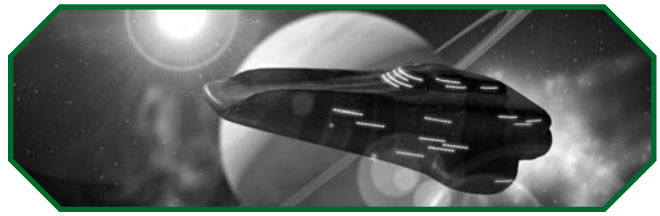
## Soft-Landing System (TL7) [hull]

A reentry shield, airbags, or parachutes designed to allow a vessel that lacks wings, thrust, or contragravity to safely land from low orbit. The system is deploys automatically and is destroyed after landing – it must be replaced each time it's used.

## *Soft-Landing System Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cost ($) | 50K | 100K | 200K | 500K | 1M | 2M | 5M | 10M | 20M | 50M | 100M |

# Solar Panel Array [hull]



A solar power system. If exposed to sunlight it generates one Power Point. A solar panel array is an exposed system and is not protected by spacecraft armor!

## *Solar Panel Array Table*

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cost ($) | 150K | 500K | 1.5M | 5M | 15M | 50M | 150M | 500M | 1.5B | 5B | 15B |

*Repair Skill*: Electrician.

# Space Sails (TL9) [hull]

Giant sails that can generate thrust from starlight or solar wind. Acceleration is very low, but there is no reaction mass consumption. Space sails are exposed systems unprotected by spacecraft armor. A space sail cannot be deployed at the same time as a stasis field or a different type of space sail. Multiple systems represent a larger sail. There are two subtypes:

*Lightsail* (TL9): This solar sail generates thrust from starlight (or a battery of launching lasers). Typical thrust in our inner solar system (at 1 AU from a Sol-type star) is 0.0001G per lightsail system. Thrust is affected by distance from the star: divide it by the square of the average distance. For stars with different luminosity than our own sun, multiply by relative luminosity.

*Magsail* (or Plasma Sail) (TL9): A huge superconducting loop mounted in front of the spacecraft that interacts with charged particles from a star's solar wind to generate thrust. It won't provide acceleration far from a star (in interstellar space) but can also be used for deceleration by starships traveling through interstellar space at velocities beyond their top speed. Typical thrust is 0.001G per magsail system. Top speed cannot exceed 375 mps. A magsail requires one Power Point to activate, but no power to maintain once powered.

## *Space Sail Table*

| SM* | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 or more |
|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | - |
| Cost ($) | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | - |

*Repair skill*: Mechanic (Lightsail or Magsail).

* A spacecraft cannot be given a space sail if its SM exceeds its TL.

# Stardrive Engine (TL^) [any!]

This is a faster-than-light drive, such as a hyperdrive, jump drive, or warp drive, as well as all necessary fuel supplies or energy banks required to operate it. The exact mechanism is up to the GM. Multiple stardrive engines normally improve performance.

In general, the base speed of a stardrive is *multiplied* by the number of stardrive engines. For jump drives or other designs that instantly travel an unlimited distance, the time required to prepare a jump drive may be *divided* by number of engines.

Since exact capabilities are up to the GM, stardrives get a simple "FTL rating," e.g., FTL-2 for two drives.

*Stardrive Engine*: A typical stardrive with FTL-1.

*Super Stardrive Engine*: In some settings, more powerful stardrives are available that have the same mass. This engine can provide FTL-1 if given one Power Point or boost up to FTL-2 if given two Power Points (!!). At the GM's option, a super stardrive can also represent a drive that provides some extra capability at a higher energy cost.

Spacecraft with stardrives usually require other maneuver drives for sublight travel, especially if the drive ceases to function near a planet or a star's gravity field, only works at particular jump points, or only travels through hyperspace. Some warp drives can simply "downshift" to function at sublight speeds (e.g., upon entering a solar system) – see the Stardrive (Reactionless) (p. 33) design switch.

## *Stardrive Engine Table*

| SM* | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 300K | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B | 10B | 30B |

Super stardrive engines are 5× cost.

*Repair Skill*: Mechanic (Stardrive).

* In *some* settings, stardrives are unavailable for small craft (e.g., SM+5 to SM+6).

## Stasis Web (TL12^) [any!]

This system places the spacecraft inside a bubble of time that runs far slower than the rest of the universe. It can be set to last anywhere from six minutes to billions of years as observed by the rest of the universe, while only microseconds pass within the bubble. Anything in stasis is frozen, unable to do anything, but is outside the normal space-time continuum, and cannot be affected by anything within it. The vessel could fall through the heart of a star or survive until the end of the universe. Viewed from the outside, an object encased in a stasis web is a perfectly reflecting mirror, and no sensors of any type can penetrate it. In space combat, stasis webs are turned on during power allocation and last for the duration set by the operator; a spacecraft using a stasis web is effectively indestructible but able to do nothing but perform an uncontrolled drift.

### *Stasis Web Table*

| ***SM*** | ***+5*** | ***+6*** | ***+7*** | ***+8*** | ***+9*** | ***+10*** | ***+11*** | ***+12*** | ***+13*** | ***+14*** | ***+15*** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 3M | 6M | 12M | 25M | 50M | 100M | 200M | 500M | 1B | 2B | 5B |

*Repair Skill*: Armoury or Electronics Repair (Force Shields).

## Upper Stage (TL7) [special]

The entire front section of a spacecraft (i.e., six systems) may be designated as an "upper stage." (The rest of the spacecraft is the lower stage.) Instead of systems, an upper stage is occupied by a different spacecraft that is one SM smaller than the lower stage, which can be ejected at any time. While an upper stage is still attached, it may not use any fuel tanks or engines installed in it, nor may it use any weapons or arrays that were installed in its rear hull. All other systems are operational. Upper stages may themselves have upper stages in their forward hulls, etc. The lower stages of a spacecraft are usually disposable, typically containing only fuel tanks and drives.

The main advantage of upper stages is to allow reaction-drive spacecraft to boost performance by using each stage's delta-V in turn (e.g., *Midnight Sun,* p. 7)

## Weapons, Major Battery (TL7) [hull!]

This is a single mount for a powerful weapon. It also includes targeting systems for aiming the battery's weapons once the vessel's array has detected a target.

First, decide if the weapon will be in a single turret or fixed mount.

*Fixed mounts* can only fire at targets that are facing the hull section the battery is installed in (e.g., a weapon in the front hull fires forward). However, superior focusing or stabilization systems give fixed mounts better range and fire control (a +2 to hit).

*Turrets* have a wide firing arc: batteries in the front or rear hull can also fire at targets that are facing the central hull; batteries in the central hull can fire at any targets. Each turret also includes an integral dedicated control station allowing the turret to be manually controlled from within the system.

There are three broad classes of weapon that can be installed in a major battery: beams, launchers, and guns. Each type is divided into several subtypes.

*Beams:* These are directed-energy weapons. They are rated for output in KJ (kilojoules), MJ (megajoules), GJ (gigajoules), or TJ (terajoules). Refer to *Beam Types* (p. 28) and choose weapon type; this can modify output.

*Guns:* These are shell-firing cannons. They're rated for caliber (projectile diameter in centimeters) and number of gun shots carried. Refer to *Gun Types* (p. 28) and choose weapon type; this may modify caliber and shots. Note that some low-tech conventional guns are *not* high-energy systems.

*Launchers*: These fire self-propelled missiles. They're rated for the diameter of missile they fire (in cm) and number of missile shots carried. Refer to *Launcher Types* (p. 29) and choose weapon type.

For reference, the table also shows the dice of d-damage of a typical beam weapon (e.g., a pulse laser). Actual damage varies by weapon type – see Chapter 4.

### *Major Battery Table*

| ***Size Modifier*** | ***+5*** | ***+6*** | ***+7*** | ***+8*** | ***+9*** | ***+10*** | ***+11*** | ***+12*** | ***+13*** | ***+14*** | ***+15*** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam output | 10MJ | 30MJ | 100MJ | 300MJ | 1GJ | 3GJ | 10GJ | 30GJ | 100GJ | 300GJ | 1TJ |
| D-damage | 4d | 6d | 2d×5 | 3d×5 | 4d×5 | 6d×5 | 4d×10 | 6d×10 | 2d×50 | 3d×50 | 4d×50 |
| Gun caliber | 10cm | 12cm | 14cm | 16cm | 20cm | 24cm | 28cm | 32cm | 40cm | 48cm | 56cm |
| Launchers | 20cm | 24cm | 28cm | 32cm | 40cm | 48cm | 56cm | 64cm | 80cm | 96cm | 112cm |
| Missile shots | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 | 150 | 200 | 300 |
| Gun shots | 70 | 100 | 150 | 200 | 300 | 500 | 700 | 1,000 | 1,500 | 2,000 | 3,000 |
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Cost ($) | 150K | 600K | 1.5M | 6M | 15M | 60M | 150M | 600M | 1.5B | 6B | 15B |

*Repair Skill:* Armoury (Heavy Weapons).

## Weapons, Medium Battery (TL7) [hull!]

Uses the same rules as a major battery (p. 26) but the weapons are less powerful and there may be up to three fixed or turrets mount weapons in the battery. It is possible to mix weapon types in the battery.

### *Medium Battery*

| *Size Modifier* | *+5* | *+6* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam output | 3$^{MJ}$ | 10$^{MJ}$ | 30$^{MJ}$ | 100$^{MJ}$ | 300$^{MJ}$ | 1$^{GJ}$ | 3$^{GJ}$ | 10$^{GJ}$ | 30$^{GJ}$ | 100$^{GJ}$ | 300$^{GJ}$ |
| D-damage | 3d | 4d | 6d | 2d×5 | 3d×5 | 4d×5 | 6d×5 | 4d×10 | 6d×10 | 2d×50 | 3d×50 |
| Gun caliber | 8cm | 10cm | 12cm | 14cm | 16cm | 20cm | 24cm | 28cm | 32cm | 40cm | 48cm |
| Launchers | 16cm | 20cm | 24cm | 28cm | 32cm | 40cm | 48cm | 56cm | 64cm | 80cm | 96cm |
| Gun shots | 50 | 70 | 100 | 150 | 200 | 300 | 500 | 700 | 1,000 | 3,000 | 5,000 |
| Workspaces | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Uninstalled | 0.5 | 1.5 | 5 | 15 | 50 | 150 | 500 | 1,500 | 5,000 | 15K | 50K |
| Cost ($) | 150K | 600K | 1.5M | 6M | 15M | 60M | 150M | 600M | 1.5B | 6B | 15B |

*Repair Skill:* Armoury (Heavy Weapons).

Cost is for the maximum three weapons; fewer are 1/3 cost each. Each weapon not installed allows carrying tons of cargo equal to the Uninstalled number.

## Weapons, Secondary Battery (TL7) [hull!]

Uses the same rules as a major battery (p. 26) except the weapons are less powerful and there may be a mix of up to 10 fixed or turret mounted weapons in the battery.

### *Secondary Battery*

| *Size Modifier* | *+6* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|---|
| Beam output | 3$^{MJ}$ | 10$^{MJ}$ | 30$^{MJ}$ | 100$^{MJ}$ | 300$^{MJ}$ | 1$^{GJ}$ | 3$^{GJ}$ | 10$^{GJ}$ | 30$^{GJ}$ | 100$^{GJ}$ |
| D-damage | 3d | 4d | 6d | 2d×5 | 3d×5 | 4d×5 | 6d×5 | 4d×10 | 6d×10 | 2d×50 |
| Gun caliber | 8cm | 10cm | 12cm | 14cm | 16cm | 20cm | 24cm | 28cm | 32cm | 40cm |
| Launchers | 16cm | 20cm | 24cm | 28cm | 32cm | 40cm | 48cm | 56cm | 64cm | 80cm |
| Gun shots | 50 | 70 | 100 | 150 | 200 | 300 | 500 | 700 | 1,000 | 3,000 |
| Missile shots | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 | 300 |
| Workspaces | 0 | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Uninstalled | 0.5 | 1.5 | 5 | 15 | 50 | 150 | 500 | 1,500 | 5,000 | 15K |
| Cost ($) | 600K | 1.5M | 6M | 15M | 60M | 150M | 600M | 1.5B | 6B | 15B |

*Repair Skill:* Armoury (Heavy Weapons).

Cost is for the maximum 10 weapons; fewer are 1/10 cost each. Each weapon not installed allows carrying tons of cargo equal to the Uninstalled number.

## Weapons, Tertiary Battery (TL7) [hull!]

Uses the same rules as a secondary battery (above) except the weapons are less powerful and there may be any mix of up to 30 fixed or turret mounted weapons in the battery.

### *Tertiary Battery*

| *Size Modifier* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|
| Beam output | 3$^{MJ}$ | 10$^{MJ}$ | 30$^{MJ}$ | 100$^{MJ}$ | 300$^{MJ}$ | 1$^{GJ}$ | 3$^{GJ}$ | 10$^{GJ}$ | 30$^{GJ}$ |
| D-damage | 3d | 4d | 6d | 2d×5 | 3d×5 | 4d×5 | 6d×5 | 4d×10 | 6d×10 |
| Gun caliber | 8cm | 10cm | 12cm | 14cm | 16cm | 20cm | 24cm | 28cm | 32cm |
| Launchers | 16cm | 20cm | 24cm | 28cm | 32cm | 40cm | 48cm | 56cm | 64cm |
| Gun shots | 50 | 70 | 100 | 150 | 200 | 300 | 500 | 700 | 1,000 |
| Missile shots | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 |
| Workspaces | 0 | 0 | 0 | 1 | 3 | 10 | 30 | 100 | 300 |
| Uninstalled | 0.5 | 1.5 | 5 | 15 | 50 | 150 | 500 | 1,500 | 5,000 |
| Cost (dollars) | 1.5M | 6M | 15M | 60M | 150M | 600M | 1.5B | 6B | 15B |

*Repair Skill:* Armoury (Heavy Weapons).

Cost is for the maximum 30 weapons; fewer are 1/30 cost each. Each weapon not installed allows carrying tons of cargo equal to the Uninstalled number shown.

## Weapons, Spinal Battery (TL7) [Special!]

This is a single fixed mount for a beam weapon or gun. It's similar to a major battery (p. 26) except it runs through the entire spacecraft. A spinal battery is actually three systems: one system may occupy any non-core front hull location, one system is located in the core of the central hull, and one system may be in any non-core rear hull location.

The weapon fires out of the front hull (unless specifically noted as being rear-facing, in which case it fires out the rear hull). A spinal battery needs three Power Points to energize (one for each system).

Use the rules under Major Batteries for spinal battery installation, with the exception that all spinal batteries are always fixed mounts. If the battery is rear-facing, note this.

If any one system in a spinal battery is disabled or destroyed, the entire battery is non-functional. For purposes of determining if ammunition explosions occur as a result of damage, missiles or shots in the battery are assumed to be in central and rear systems.

### Spinal Weapon Battery Table

| *Size Modifier* | *+5* | *+6* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam output | $30^{MJ}$ | $100^{MJ}$ | $300^{MJ}$ | $1^{GJ}$ | $3^{GJ}$ | $10^{GJ}$ | $30^{GJ}$ | $100^{GJ}$ | $300^{GJ}$ | $1^{TJ}$ | $3^{TJ}$ |
| D-damage | 6d | 2d×5 | 3d×5 | 4d×5 | 6d×5 | 4d×10 | 6d×10 | 2d×50 | 3d×50 | 4d×50 | 6d×50 |
| Gun caliber | 12cm | 14cm | 16cm | 20cm | 24cm | 28cm | 32cm | 40cm | 48cm | 56cm | 64cm |
| Launchers | 24cm | 28cm | 32cm | 40cm | 48cm | 56cm | 64cm | 80cm | 96cm | 112cm | – |
| Gun shots | 70 | 100 | 150 | 200 | 300 | 500 | 700 | 1,000 | 1,500 | 2,000 | 3,000 |
| Missile shots | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 | 150 | 200 | 300 |
| Workspaces | 0 | 0 | 0 | 0 | 0 | 3 | 9 | 30 | 90 | 300 | 900 |
| Cost (dollars) | 500K | 1.5M | 5M | 15M | 50M | 150M | 500M | 1.5B | 5B | 15B | 50B |

Cost and workspaces are for the combination of all three systems that make up the mount.

*Repair Skill:* Armoury (Heavy Weapons).

## Weapon Types

Various weapons can be installed in weapons batteries. For detailed weapon effects, see the *Beam Weapon Table* in Chapter 4.

Note: If conventional guns or missile launchers are mixed with other weapons in the same battery one Power Point is still required to energize the other weapons, but if that Power Point is not spent, the conventional guns in the battery will still be able to fire.

### Beam Types

These are directed-energy weapons. Use Gunner (Beams) skill except for ghost particle beams, which uses Artillery (Beams).

*Heat* (TL7^): A generic beam of "pure energy" with no special effects at all, for emulating pulp SF beam weapons.

*Laser* (TL9): A beam laser operating in visible light or near-ultraviolet frequencies.

*Particle* (TL10): A neutral particle beam optimized for space combat. It has superior armor penetration, but range and accuracy are inferior to lasers.

*Plasma* (TL10^): These accelerate bolts of ionized plasma with double the damage of other weapons but poor range and accuracy.

*UV Laser* (TL10): A free electron laser operating in far-ultraviolet frequencies with superior range to lasers.

*Antiparticle* (TL11): Accelerates a beam of antiparticles, causing surface explosions and radiation effects; similar to a particle beam, but with greater damage.

*Ghost Particle* (TL11^): Fires high-energy mesons or other exotic particles that pass through armor before detonating *inside* the target. Range and accuracy are inferior to a laser. Use Artillery (Beams) to fire it.

*Tractor* (TL11^): Uses a ranged force field or gravity effect to pull or manipulate objects over a distance, but inflicts no damage at all.

*X-Ray Laser* (TL11): A free-electron laser operating in the X-ray frequency, with superior range to lasers and excellent penetration.

*Graviton* (TL11^): Reaches *inside* the target, crushing or shaking it. Range and damage are inferior to lasers, but ignores armor and has superior force field penetration.

*Conversion* (TL12^): Converts matter into energy or antimatter, not only disintegrating a portion of the target, but also causing an explosion.

*Graser* (TL12): A gamma-ray laser similar to an X-ray laser, but with greater penetration.

*Disintegrator* (TL12^): Reduces target to component particles or erases its existence.

*Option: Improved* (+1TL): A high-efficiency or multi-barrel weapon with the same effectiveness but double the rate of fire. E.g., an "improved UV laser" will be TL11.

*Option: Rapid Fire or Very Rapid Fire*: All beams except graviton and tractors are also available in *rapid fire* versions with a higher RoF but only 10% of output (e.g., a 3 MJ beam would becomes 300KJ rapid fire beam) or *very rapid fire* (VRF) with 1% of output (e.g., 3 MJ would become 30 KJ). This can be combined with "improved."

### Gun Types

These are rated for their caliber in centimeters (cm). The projectiles fired are often slower than the spacecraft, especially with conventional guns. Range is theoretically *unlimited* in vacuum but ability to hit is severely limited at a distance. To compensate, guns fire shell packages with small thrusters and guidance systems for limited course correction. Even so, they're best used in close combat or against non-maneuvering targets (e.g., planets or space stations). Use Gunner (Cannon) skill.

*Conventional Gun* (TL7): A large caliber conventional gun similar to a modern tank or heavy naval gun, with a mechanical autoloader. It is *not* a high-energy system.

*Electromagnetic Gun* (TL9): A coil gun or railgun with much higher muzzle velocity.

*Grav Gun* (TL11^): A superscience weapon with a very high muzzle velocity.

Two mutually-incompatible options can be added to any gun:

*Option: Rapid Fire*: Use half the listed caliber but it has a higher RoF and five times the shots, e.g., a 20cm conventional gun becomes a 10cm rapid fire conventional gun.

*Option: Very Rapid Fire (VRF)*: A multi-barrel or fast electromagnetic gun. It has 1/4 the listed caliber (e.g., 6cm becomes 1.5cm) and 20 times the shots on the table.

### Launcher Types

There are two types of launcher, rated for their caliber in cm. Use Gunner (Guided Missile) skill.

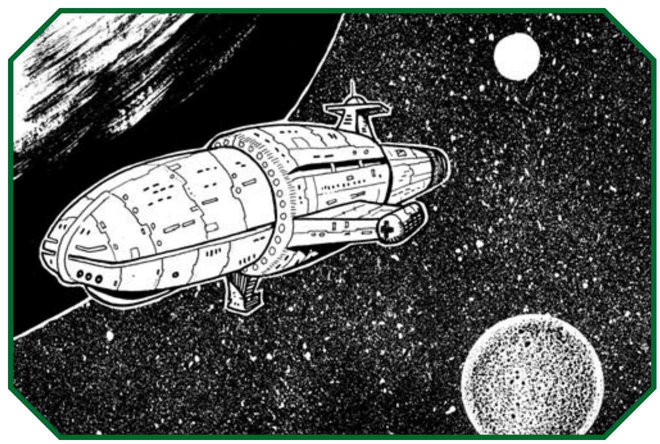
*Missile Launchers* (TL7): These fire self-propelled guided missiles. They are not high-energy systems.

*Warp Missile Launchers* (TL11^): These fire similar missiles, but accelerate them to relativistic pseudo-velocities (see *Pseudo-Velocity*, p. 33) using an internal warp field accelerator, allowing the missile to reach distant targets nearly instantly. They are high-energy systems.

# Design Features

This is a list of additional options that can be added to systems or vessels.

They do not count as systems.



### Artificial Gravity and Gravitic Compensators (TL^)

*Artificial Gravity:* Spacecraft may have superscience artificial gravity generators that create a gravity field that can be varied from 0 to 3G. Artificial gravity may be set for each hull section, and, in habitats or work spaces, for each room (from within the room).

*Gravitic Compensators*: This field negates up to 99.5% of felt acceleration but does not produce artificial gravity.

### Artificial Gravity and Gravitic Compensator Table

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cost($) | 30K | 0.1M | 0.3M | 1M | 3M | 10M | 30M | 100M | 300M | 1B | 3B |

Either capability is distributed through the vessel but will fail locally in systems that are destroyed (e.g., if characters are moving through a wreck, it won't have artificial gravity).

### Automation

Many systems on large vessels have a "Workspace" entry that represents the facilities that maintain the system and their crew. To reduce technical crew, a spacecraft can have automation. *Total Automation* is available for any system that requires workspaces. It eliminates that requirement. *High Automation* is available for vessels of SM+12 or larger; it reduces number of workspaces (and techs) by a factor of 10. This feature's cost is the number of workspaces the vessel required *before* reduction multiplied by $5M (total automation) or $1M (high automation). *Example:* If an SM+13 ship required 90 workspaces (and techs), total automation cost would be $450M.

### Emergency Ejection

A Control Room on an SM+5-8 vessel that was not installed in a [core] location may incorporate ejection capability to facilitate rapid escape. Ejection takes only one second (a free action in space combat turns) as long as the control room was not destroyed. Treat an ejected control station as a *lifepod* (p. 65) except it holds the crew of the control room (and a backup of the computer). Emergency Ejection adds an extra $500K to cost.

### Hardened Armor and Indestructible Armor

Armor (other than ice, organic, or stone) may be *hardened*. This might represent technologies such as multi-layer composites designed to defeat penetration or thin layers of ultra-hard or hyperdense plating. Hardened armor doubles armor cost but reduces the effect of an attack's armor divisor by one step against that armor layer only, as per p. B47. If used, it must be applied to *all* armor systems on a given hull section.

*Indestructible Armor* (TL^): Buy this as exotic laminate (p. 13) except it has *infinite* dDR, and is 10× the cost. It won't stop attacks that ignore armor. Fictional versions often have certain weaknesses – e.g., it may be transparent (dDR 0 vs. lasers).

## Ram-Rockets

The nuclear thermal rocket, antimatter thermal rocket, fusion torch, super fusion torch, antimatter plasma torch, and super antimatter plasma torch drives may have an auxiliary air-breathing air-ram mode for atmosphere. They suck in air with a turbine, heat it using their onboard drive reactor, and expel it for thrust. Thus, they don't require fuel while flying in an atmosphere (breathable or otherwise) provided it is "very thin" or greater density (see p. B429). Multiply cost by 5.

## Spin Gravity

Larger *unstreamlined* spacecraft may be designed so part or all of the ship can spin to simulate interior gravity via the Coriolis effect. The maximum gravity (G) possible is shown on the Spin Gravity Table; it can spin slower for lower G. Spin gravity does not provide simulated gravity to core systems. A spacecraft using spin gravity is a -2 on its Handling while spinning.

## Spin Gravity Table

| SM | +8 | +9 | +10 | +11 | +12 | +13 | +14 | +15 |
|---|---|---|---|---|---|---|---|---|
| Max G | 0.1G | 0.15G | 0.2G | 0.3G | 0.5G | 0.7G | 1G | 1.5G |
| Cost ($) | 0.1M | 0.3M | 1M | 3M | 10M | 30M | 100M | 300M |

## Stealth Hull Options

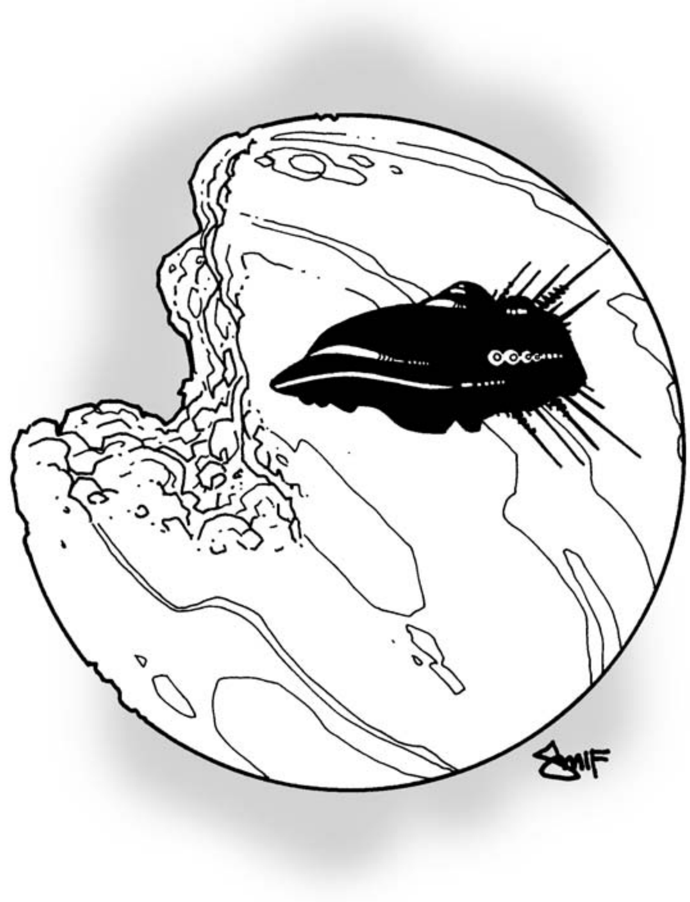
Spacecraft may have either or both of these hull options:

*Stealth* (TL8): The spacecraft hull is harder to detect with sensors. Subtract (TL-6) × 2 from rolls to detect it.

*Dynamic Chameleon* (TL10): The spacecraft has a digital chameleon surface that can blend the vessel into the background or paint the surface with any desired markings or imagery. It gives -4 penalty to detect the vehicle with ordinary vision only.

## Stealth Options Table

| Hull | Chameleon | Stealth |
|---|---|---|
| SM+5 | $180K | $250K |
| SM+6 | $350K | $500K |
| SM+7 | $700K | $1M |
| SM+8 | $1.5M | $2M |
| SM+9 | $3M | $5M |
| SM+10 | $7M | $10M |
| SM+11 | $15M | $20M |
| SM+12 | $35M | $50M |
| SM+13 | $70M | $100M |
| SM+14 | $150M | $200M |
| SM+15 | $350M | $500M |



## Winged

A streamlined spacecraft of up to SM+12 may be designated as *winged*. It has a wing (and perhaps a tail) and structural strengthening, providing extra lift and better handling when flying in atmosphere. The *Winged Table* shows cost:

## Winged Table

| SM | +5 | +6 | +7 | +8 | +9 | +10 | +11 | +12 | +13 or more |
|---|---|---|---|---|---|---|---|---|---|
| Cost ($) | 150K | 500K | 1.5M | 5M | 15M | 50M | 150M | 500M | – |

# Design Switches

These are setting-specific design "switches" that can be added to any spacecraft to emulate various superscience or setting paradigms. Specific switches are often applied to *all* spacecraft in a setting.

## Adapting Fictional Spaceships

GMs adapting existing fictional spacecraft should feel free to modify statistics to better fit source material, combine several systems into one, or simply take an effects-based approach that aims for a general flavor without paying too much attention to the precise "technobabble" description and numerical values.

### Cosmic Power

In some space opera universes, vessels employ starkly powerful energies far surpassing baseline levels! To handle this, apply the Cosmic Power switch.

Any antimatter or superscience Reactor may be designated as producing Cosmic Power Points instead of Power Points. Typically, their reactor fuel will incorporate some rare hypothetical element or be stored in compact superdense form (at 10× refueling cost or more).

High-energy systems that require Cosmic Power Points are "cosmic powered." The main effect is on beam weapons and force screens:

Cosmic beam weapons get 1,000 times their output: Raise kJ to MJ, raise MJ to GJ, raise GJ to TJ, and raise TJ to PJ (petajoules), e.g., 300GJ becomes 300TJ, which increases damage (see Chapter 4). Cosmic electromagnetic or grav guns get 10× minimum velocity (see chapter 4) and their sAcc is also increased by +3.

Cosmic force screens get 10 × dDR.

In addition, the following superscience systems can be specified as requiring Cosmic Power Points to work *at all*: cloaking device, contragravity lifter, jump gate, reactionless drive, replicator, stardrive engine, stasis web.

Reactionless drives will usually use either super reactionless or subwarp variants.

If the Cosmic Switch is used, assume spacecraft have enough auxiliary power to power any ordinary systems that use mere high-energy systems without installing power plants! Some ***Ultra-Tech*** gadgets (e.g., disintegrators) assume cosmic power levels!

If using this switch, GMs may optionally make TL^ "cosmic armor" standard as well, at no extra cost for any armor type. Cosmic armor has 10×dDR (perhaps due to enhancing the nuclear forces binding matter together or a coating of low-cost hyperdense matter) made possible due the vast amount of extra power available to such a society.

### Drive Field

Some reactionless drive engines or star drives may generate defensive fields as a side effect of their drive. The GM may rule that any reactionless engine is *also* a low-powered force screen at no extra power cost. Most often they function as screens with the kinetic and sometimes "partial" design switches (usually either the front or central hull).

### Electro-Mechanical Computers

Computers can be much slower than the baseline. This is typical of some "retrotech" settings, such as golden age space opera. Reduce computer network Complexity by -1 at TL7, -2 at TL8, -3 at TL9, -4 at TL10+.

### Exposed Radiators

If this switch is used, spacecraft have large radiator arrays. This is realistic, but often ignored even in hard science fiction!

Exposed radiators are appropriate for any "hard sf" spacecraft with any reactor, or which use any fission, nuclear pulse, fusion, antimatter, or total conversion engine *except* nuclear thermal rocket, external pulsed plasma, or *high-thrust* antimatter thermal rocket engine.

A vessel with exposed radiators has a retractable "main radiator array" extending out like a set of wings or fins. It is not a system – its mass is included with the power plant or drive. But it is vulnerable to damage and special rules apply to using them (or retracting them in combat) – see *Main Radiators in Combat* (p. 65).

*Coolant Tanks:* A spacecraft with a main radiator array may fill some fuel tanks with coolant to prevent overheating if the radiator is damaged or retracted. Each fuel tank filled with coolant extends operating time when radiators are nonfunctional by 100%.

## *Force Screen Variants*

Various options are possible for screens. In some settings, specific options may be mandatory. The cost modifier may be applied to the cost of the force screen system, but this is recommended only if multiple variants exist in the same setting. If a mandatory "switch" is applied to all screens, don't worry about it.

*Adjustable:* Screens can be *angled* to increase their current dDR across a particular hull section by ×2 at the cost of halving (round down) current dDR across *both* other hull sections. In combat, this is done when screens are powered up. +100% cost.

*Cloaking:* Functions as both a screen and cloaking device (p. 13) whenever turned on. +100% cost.

*Energy:* Only protects against beam weapons (or energy melee weapons like force swords), radiation, and the burning damage of nuclear or antimatter blasts. -50%.

*Hardened*: The screen is hardened (p. B47) vs. all attacks, e.g., a graviton beam's normal (1/100) divisor vs. screens becomes (1/10). +50% cost.

*Kinetic:* Only protects against physical attacks, including collisions, conventional gun or missile warheads, and the crushing damage from explosions (including nuclear or antimatter blasts in atmosphere). It won't protect against beams, radiation, or the burning damage from nuclear or antimatter explosions. Useful for GMs who want to downplay missiles without diminishing beams. -50% cost.

*Nuclear Damper:* Provides no dDR but instead prevents nuclear warheads from detonating. Read "dDR" as "field radius in miles" around the vessel. You can have both a nuclear damper and another force screen.

*Opaque:* Vision and sensors can't see in through the screen – it just appears a blank bubble (often black or silver) surrounding the vessel. The vessel can be detected and attacked, but sensor analysis tasks against the vessel are impossible and enemy gunners may not target precise locations. People inside can see out normally. +50% cost.

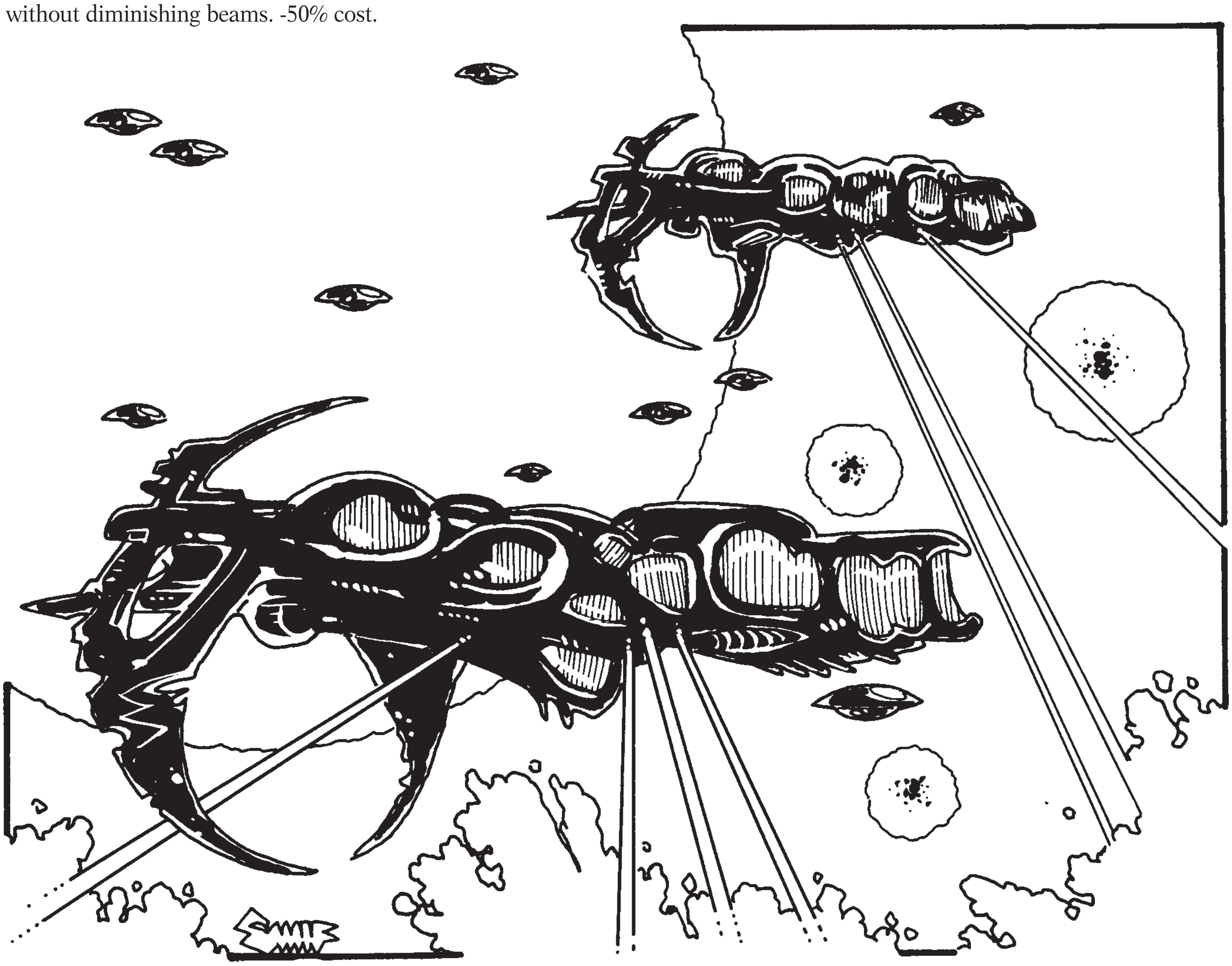
*Partial:* Screens only affect the hull section they are placed in, but have triple dDR.

*Reality-Stabilized:* Teleport projectors (and optionally other teleport or Warp effects) will not penetrate it. Gets 1/5 dDR vs. ghost particle beams. +100% cost.

*Two-Way:* Screened vessel may not fire or launch anything the screen stops. If the screen is opaque, the vessel's crew may not detect other vessels or use sensors. -40% cost.

*Velocity:* Slow moving objects can pass through the screen. You can walk or throw a baseball through it, but anything over 100 mph (Move 50) is stopped. Does not protect against minimal-speed collisions. -10% cost.

Unless noted, options can be combined at cumulative effect on cost. A screen may not combine energy, EM, and kinetic. Minimum cost of a screen is 10% of listed cost.



### *FTL Comm/Sensor Arrays (TL^)*

The active sensors and/or communicators in a comm/sensor array may optionally work at faster-than-light speeds.

*FTL active sensors* usually also have extended ranges, but in game terms mainly serve to justify safe navigation using warp drives. The GM may multiply active sensor ranges by 10, or vastly increase them (measured in AU, or even parsecs).

*FTL comms* allow communication over interstellar distances. GMs can assume FTL signals are instant and comm suite ranges in AU are now measured in parsecs, or give the signal a finite (but faster-than-light) speed. See ***GURPS Space*** for various options.

### *Gravitic Focus (TL^)*

All beams except graviton beams, tractor beams, X-ray lasers and grasers may have gravitic focus (or some similar gimmick) to boost range at the expense of damage. When turned on, treat as if the weapon has 10× its output for range but 1/10th its output for damage. Gunners may opt to turn on or off gravitic focus.

### *Multiscanner Array (TL^)*

The active sensors in a science or multipurpose array may be optionally be designated as a superscience system that uses para-radar technology. Multiscanner arrays can use their active sensors to scan for life, chemical composition, energy readings, etc.

### *Negative Mass Propulsion (NMP) Drives (TL^)*

Any *reactionless drive* may be an NMP drive. It uses the juxtaposition of ordinary positive mass and exotic matter that has negative mass (and negative inertia) to provide continuous thrust. It requires neither reaction mass nor energy, and does so without violating the principles of conservation of momentum or energy. It does require the creation of a sizable negative mass, which is expensive. NMP drives are not high-energy or cosmic energy systems but the drives are 10× as expensive.

### *Pseudo-Velocity*

Reactionless drives and stardrives may produce motion without accumulating momentum or kinetic energy. The drive does not produce acceleration effects on the ship or anything inside it (it's in zero G unless given artificial or spin gravity; crew and vessel don't experience acceleration.). If turned off or disabled, a vessel loses all speed gained as a result of acceleration while under pseudo-velocity. In the event of a collision involving the vessel, do not count velocity reached while under pseudo-velocity drive.

### *Singularity Drive*

Any *stardrive* or *reactionless drive* engine may be a singularity drive, using a miniature black hole or similar object as its power source. It requires no Power Points, but is costly (5× cost) and massive: spacecraft must have SM +(22-TL) or greater.

### *Stardrive Fuel*

Rather than assuming they include any necessary fuel, stardrive engines may optionally require separate fuel tanks. Typically, the contents of an entire fuel tank provides enough fuel for one stardrive engine for one jump (if a jump drive) or one week of travel (for hyperdrive or warp drive). Fuel may be hydrogen, or more exotic.

### *Stardrive (Reactionless)*

A stardrive (usually a warp drive or hyperdrive) with this option can function at sublight speeds exactly as if it were a reactionless drive. Sometimes such drives simply boost to light speed as a prerequisite for "going FTL." Specify the type of reactionless drive in parenthesis, e.g., Stardrive (Super Reactionless). No extra cost if this is standard feature of the setting's stardrives, otherwise twice the combined cost of *both* drives.

# CREW

Suggested crew requirements are given below. Bridge crew, gunners, and administrators may be sapient computer programs; others must be live or robots. On vessels organized on hierarchical lines, 10% of the technicians and most of the bridge crew are usually officers, often provided with better quarters.

#### *Control Room Crew*

One per control station. If there's only one or two control crew, they're usually styled as a pilot and co-pilot. If more, generalize them as "control room crew" or specify various duties or combinations as desired: this can include commanding the spacecraft ("captain" and possibly also "executive officer"), maneuvering the vessel ("pilot"), plotting courses, especially for hyperdrive or jump drive ("navigator"), controlling drives and power plants ("chief engineer"), operating comm/sensor arrays ("communications officer," "sensor operator," "tactical officer," or "science officer" depending on array type), and control of weapon batteries or missile batteries ("gunner").

#### *Turret Gunners*

Weapons battery turrets can be controlled from the control room, but also include their own dedicated control station. They are often assigned one gunner per turret.

#### *Technicians for Workspaces*

Add up the number of workspaces on the vessel, modifying for automation (p. 29) to find the number of technicians required. Either list that total number of technicians, or for greater detail, specify them by job title based on the Repair skill required (e.g., armorers or life support mechanics) and/or

system ("habitat techs"). Warships sometimes carry 2-3× that number of technicians, for extra damage control parties and to replace casualties.

### *Medics*

If a spacecraft habitat has sickbay beds, it should have one medic per 10 (or fraction thereof) non-automed sickbay beds or 20 stretchers.

### *Passenger Care and Entertainment*

Accommodations assigned to paying passengers usually have a passenger attendant for every two luxury-class, five first-class, or 20 economy-class passengers.

### *Small Craft*

Spacecraft may have dedicated crews for any small craft they carry in hangars. Craft used only occasionally (e.g., lifeboats) may not have a dedicated crew; control crew or others will man them as needed. Craft are maintained by hangar workspace techs.

### *Specialists*

Spacecraft whose habitats contain labs, establishments, offices, ops centers, etc. may need appropriate workers (entertainers, administrators, scientists, computer operators, etc.); see the *Specialized Rooms for Habitats* (p. 18) box.

# Finalizing the Spacecraft

Determine and record the spaceship's statistics based on the design decisions. If a spaceship lacks propulsion systems (a station), omit the Hnd/SR and Move statistics.

## *Cost*

Total up the cost of all systems, design features, and switches to get the base cost of mass production. Limited production (e.g., a NASA spacecraft) is 100-1,000 times cost!

### *Buying Spacecraft*

Characters with appropriate Rank and Duty may get spacecraft from the organization they work for (which can also take it away). Wealthy characters may buy spacecraft outright, or share the cost between PCs. Debt (p. B26) against Wealth, representing bank loans to buy the vessel, or Signature Gear (p. B85) are common alternatives. Complete details on spacecraft financing will appear in the next volume.

## *Basic Statistics Block*

If it has a maneuver drive engine, determine the skill required to pilot it: Piloting (Lightsail) for vessels with lightsail propulsion, Piloting (Low-Performance Spacecraft) for other vessels with acceleration under 0.1G; Piloting (High-Performance Spacecraft) if 0.1G+. Vessels using warp drives for sublight travel use Piloting (Starship).

**TL:** Record the TL.

**dST/HP:** Record the value from the *Hull Table* (p. 9) that corresponds with the chosen SM. It's also convenient to record a damage threshold equal to 10% of basic dHP. When using the space combat rules, each multiple of 10% of dHP that is lost due to penetrating damage causes the vessel to suffer one system damage roll.

**HT:** This starts at HT 13. Reduce HT by 1 for each the following: if the vessel has SM +5-9 with no engine room; if using high or total automation at TL7-9. Add +1 to HT if it has at least one robofac, nanofactory, fabricator, or replicator system aboard.

**Hnd/SR**: If the spacecraft has no maneuver drive, omit. Otherwise, record the Hnd/SR value from the *Hull Table*. Hnd/SR are both -1 at TL7-8. Adjust as follows:

## Hnd Modifier

| Acceleration | Modifier |
|---|---|
| 0.001G | -3 |
| 0.01G | -2 |
| 0.1G | -1 |
| 1G | 0 |
| 10G | +1 |
| 100G | +2 |
| 1,000G+ | +3 |

If a value falls between, use the lower, e.g., 4G is a 0 modifier.

**Move:** If the spaceship uses a reactionless drive, record combined acceleration of its engines in G (gravities) followed by a slash, then the notation *c* (it can accelerate to near-lightspeed). If it uses a reaction drive, record the combined acceleration of these engines in G and then, as its top speed, the delta-V calculated under *Fuel Tanks* (p. 17). If fitted with more than one type of maneuver drive, it will have different performance statistics depending on which drive is in use; add explanatory notes as necessary.

**SM:** Record the spacecraft hull's chosen SM.

**LWt:** Refer to the *Hull Table* (p. 9) and record the loaded weight that corresponds with the chosen hull mass and SM.

**dDR:** Add up the cumulative dDR from the spaceship's armor systems protecting each hull section. Record front dDR, central dDR, and rear dDR, separated by slashes, in that order (or just one dDR if they're identical).

**Occ:** Occupancy is simply a summary of the vessel's personnel capacity. First, decide if the occupancy statistic will refer to accommodation or short-term occupancy. Usually accommodations are listed if they vessel has them; otherwise record short-term occupancy. If none, record 0.

*Long-term accommodations* provide full life support for an indefinite period. Occupancy is two per cabin or luxury cabin, four per bunkroom, cell, or cage. Record occupancy followed by the suffixes A (accommodations), S (sealed) and V (Vacuum support), e.g., 20ASV.

*Short-term occupancy* provides limited life support for one man-day times occupancy. It is split into crew + passenger occupancy. Crew occupancy is one person per control station, turret, or workspace, and two per lab, establishment, or office. The passenger occupancy is one per seat, stretcher, or sickbay bed, 10 per briefing room, 30 per establishment, 100 per open space. Usually this statistic is only recorded only if the vessel has no long-term occupancy. Record occupancy as "crew + passengers" followed by the suffixes SV (omitting A), e.g., 2+6AV.

Hibernation chambers are indicated in footnotes.

**Load:** This is the sum of the capacities, in tons, of all cargo hold, steerage cargo, and hangar bay systems, plus 0.1 ton per occupant.

**Cost:** Record the total cost of all systems.

**Notes** may be added for extra details, e.g., force screens, ground, or air performance.

## Air Performance

This is the aerial performance in a "very thin" or denser atmosphere (see p. B429), i.e., not trace or vacuum conditions. A ship can fly in atmosphere if it is winged, or has an acceleration greater than local gravity, or is equipped with contragravity lifters. Use Piloting (Aerospace) or if flying with contragravity, Piloting (Contragravity).

Speed depends on acceleration of all drives used in atmosphere. The table below shows speeds in mph for streamlined craft with accelerations of 0.5G to 10G; divide by 10 for unstreamlined craft. For craft with different accelerations, find the square root of acceleration in G; then multiply by 2,500 if streamlined or 250 if unstreamlined. Round to the nearest 100 mph (nearest 1,000 if speed is 10,000 mph+).

## Air Performance Table

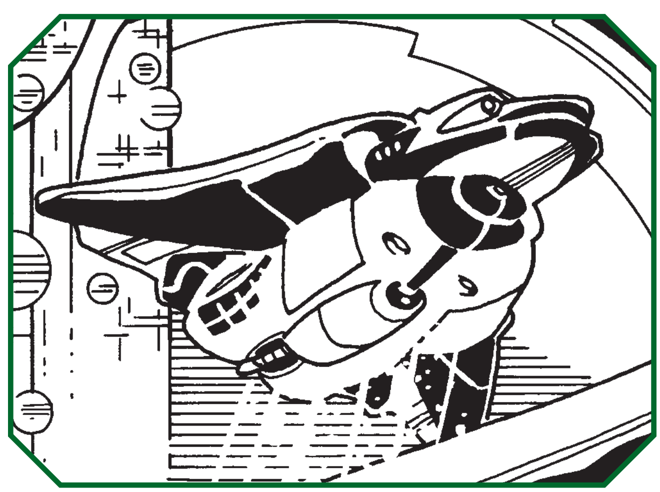
| G | Speed | G | Speed |
|---|---|---|---|
| 1G | 2,500 mph | 6G | 6,100 mph |
| 2G | 3,500 mph | 7G | 6,600 mph |
| 3G | 4,300 mph | 8G | 7,100 mph |
| 4G | 5,000 mph | 9G | 7,500 mph |
| 5G | 5,600 mph | 10G | 7,900 mph |

For half-G increments round up but multiply by 0.7, e.g., 0.5G is 1,750 mph.

Relevant air performance statistics to record are Move and Hnd/SR.

*Move:* As on p. B463, the first number for air Move is acceleration and the second is top speed in yards per second. For air acceleration, multiply acceleration in G of all drives used in atmosphere by 10. To get top speed, halve the calculated air speed in mph.

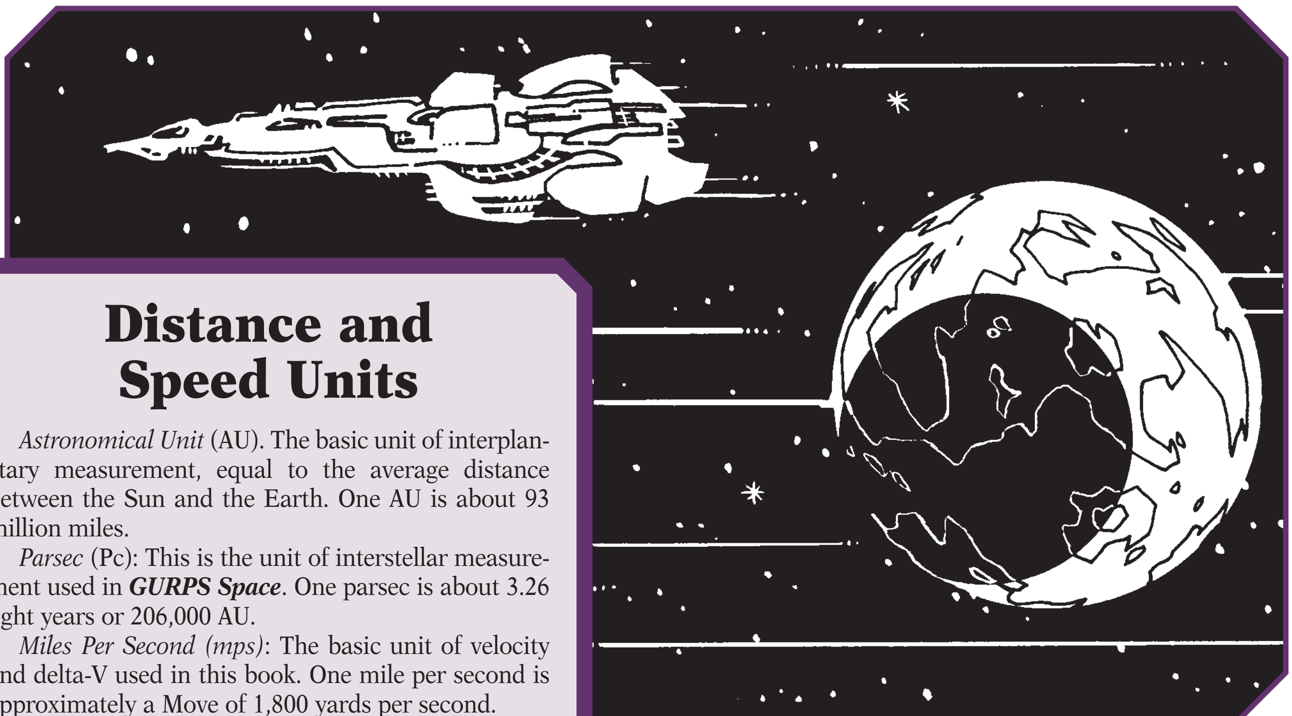
*Hnd/SR:* Use the spacecraft's Hnd/SR but add +2 to Hnd if it has contragravity lifters and +4 to Hnd and +1 to SR if winged. Max Hnd. is +5 regardless of bonuses!



# Chapter Three

# Space Travel

A space flight could be a journey of a few hundred miles up to low orbit, or an epic trek across the galaxy. This chapter presents basic rules for space travel, as well as common shipboard activities such as sensor scans, routine maintenance, and refueling. It also includes cost and mass statistics for consumables such as food and ordnance.



## Distance and Speed Units

*Astronomical Unit* (AU). The basic unit of interplanetary measurement, equal to the average distance between the Sun and the Earth. One AU is about 93 million miles.

*Parsec* (Pc): This is the unit of interstellar measurement used in ***GURPS Space***. One parsec is about 3.26 light years or 206,000 AU.

*Miles Per Second (mps)*: The basic unit of velocity and delta-V used in this book. One mile per second is approximately a Move of 1,800 yards per second.

# Maneuver Drives

Maneuver drives are used to propel a spacecraft through normal space, and if powerful enough, can be used to lift off from a planet or maneuver through an atmosphere.

### *Interplanetary Voyages*

The distance separating two planets in a star system may be as short as the difference between their distances from their star or as long as the sum of those distances, depending on their orbital positions. For an approximation, assume the distance between two worlds is equal to the average orbital radius (distance from its star) of the world *furthest* from that star.

The table below shows the orbital radii of planets and other significant bodies in our own solar system. ***GURPS Space*** can be used to determine these statistics for other systems, or the GM can just make up numbers using our solar system as a guideline.

The table shows orbital velocity (how fast the planet is moving in its orbit around the sun) in miles per second and orbital period (the time it takes to orbit the sun) in Earth years. These two statistics are used when calculating *Interplanetary Transfer Orbits* (p. 38). Also shown are gravity (G) and escape velocity, two statistics important for determining if a spacecraft can take off or leave orbit.

## Solar System Travel Table

| Planet | Orbital Radius | Orbital Velocity | Orbital Period | G | Escape Velocity |
|---|---|---|---|---|---|
| Sun | – | – | – | 28G | 383 mps |
| Mercury | 0.39 AU | 29.6 mps | 0.24 yr. | 0.38G | 2.7 mps |
| Venus | 0.72 AU | 21.8 mps | 0.62 yr. | 0.91G | 6.4 mps |
| Earth | 1 AU | 18.5 mps | 1 yr. | 1G | 6.96 mps |
| – Luna | 1 AU | – | – | 0.16G | 1 mps |
| Mars | 1.5 AU | 15.1 mps | 1.88 yr. | 0.38G | 3.1 mps |
| Ceres* | 2.7 AU | 11.3 mps | 4.6 yr. | 0.03G | 0.32 mps |
| Jupiter | 5.2 AU | 8.1 mps | 11.9 yr. | 2.36G | 37 mps |
| Saturn | 9.5 AU | 6 mps | 29.5 yr. | 0.92G | 22 mps |
| Uranus | 19 AU | 4.2 mps | 84 yr. | 0.89G | 13.2 mps |
| Neptune | 30 AU | 3.4 mps | 165 yr. | 1.19G | 14.6 mps |
| Pluto* | 40 AU | 2.9 mps | 248 yr. | 0.067G | 0.68 mps |
| Oort Cloud (comets) | about 10,000 AU | 0.59 mps | 200 yr. | neg. | neg. |

* Ceres is the largest main belt asteroid; Pluto is a large Kuiper Belt object. Oort cloud statistics are for a typical long-period comet.

# Newtonian Space Flight and Delta-V

The top speed of a spacecraft that uses a reaction drive is really its "delta-V": the maximum change of velocity it can perform before running out of reaction mass (rocket fuel, etc.). Each acceleration or deceleration "costs" a fraction of this delta-V.

The important spacecraft statistics are the acceleration of the reaction drive engines and the fuel tank's delta-V reserve of reaction mass for those engines.

The GM will want to know how far the destination is, in miles or AU, as well as the escape velocity (in mps) and gravity (in G) of the origin or destination worlds.

*Example:* The *Princess of Helium* is a passenger liner with a fusion torch drive. She's presently in Mars orbit. She has enough reaction mass in her fuel tanks to give the ship a delta-V reserve of 55 mps, and her drive has a 1G acceleration using her fusion torch engines. She's bound for Earth, which at this time we'll assume is about 1.5 AU from Mars.

## Getting into Space

To take off from a planet and reach a *low orbit* around a body requires a delta-V equal to 80% of the planet's escape velocity. This is 5.6 mps for Earth orbit. The spacecraft's acceleration must exceed gravity (1G, for Earth), or it must have wings (in atmosphere) or contragravity lifters.

To reach low orbit around a celestial body and then break orbit, escaping its pull of gravity, requires a delta-V equal to escape velocity. This is about 7 mps for Earth. The spacecraft's acceleration must also exceed gravity (1G, for Earth), or it must be winged (in atmosphere) or have contragravity lifters.

A spacecraft that is *already* in low orbit uses delta-V equal to about 30% of escape velocity to break orbit. This is about 2 mps to leave Earth orbit.

A winged or contragravity lifter-equipped spacecraft with jet engines (or reaction engines with the ram-rocket design feature) in a very thin or denser atmosphere (p. B249) needs less delta-V to reach orbit or escape velocity. First calculate air speed (see Air Performance, p. 35) using *only* the jet engine or ram-rockets; then divide mph by 3,600 (giving air speed in mps); then subtract this from required delta-V.

If escape velocity of other planets is not known, values can be determined from a planet's mass and radius relative to Earth. Multiply the above velocities by the square root of (Me/Re), where *Me* is mass in Earth masses and *Re* is planetary radius in Earth radii.

*Stars and Escape Velocity*: The sun's escape velocity is 383 mps. For other stars and remnants such as neutron stars or black holes, multiply this velocity by the square root of (Ms/Rs), where Ms is the mass in solar masses and Rs is the radii in solar radius.

Time required is to lift off or break orbit:

**T = dV × 0.045/A.**

*T* is time in hours.

*dV* is the total delta-V required.

*A* is the spacecraft's acceleration in G.

*Example:* The *Princess of Helium* is orbiting Mars and wants to break orbit. This requires 30% of Mars escape velocity. The escape velocity of Mars is 3.1 mps (see table), so she needs 0.93 mps. She reduces the reaction mass in her tanks from 55 mps to 54.07 mps. She could accelerate at full 1G, but since her passengers are from Mars, she decides to use less than that: a gentle 0.5G, intermediate between Earth and Mars gravity. Accelerating at 0.5G, time required is 0.93 × 0.045/0.5G = 0.084 hours, or about 5 minutes. After a brief acceleration, she's free of Mars' gravity!

## Space Travel with Reaction Drives

Orbital maneuvers, or interplanetary travel once a spacecraft has escaped orbit, require accelerating to the desired cruising velocity, coasting through space, then decelerating to the velocity required to orbit the destination.

To plot a space journey for a reaction drive-propelled spacecraft, decide how much of the spacecraft's delta-V reserve will be used to accelerate. This delta-V is the cruising velocity. An equal amount, minus the destination's own escape velocity, must then be used to decelerate, unless the spacecraft is to fly past or impact the destination.

*Example:* The *Princess of Helium* has just escaped Mars orbit and is boosting for Earth! She has a reserve of 54.07 mps of delta-V left in her fuel tanks. The navigator decides to accelerate to a cruising velocity of 25 mps, and as the spacecraft nears Earth, another 25 mps – 2.1 mps (Earth's "to orbit" velocity) to decelerate.

### *Travel Time*

The full travel time breaks down into acceleration, cruise, and deceleration steps.

#### *1. Time to Accelerate*

First, determine time the spacecraft will spend accelerating to the desired cruising delta-V. This is the acceleration time.

**T = dV × 0.0455/A.**

*T* is time in hours.

*dV* is the total delta-V required for the acceleration and deceleration.

*A* is the spacecraft's acceleration in G.

The spacecraft will normally spend the same time decelerating.

*Example*: Since *Princess of Helium* has an acceleration of 0.5G and wants to reach 25 mps, it spends 25 × 0.0455/0.5 = 2.3 hours accelerating to cruising speed near Mars. In the process, the occupants experience a gentle one-half of an Earth gravity acceleration. The ship will need to decelerate for the same time at the other end of its trip.

#### *2. Distance Traveled during Boost*

An additional complication that is important during short voyages is the distance that was traveled during the acceleration and deceleration phases of the journey.

**cD = T$^2$ × A × 0.00042.**

*T* is the acceleration time in hours as calculated above. *A* is the acceleration in G. *cD* is the distance traveled in AU during constant acceleration.

It's usually simplest to assume the deceleration distance is the same: double the distance.

*Example*: Since *Princess of Helium* spent 2.3 hours accelerating at 0.5G, she traveled 2.3$^2$ × 0.5 × 0.00042 = 0.0011 AU. We double that to include the deceleration burn, for 0.0022AU.

#### *3. Cruise Time*

If the distance traveled during the acceleration and deceleration phase is less than the total distance to the destination, the spacecraft will also spend time coasting. The time spent coasting (in zero-gravity, unless the spacecraft has spin gravity or artificial gravity generators) is calculated using this formula:

**Time spent coasting (days) = tD × 1,076/dV.**

*tD* is the distance to the destination in astronomical units (AU) minus the distance traveled during boost (while accelerating and decelerating).

*dV* is the cruising delta-V in mps.

*Example*: The distance from Mars to Earth is 1.5 AU. *Princess of Helium* has already traveled 0.0022AU while boosting to and decelerating from a speed of 25 mps, It therefore spends the following time between boost periods coasting in zero gravity: (1.5-0.0022) × 1,076/25 = 64.46days.

## Continuous Acceleration with Reaction Drives

A reaction drive vessel with enough delta-V can accelerate to midpoint, turn about, then decelerate, thrusting all the way, much like a reactionless drive craft:

**Delta-V (mps) required = (square root of [distance in AU/acceleration in G]) × 1,482 × acceleration in G.**

**Voyage time (hours) = delta-V/(21.8 × acceleration).**

### *Special Case: Ramscoops*

Spacecraft using reaction drives whose reaction mass is being provided by ramscoops can travel as if they had reactionless drive. However, they will generally first need to accelerate normally up to the ramscoop velocity (1,800 mps or more)!

## Travel with Reactionless Drives

Spacecraft with reactionless drives don't need to worry about reaction mass. They can continuously accelerate as long as the drives have power, although most are limited to velocities a fraction below light speed (186,000 mps).

## Interplanetary Transfer Orbits

Planets and other celestial bodies don't stand still. It's possible to carefully time an interplanetary trip so that the two planets' own orbits provide most of the necessary delta-V. Exact travel times will vary depending on the time of year. However, you can estimate the statistics of typical low-energy transfer orbit between two planets or other bodies (starting in orbit around one and ending in orbit around the other) using their orbital velocities and orbital periods. The *Solar System Travel Table* (p. 37) shows values for planets in our own system.

A transfer orbit involves maneuvers that require a delta-V equal to the difference in the two planet's orbital velocities (in mps). Use the first step of the reaction drive travel rules to find the time spent maneuvering.

The majority of the trip is spent drifting in the low-energy orbit. To find out how long this takes, add together the origin and destination body's orbital periods (in Earth years) and divide by 4 to get travel time in years. Multiply by 365 for days.

### *Blast Off!*

A spacecraft using a reactionless drive can fly into space if it has anacceleration less than the planetary gravity, or is winged (in a very thin or denser atmosphere), or is using contragravity lifters.

**To Orbit: T = ([Escape Velocity × 0.8]-Air Speed) × 2.8/-(A-G).**

**To Escape Velocity: T= (Escape Velocity)-Air Speed × 2.8/(A-G).**

*T* is time in minutes.

*Air Speed* is the top air speed in mps (mph/3,600) *if* the spacecraft has wings or contragravity. If not, treat as 0.

*A* is the spacecraft's reactionless drive acceleration in G.

*G* is the world's gravity; treat as *0* if the spacecraft uses wings or contragravity lifters.

### *Breaking Orbit*

A reactionless drive vessel that is *already* in orbit takes the following time to escape orbit:

**T = (eV × 0.3) × 0.0455/A.**

*T* is time in hours.

*(eV × 0.3)* is 30% of the world's escape velocity.

*A* is the spacecraft's acceleration using reactionless drive.

### *Space Travel Time (long voyages)*

Once a spacecraft has broken orbit, the time in hours required to travel a distance measured in AU, including acceleration and deceleration, is shown below.

**T = 68 × [square root of [D/A]).**

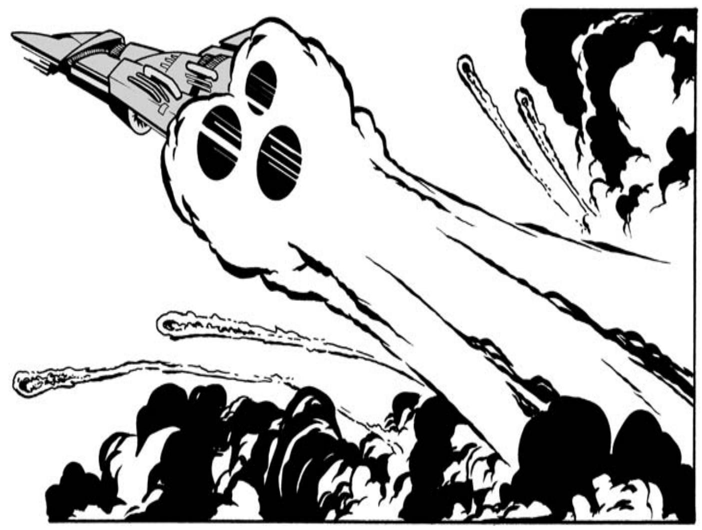
*T* is time in hours.

*D* is the distance in AU.

*A* is the spacecraft's acceleration in G.

The table below gives some typical times and distances.

(Peak velocity in mps will be: **10.9 × T × A**).



## *Travel Times*

| *AU* | *0.0001G* | *0.001G* | *0.01G* | *0.1G* | *1G* | *2G* |
|---|---|---|---|---|---|---|
| 0.1 | 3.1 months | 1 month | 9 days | 68 hours | 22 hours | 16 hours |
| 0.2 | 4.5 months | 5.7 weeks | 1.8 weeks | 4 days | 31 hours | 22 hours |
| 0.5 | 7 months | 9 weeks | 2.9 weeks | 6.3 days | 2 days | 34 hours |
| 1 | 10 months | 13 weeks | 1 month | 9 days | 2.8 days | 2 days |
| 2 | 14 months | 4.5 months | 6 weeks | 13 days | 4.1 days | 2.8 days |
| 5 | 23 months | 7 months | 9 weeks | 2.9 weeks | 6.3 days | 4.5 days |
| 10 | 32 months | 10 months | 13 weeks | 1 month | 9 days | 6.3 days |
| 50 | 5.5 years | 23 months | 7 months | 9 weeks | 2.9 weeks | 2 weeks |
| 100 | 7.8 years | 32 months | 10 months | 13 weeks | 1 month | 2.9 weeks |

### *Space Journey (short voyages)*

For short distances, such as from the Earth to the Moon, or moving about within a planetary orbit, distances in miles are easier to calculate. The time in minutes required to travel a distance measured in *miles,* including acceleration and deceleration, is shown below.

**T = 26 × [square root of [D/A]).**

*T* is time in minutes.

*D* is the distance in miles.

*A* is the spacecraft's acceleration in G.

(Peak velocity in mps will be 0.18 × T × A).

### *C-Fractional Velocity*

High acceleration reactionless drives may just boost up to near-light speeds. The time required to accelerate to (or from) a fraction of light speed, **c,** is shown below:

**T = V*c* × 8,300/A**.

*T* is time in hours.

*A* is acceleration in G.

*Vc* is the desired velocity as a fraction of light speed (1 *c* = 186,000 mps).

## Lightsails and Magsails

Treat space sails as reaction drives but with no limit on the delta-V they can spend (though their top speed is limited as noted in their description). They get more acceleration the closer they are to a star. Multiply the base thrust by $(1/D)^2$ where *D* is the average distance in AU from the star during the voyage.

This is a (somewhat unrealistic) simplification of actual sail flight. Most light sail or magnetic sails will accelerate into low-energy transfer orbits!

*Interstellar Voyages (measured in parsecs and years)*

Time required for a long voyage at c-fractional velocity:

**Ty = D × 3.261/Vc.**

*D* is the distance in parsecs.

*Ty* is the travel time in years.

*Vc* is the cruising velocity as a fraction of light speed.

*Interplanetary Voyages (measured in AU)*

**T = 500 × D/Vc.**

*T* is the travel time in seconds.

*D* is the distance in AU.

*cV* is as above.

*Short Voyages (measured in miles)*

A ship can travel **186,000 miles × Vc** every *second*.

## Atmospheric Flight

Spacecraft with wings, contragravity lifters, or if streamlined and with an acceleration greater than local gravity, can fly in an atmosphere.

Use the rules on p. B466 for air travel. Use Piloting (Aerospace) skill rather than their normal spaceship operation skill. Ships using contragravity lifters use Piloting (Contragravity).

### *Atmospheric Landings*

In a very thin or denser atmosphere (p. B429), a streamlined winged spaceship can glide down for orbit, landing like an airplane, even without engines, as can any spacecraft with a soft landing system Roll against Piloting (Aerospace) as described on p. B214; add the spacecraft's Handling modifier.

Failure means the approach wasn't perfect and the ship must abort and double back, or land in the wrong place. In busy airspace, the pilot may get in trouble for violating regulations. On a critical failure, or any failure by more than its SR, it's a crash landing that inflicts damage as per a very low velocity collision (p. 61) to one location. Roll: 1-3 front hull, 4-6 center hull.

Apply modifiers for terrain and weather. Spacecraft sensors can mean visibility is not a problem, but wind, hail, storms, ice, mountains, or built-up areas all give penalties: -1 (mountains), -2 (skyscrapers, strong winds, thin atmosphere), -3 (electrical storm), -4 (hail, very thin atmosphere), -5 (blizzard), -6 (hurricane).

### *Vertical Landing*

A spacecraft with acceleration better than the local gravity, or contragravity, can perform a vertical landing – "bringing her down on her jets." This is the only way to land if a world has a trace or vacuum atmosphere!

Landing takes 20/(Acceleration-Gravity) minutes. A Piloting roll is needed every five minutes (minimum one roll). If the vessel is streamlined and landing in atmosphere, this is easier: halve the time required. Modifiers are as for atmospheric landing, though weather is ignored in vacuum. Use the space handling rather than air handling modifiers if landing in a vacuum.

If using a reaction drive, this requires spending delta-V reserve equal to 0.1 mps × local gravity per attempt. Roll vs. Piloting skill. Success means a proper landing, failure means you may abort or suffer a crash landing (as detailed above), critical failure means you have a crash landing.

# Stardrives

Stardrives can work in just about any way the GM wishes. Thus, their performance depends on the intended scope of the campaign more than anything else. The GM should work out the mechanics of stardrive operation to suit the campaign. ***GURPS Space*** has detailed guidelines on the many different options and possibilities for GMs who wish to design their stardrives to suit a campaign. For GMs without ***GURPS Space,*** this section presents some ready-to-use examples.

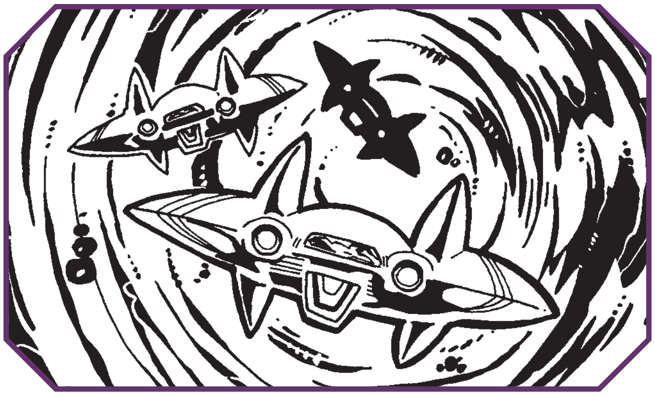
## Hyperdrive

This drive assumes the existence of *hyperspace*, a parallel dimension in which differing laws of physics permit faster-than-light travel. A vessel with a hyperdrive may enter hyperspace, taking a "short cut" through that dimension for a few days or weeks while traveling at faster than light speeds, then emerge back into the normal universe.

Typically, a starship must set a course to a specific destination, the navigator must plot a course, and then power up the drive to enter hyperspace. Some variants of hyperdrive also require first accelerating to a minimum velocity (which may be as high as near-light speeds) while heading in the general direction of the target. Once in hyperspace, a starship does not interact with the normal universe and may not maneuver or deviate from its plotted course. This may work differently in some universes!

The hyperspace voyage, or "skip," lasts for **distance in parsecs/FTL speed** days. Then the spaceship emerges into normal space. Any restrictions that apply to entering hyperspace usually apply to leaving it, e.g., if the drive won't work near a planet or star's gravity the starship must emerge a considerable distance away from any celestial bodies.

Skip accuracy typically is up to the GM, but often a successful Navigation (Hyperspace) roll is required. Plotting normally



takes about 30 minutes and usually can only be done from the general area of space where the skip is being performed. Success gets the spacecraft as close as it can safely come to the destination (depending on drive technology). Failure may be a miss by 10% of that safe distance × the margin of failure. Critical failure may be off by parsecs, an arrival someplace unpleasant, or an arrival *closer* than the safe distance with the drive disabled (destroyed on a failed HT roll).

## Jump Drive

This drive assumes the existence of natural or artificial jump points. These are "wormholes" or "jump lines" that connect two distant points in space, usually over interstellar distances, and which may require a special drive to open.

Solar systems on main travel routes will have two or more jump points leading to different destinations, creating a network of jump point routes that connect one system to the next. There may also be cul-de-sacs systems – dead ends with only one jump point. Jump point connections may or may not relate to real space: a jump point may connect to the nearest star, halfway across the galaxy, or even to alternate dimensions or times. Their size is also up to the GM – they could be thousands of miles across, or small enough that they limit the size of ships that can traverse them.

To use a jump point, a ship travels to it, powers up the jump drive, and is transported through to the other end of the jump point. Often the engines must be powered up for a total of 60/FTL hours, where FTL equals the FTL rating. A jump is normally instantaneous (although the GM may rule it requires a finite time). Jump points are often located thousands or millions of miles from planets, stars, and other jump points, so lengthy voyages through normal space may also be required. Therefore, a jump drive is usually installed in addition to another type of space drive.

Jump points that automatically connect directly to a single other jump point generally don't require Navigation rolls, although a Navigation or Piloting roll may be required if entering a jump point requires a very precise course.

### Jump Drive Variations

***Hyper Jump Drive:*** The starship must be at a jump point to use the drive, but the destination may be *any* other jump point within range and the drive otherwise functions like a hyperdrive.

***Probability Drive:*** When activated, probability is altered so the spacecraft vanishes from its own location and appears somewhere else, without crossing intervening space. Range is up to the GM; it could even be infinite. Using a probability drive requires Navigation or Electronics Operation (Matter Transmission) rolls, with a hefty minus (e.g., -10) if the destination is uncharted. Failure results in the starship becoming lost – it could turn up just about anywhere – and disables the drive until repaired. A critical failure may warp probability in strange ways, producing bizarre events or stranding the vessel in an entirely different dimension.

## Warp Drive

This allows the ship to travel and maneuver at faster-than-light speeds while still interacting with the normal universe. The drive may surround the ship it is mounted on in an energy field, such as a bubble of hyperspace, or may be a "blink warp" drive that moves the ship forward via a series of rapid micro-jumps.

A typical warp drive ship has a speed in parsecs per day equal to its FTL rating. (A speed of one parsec per day is equivalent to 220,000,000 miles per second.)

Standard warp drives only function in deep space. Some are automatically slowed to sublight speed when in close proximity to a star (e.g., within about 75 AU of a sun-sized body) but still work, e.g., at a speed of light-seconds per minute rather than parsecs/day.

# Space Operations

These are common activities such as entering or leaving the vessel, sensor scans, routine maintenance, and refueling.

## Access

The most common way to board a spacecraft is via a the vessel's airlock, but there are other methods!

### Airlock

An airlock allows people to enter or leave a ship in space without decompressing the vessel. The airlock is chamber with a heavy, pressure-tight door, valve, or hatch at either end. Some superscience airlocks may use rigid, airtight force fields instead of doors, although these are risky if the power fails!

The outer door connects the chamber to the outside. The inner door leads from the chamber to the spacecraft's corridors in whatever hull location the airlock is attached to.

A control panel is outside the spacecraft next to the outer door. A second panel is in the airlock chamber. A third panel is in the spacecraft corridor beside the inner door. Each panel includes airlock controls, an intercom, and a camera. The airlock can be operated via input from a panel, a control station, or the spacecraft's computer.

Individual control panels may be left "unlocked" so anyone can access them. Otherwise, a visitor must insert an access key, type an access code, submit to a biometric scan, or call someone for permission to enter (procedures will vary for each spacecraft).

Air pressure sensors and a pump are installed in the inner chamber.

### *Airlock Capacity*

The capacity of an airlock is the maximum number of human-sized individuals that can occupy it. The table below shows airlock capacity and area (in hexes) by spacecraft SM:

| *SM* | *+5-7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|
| Capacity | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Hexes | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 4 |

*Airlock Doors:* These have half of the armor of the hull section they are installed in. Multiply the hull section's dDR by 5 to determine an airlock's DR. They are HP 75.

### *Entering a Spacecraft via Airlock*

1. Access the outer airlock's control panel, or call inside. 2+ seconds.

2. Option: Use airlock controls to alter the pressure in the airlock chamber to the same pressure as the outside environment. It takes 1 minute × pressure differential in atmospheres, e.g., 1 minute to go from standard atmosphere (1 atm) to vacuum.

3. Unlock and open the outer door. 2 seconds. The atmosphere in the airlock chamber (if any) and outside environment will mix.

4. Enter airlock chamber. 1 second.

5. Use airlock controls to close and lock outer door. 1 second.

6. Option: If sensors indicate a foreign atmosphere in the airlock chamber, use controls to pump out existing air and replace it with the spacecraft's own atmosphere. 1 minute + (1 minute × pressure differential).

7. Option: If the airlock chamber is equipped with decontamination systems, initiate these procedures. This takes a further (13-TL) minutes.

8. Use controls to unlock and open outer door. 1 second.

9. Enter spacecraft. 1 second.

Chambers can typically vary their pressure from 0 to 5*n* atmospheres, where *n* is the hull dDR.

### *Exiting an Airlock*

1. From inside the spacecraft, unlock and open the inner door. 2 seconds.

2. Enter airlock chamber. 1 second.

3. Close and lock inner door. 2 seconds.

4. Option: If the airlocks are equipped with decontamination systems, use controls to initiate decontamination. These procedures take (13-TL) minutes.

5. Option: If the external pressure is less than that of the spacecraft, e.g., a vacuum, depressurize the airlock chamber. This will prevent the occupants being blown out into space when the door is opened! This takes two seconds to initiate. A depressurization warning sounds. The pressure starts to drop slowly to the desired level, which takes 1 minute × pressure differential in Earth atmospheres. The cycle can be halted or reversed.

6. Unlock and open outer door. 1 second. The airlock chamber is exposed to the outside environment. If the outside environment is at a lower pressure than the chamber, any air rushes out, possibly also sucking out any occupants of the airlock chamber.

7. Leave airlock (unless blown out already!). 1 second.

### *Docking*

Standard airlock doors are designed so that a spaceship can mate airlocks directly with a station, or so that a small craft can mate directly with a larger spacecraft. Airlocks designed by different spacefaring cultures are normally incompatible, but regular trade might result in agreements that standardize these fixtures, even between aliens!

Docking generally takes about one minute and requires a Piloting roll by the pilot of any craft that is actively maneuvering. The larger craft will usually hold its course as the smaller one docks (only the pilot of the smaller craft rolls), but if both vessels are maneuvering, both pilots must roll. Failure means that another minute is needed. Critical failure results in an emergency situation. Roll again: any success means trouble is averted, but a second failure or critical failure results in a minimal-speed collision (p. 61).

### *Passage Tubes*

A passage tube is a flexible tube that connects the airlocks of two spacecraft in space that have compatible atmospheres. It holds pressure, allowing the occupants to travel between ships without the need to cycle airlocks. It may be extended out to 30 yards, is about two yards in diameter, and hooks to standard fittings around exterior airlocks. Rigging it takes about an hour in free fall (30 minutes with multiple workers), and requires a Mechanic (Vehicle Type) roll.

## *Emergency Pressure Doors*

Spacecraft may have pressure-tight doors to seal off compartments.

SM +5-6 spacecraft have no pressure doors. If the spacecraft hull is breached or a cargo bay door is opened, the entire spacecraft is affected.

SM +7-9 spacecraft have pressure doors that separate each hull section: one for the front hull, one for the center hull, and one for the rear hull. A breach or open cargo bay door will affect the hull section it occurs in.

SM +10 and up spacecraft have pressure doors that separate each *system*, excluding armor systems. A breach or open bay door only affects that particular system.

Doors are armored with half the dDR of their hull section's armor, i.e., DR = 5 × hull dDR, or DR 5 if the hull section has no armor. A door seals shut automatically if emergency sensors detect pressure loss, fire, or smoke in the compartments on either side of the door. Doors will seal in two seconds and will do (ship SM) dice crushing damage each turn to anyone caught in them. A character next to a door can roll vs. DX to try and jam the door or dive through it. Failure means the character was caught by the door and takes (spacecraft SM) dice of crushing damage. Roll hit location – if the door fails to kill the character (torso or head) or destroy a limb (or whatever was jammed into it), then it is stuck open. Doors can be manually overridden via an appropriate authorization code input through the vessel's computer or control stations; authority to do this is usually restricted to engineering damage control teams or the spacecraft's command crew.

## Cargo Bay Doors

If a spacecraft hull section (front, center, or rear) has cargo holds, it will have cargo bay doors. A given hull section has *one* set of cargo bay doors, which provide access to all cargo holds in that part of the hull. Doors have the same dDR as the spacecraft hull. They are not airlocks – air spilled is lost. It takes two seconds to open or close cargo bay door, using controls next to the bay doors on the outside and inside. Computer AIs and control stations can also open or lock them.

The maximum SM object that easily fits through cargo hold doors is the hull SM-5 if the hull section has 1-2 cargo holds, or hull SM-4 if it has 3-6. A successful Freight Handling roll lets an object of one SM greater to be maneuvered through the door. Failure means the item is stuck, requiring minor repairs (dismantling the door or the object) to clear access. The actual width and length a cargo bay door (in yards) is shown below, depending on the number of cargo holds in that hull section:

| *SM* | *+5* | *+6* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-2 holds | 1.5 | 2 | 3 | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 |
| 3+ holds | 2 | 3 | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 |

## Hangar Bay Doors

Hangar bays are equipped with much larger doors than cargo bays. Moreover, the entire bay is designed to function as a giant airlock! It can be evacuated (storing the air in holding tanks) before the doors are opened. It takes 1.5 minutes × pressure differential (in atmospheres) to change the pressure in a hangar bay. Thus, it usually takes 1.5 minutes to go from 1 atmosphere to vacuum, or vice versa. The normal procedure is to evacuate the hangar bay and keep it evacuated during all launch or recovery operations.

If a spacecraft hull section (front, central, or rear) has hangar bays, it has hangar bay doors. They take two seconds to open or close. A given hull section has one set of hangar bay doors, which accesses all hangar bays in it. The diameter (in yards) is shown below:

| *SM* | *+5* | *+6* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-2 bays | 2 | 3 | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 |
| 3+ bays | 3 | 5 | 7 | 10 | 15 | 20 | 30 | 50 | 70 | 100 | 150 |

The maximum SM object that can be maneuvered through the doors is equal to hull SM-4 if 1-2 bays or hull SM-3 if 3-6 bays. Squeezing larger objects through is not possible, as the airlocks are more complex than cargo bay doors.

## Hull Breaches

Another way to get into or out of a spacecraft is through a big hole. The hull is *breached* if any non-core system is disabled or destroyed. Typical breach diameter (in yards) is shown on the table below. For disabled systems, roll for diameter. For destroyed systems, the breach is automatically the maximum possible size that can be rolled (e.g., instead of a +9 SM hull having a 2d yard breach, it is 12 yards).

| *Hull SM* | *+5* | *+6* | *+7* | *+8* | *+9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Disabled | 1d-3 | 1d-2 | 1d | 1d+2 | 2d | 2d+3 | 4d+1 | 6d-1 | 8d+2 | 12d-2 | 16d+4 |
| Destroyed | 3 | 4 | 6 | 8 | 12 | 15 | 25 | 35 | 50 | 70 | 100 |

See the section on *Emergency Pressure Doors* for how much of the hull will be evacuated or exposed to foreign atmosphere during a breach. Most spacecraft systems are designed to survive decompression, but plants in open spaces and delicate furnishings or supplies in habitats (e.g., bottles of wine in bar establishments, etc.) will be lost if exposed.

### *Teleport Projectors*

Why bother with doors? See *Teleport Projector* (p. 18).

## Cargo Handling

Loading or unloading time for cargo is about one man-hour per 100 tons at a port facility with heavy machinery or if the vessel is docked in a larger spacecraft's hangar bay, or at a rate of 1 man-hour per 10 tons otherwise (including moving ammunition from a cargo bay to a gun or launcher, or a vessel in a hangar bay). Roll against Freight Handling (and Hazardous Materials, if necessary) skill to properly load cargo. Success means everything is stowed properly. Failure means it was stowed haphazardly: any attempts to unload the cargo take twice as long. Critical failure results in unsafe stowage: triple unload time, and the cargo may break, leak, or escape!

## Computers and Software

Spacecraft with computer networks use the rules on p. B473. Control stations and offices or ops centers have terminals that can access it; computers carried by occupants and desktop models installed in cabins or bunkrooms may be able to interface with the network if it's designed to allow it.

These rules ignore most software. Ship navigation, targeting, etc., is a simple computing problem; even the lowest-complexity spacecraft systems can simultaneously run all necessary software. Weapon sAcc values already include targeting programs.

The major advantage of better computers is to run high complexity programs like cryptographic analysis, language translation, or even Artificial Intelligences that can function as crew members! See ***GURPS Ultra-Tech*** for AIs and other software.

## Comm/Sensor Arrays

Any vessel with a control room has a basic comm/sensor array. Some vessels have enhanced, multipurpose, science, or tactical comm/sensor arrays. All are integrated communication and sensor suites whose capabilities are simplified into a single comm/sensor array *level*.

Unless given the FTL option, detection and communications occur at the speed of light, and over long distances. Time lag is one second per 186,000 miles, or 500 seconds per AU, each way.

Arrays have the following navigational, sensor, and communications capabilities:

### *Passive Sensors*

Comm/sensor arrays include telescopes (visual, infrared, ultraviolet, radio) for navigation, detection, and targeting. They usually operate in infrared mode for long range detection, but also produce telescopic imagery ("on screen") or perform multispectral sensing.

Passive sensors are operated from a control station (or by a sapient program). The operator uses Electronics Operation (Sensors) skill, using the *Sensors* rules (p. B471). The sensors are vehicular imaging sensors (p. B471) that provide Hyperspectral Vision (p. B60) with Extended Low Band (and Extended High Band, for science and multipurpose arrays), Telescopic Vision (p. B92) and 360° Vision (p. B34). The Telescopic Vision Level is equal to the comm/sensor array level.

Passive sensors can also detect and locate any operating active sensor or broadcast signal within twice its own range (see Signal Detection, below).

Spacecraft will usually be using passive sensors to detect other spacecraft. The relevant modifiers are summarized below. Roll vs. Electronics Operations (Sensor) skill adding the modifiers shown below; if the modifiers total +10 or more, the GM may assume automatic identification. Passive sensors only detect objects in line of sight – something behind a world, larger station, underwater, etc. won't be detected. Modifiers:

**SM:** Add the object or spacecraft's Size Modifier.

**Time Spent:** Assume a complete scan around the vessel takes 20 seconds. Time spent modifiers apply (e.g., +3 for a full 3-minute space combat turn, or +5 for half an hour).

**Range***:* Apply the Range modifiers from p. B550. In space combat, -10 at zero (100 yards), -30 at point-blank (100 miles), -34 at close (500 miles), -38 at short (2,500 miles), -42 at long (10,000 miles), -46 at extreme (50,000 miles). For astronomical ranges: -50 at 200,000 miles (1 LS), -54 at 1 million miles (5 LS), -60 at 10 million miles (100 LS), -66 at 100 million miles (1 AU), -72 at 1 billion miles (10 AU), -75 at 7 billion miles (75 AU; scan entire solar system).

**Telescopic Vision:** Reduce the above range penalty by the level of Telescopic Vision. You may "zoom in" and use twice the Level if the target's approximate location is already known. This includes attempts to get a better look at a detected target, rolls to spot targets whose orbits are already charted (e.g., charted satellites, celestial bodies, etc.) or whose radio, radar, or transponder emissions have been detected.

**Damage:** If an enhanced, tactical, multipurpose, or science array is disabled or destroyed, a vessel can use its basic array. A basic array is only destroyed if the control room or spacecraft is destroyed. All arrays are at -1 if the spacecraft is reduced to 0 HP or less.

**Observation:** +10 if object is in plain sight (in space, air, or a world's surface) rather than concealed, camouflaged, hidden among debris, or using a Cloaking Device.

**In Space:** +2 if the object is silhouetted against a larger celestial body, +24 if silhouetted against deep space. Note that this is cumulative with the plain sight modifier.

**IR Signature***:* Spacecraft often put out a lot of heat and light! If trying to detect a spacecraft or similar object, apply the single highest applicable modifier:

Minimal power: 0*.

Auxiliary power: +3.

Fuel cell, solar panels, or jet engine: +4

MHD turbine, chemical or HEDM rocket engine, or flying in atmosphere at 3,600+ mph: +5

Fission reactor, nuclear thermal rocket, nuclear light bulb, or performing a high-speed atmospheric reentry: +6.

Antimatter thermal rocket engine, antimatter reactor, fusion reactor, super fusion reactor, total conversion reactor, magsail, lightsail: +7.

Fusion pulse drive or fusion rocket engine: +8.

Advanced fusion pulse, antimatter plasma, nuclear saltwater rocket, or external pulsed plasma engine: +9.

Antimatter plasma torch, antimatter pion, or fusion torch engine: +10.

Antimatter pion torch, super antimatter plasma torch, or total conversion torch engine: +11.

Super conversion torch engine, or any "cosmic" power plant: +12.

Reaction engine modifiers assume the rear hull (with drive) is facing toward the sensor array; if it's the central hull, reduce by one; if it's the front hull, reduce by two.

**Countermeasures***:* The following modifiers apply:

-10 if target is using a cloaking device.

-2×(TL-4) if using a stealth hull *unless* the target has signature modifiers of +5 or more.

* Auxiliary power permits operation of all non-high-energy or cosmic energy systems. Minimal power does not permit the use of any life support (except hibernation chambers), active sensors, or ECM.

*Failure* means no contact (a critical failure may mean a misidentified contact or other error); the operator may repeat the task on later turns if there is reason to believe something is out there.

*Success* means detection of the object's presence, range, course, temperature class, and SM, but no other details. Once an object is detected the sensors will automatically keep track of it (along with anything it launches). It remains detected as long as it remains in line of sight and does not activate a cloaking device. If it cloaks, a new detection roll is required. If it leaves line of sight and reappears later, a new roll is also needed.

## *Signal Detection*

The passive sensors in comm/sensor arrays also incorporate radio, laser, and radar detectors. If a vessel is using radar or broadcasting radio signals, or using a transponder, these sensors automatically detect the signal out to twice the active or broadcast range. (1.5× range if the signal was low-probability intercept (LPI) – see p. B82). Ladar and tight beam laser comm signals are detected only if the spacecraft was their target, or happened to be in their path. FTL radio and para-radar multiscanner emissions can only be detected if the vessel also uses such a system; if so, treat them as radio and radar, respectively. The sensor operator will detect the type of signal, the content of any (non-encrypted) broadcast and an approximate bearing (passive sensors can use twice their Telescopic Vision level from range modifier). A successful Electronics Operation (EW) roll can also reveal useful details ("that was a Type 23 radar used by the Federal Navy").

## *Active Sensors*

Active sensors in a comm/sensor array consist of radar and ladar used for navigation, detection, and targeting. Their range is measured in light seconds (one light second is 186,000 miles). They can be operated from one of the vessel's control stations or its computer. All sensors can generate multiple sensor beams that can track any number of targets simultaneously.

Active sensors are less important for spacecraft than passive sensors; usually the passive sensors detect targets at much longer distances. Active sensors are mainly used as part of targeting systems, for radar mapping of worlds (especially if cloud covered) and, in the case of superscience multiscanners, for "sensor scans" to analyze a target.

Active sensor use in space combat is integrated into the combat rules in Chapter 4. Otherwise, use the vehicular active sensor rules (p. B471-472).

All types of array can be used as a radar (p. B81) with the Extended Arc (360 degrees), LPI, and Multimode enhancements. Enhanced, tactical, and science arrays also include a ladar with (p. B81) with Extended Arc (360 degrees) and LPI enhancements; see *Scanning Sense*, pp. B81-82. If the spacecraft has the multiscanner design switch all arrays have a para-radar (p. B81) with the Extended Arc (360 degrees) enhancements.

The active sensor's range in light seconds is determined by the array level: see *Active Sensor and Comm Range Table* below. You can multiply by 200,000 to get range in miles. On a world, it can see out to the horizon.

### *Active Sensor and Comm Range Table*

| *Level* | *Range* | *Level* | *Range* |
|---|---|---|---|
| 1 | 0.1 | 10 | 3 |
| 2 | 0.15 | 11 | 5 |
| 3 | 0.2 | 12 | 7 |
| 4 | 0.3 | 13 | 10 |
| 5 | 0.5 | 14 | 15 |
| 6 | 0.7 | 15 | 20 |
| 7 | 1 | 16 | 30 |
| 8 | 1.5 | 17 | 50 |
| 9 | 2 | 18 | 70 |

E.g., a Level 8 array has a 1.5 LS range active sensor and 1.5 AU range comm suite.

## Detection

This information is automatically available about a detected spacecraft:

Size, mass, and acceleration.

Type of maneuver drive, if the spacecraft accelerated.

Power plant and Power Points.

At point-blank or short range, these systems will be visible if they are in a hull section on a detected object facing the targeting vessel:

Comm/sensor array (any type), habitat, hangar bay, reaction drives, weapon battery, robot arms or legs, any destroyed systems (but not what they were), open space.

Operating force screens (at GM's option).

The main radiator array and winged features.

Additional information may be available via *Sensor Analysis* tasks (p. 52).

### *Communications ("Comm Suites")*

Comm/sensor arrays have very long range laser communication and radio (p. B91), communicators. Range depends on the array level – see the *Active Sensor and Comm Range Table,* reading the range in astronomical units (AU). Use the communications rules on p. B471 and p. B91. Spacecraft also have internal intercoms in all systems except armor and fuel tanks, as well as outside next to airlock, hangar, and cargo doors.

#### *Transponders*

Comm suites may be set to automatically broadcast identification codes for traffic control purposes. Regulations may require civilian spacecraft to broadcast their identity using transponders whenever they are operating in civilized shipping lanes. Crews that find this onerous may reprogram them to emit false identity signals. Reprogramming a transponder may be a trivial exercise, or it may require difficult Electronics Operation (EW) or Computer Programming rolls (GM's discretion). The usual deterrent to using a false signal or no signal is fines or worse if caught by authorities.

## Overloading Life Support

A spacecraft's ability to carry people is normally limited by its rated occupancy, but it can be increased *in extremis* by cramming more people into it. Roll 3d against HT+4 each day of overloading, at -1 per full 10% by which the number of people aboard exceeds system capacity. On a failure, the system begins to break down, losing 10% of its current capacity for each point by which the roll was missed. A Mechanic (Life Support) roll can be attempted once per day; if it succeeds, it will restore 10% of full capacity. Once the life-support system begins to fail, the effect snowballs; if the ship remains overloaded, life support will eventually reach 0% and fail. At that point, all oxygen in the air will be used up within a few hours. Then everyone who needs to breathe will start to suffocate.

## Repair and Maintenance

Spacers often spend much of their time maintaining onboard systems; the listed workspace requirements in Chapter 2 cover the crew (humans or robot) needed.

See the Damage Control rules in Chapter 4 for the rolls needed to repair disabled systems and dHP. A destroyed system must be replaced at full cost (usually at a shipyard with sufficient hangar space for the vessel) plus a 10% fee. It will normally require one day per spaceship dHP for a full dockyard to replace a destroyed system. Multiply this time by 10 if the space yard doesn't have sufficient hangar space to put the spacecraft in an internal dock. If the spacecraft has fabricators, robofacs, nanofacs, or replicators, it can manufacture replacements onboard.

# Consumables

Spacecraft may require various consumables: fuel, coolant, food, ammunition, and ordnance. This is not included in the spacecraft's base cost.

## Refueling

Reaction drives consume reaction mass from fuel tanks as spacecraft use up their delta-V. Some power plants require periodic refueling.

### *Refueling Fuel Tanks*

Fuel tanks are rated for their tons of fuel and the delta-V reserve they provide. The cost to completely refill a tank depends on the tons and type of reaction mass stored in it.

### *Reaction Mass Cost Table*

| *Reaction Mass* | *Cost per Ton* |
|---|---|
| Water | $20 |
| Coolant | $150 |
| Ionizable reaction mass (e.g., argon) | $180 |
| Rock dust (for mass drivers) | $2 |
| Rocket fuel (liquid hydrogen/oxygen) | $800 |
| Hydrogen | $2,000 |
| Jet fuel | $4,000 |
| HEDM rocket fuel | $6,000 |
| Antimatter-catalyzed hydrogen or water | $20,000* |
| Nuclear pellets | $50,000 |
| Uranium-saltwater | $100,000 |
| Antimatter-boosted hydrogen or water | $12,000,000* |
| Nuclear bomb pulse units | $250,000 |
| Matter/antimatter | $10,000,000,000,000* |

* In superscience settings where total conversion power or cosmic energy technology exists, cost of *any* type of antimatter reaction mass may be as little as $6,000/ton.

The cost to *partially* refill a tank to replace 1 mps of delta-V is:

Cost of 1 mps delta-V = refill cost divided by full tank's delta-V.

#### *Fuel Transfers*

If two spacecraft with different sizes or different reaction drives transfers tons of reaction mass between each other, adjust each of their reserves of delta-V:

Current delta-V (mps) = (remaining tons/full tons) × full delta-V.

*Remaining tons* is the tons of reaction mass the spacecraft has left after the transfer.

*Full tons* is the tons of reaction mass the spacecraft has with full tanks.

*Full delta-V* is the spacecraft's delta-V with full tanks.

A spacecraft can transfer up to 10% of its total fuel or reaction mass every three minutes (1% every 20-second turn).

### *Power Plant Refueling*

Power plants whose endurance is measured in years combine refueling with major reactor overhauls (since their cores are often radioactive). The fuel for the normal listed endurance is included with the spacecraft's cost. Refueling requires a shipyard of the power plant's TL or greater. The cost, with maintenance, is a fraction of the cost of the power plant: 10%

## *Gun and Missile Ammunition Table*

| *Caliber* | *Conventional Gun* | *Electromagnetic Gun, Grav Gun* | *Missile* | *SM* |
|---|---|---|---|---|
| 2cm | 1/4,000 | 1/8,000 | – | -7 |
| 2.5cm | 1/2,000 | 1/5,000 | – | -7 |
| 3cm | 1/1,600 | 1/3,200 | – | -6 |
| 3.5cm | 1/1,200 | 1/2,400 | – | -6 |
| 4cm | 1/800 | 1/1,600 | – | -5 |
| 5cm | 1/400 | 1/800 | – | -5 |
| 6cm | 1/200 | 1/400 | – | -4 |
| 7cm | 1/125 | 1/250 | – | -4 |
| 8cm | 1/80 | 1/160 | – | -3 |
| 10cm | 1/40 | 1/80 | – | -3 |
| 12cm | 1/25 | 1/50 | – | -2 |
| 14cm | 1/16 | 1/32 | – | -2 |
| 16cm | 1/10 | 1/20 | – | -1 |
| 20cm | 1/5 | 1/10 | 1/5 | -1 |
| 24cm | 1/3 | 1/6 | 1/3 | 0 |
| 28cm | 1/2 | 1/4 | 1/2 | 0 |
| 32cm | 1 | 1/2 | 1 | +1 |
| 40cm | 2 | 1 | 2 | +1 |
| 48cm | 4 | 2 | 4 | +2 |
| 64cm | 7.5 | 4 | 7.5 | +2 |
| 80cm | – | – | 15 | +3 |

Ammunition costs $100K per ton for guns or $1M per ton for missiles.
*SM* is used when the projectile is attacked as part of point defense fire.

for fission, fusion, or super fusion power plants, 50% for antimatter power plants.

Fuel cells are refueled the same way as fuel tanks. Refueling a fuel cell costs 25% of the cost replacing a tank of rocket fuel for the same SM spacecraft.

# FOOD

Spacecraft with limited or full life support must carry food supplies. Spacecraft with total life support, or with replicators or open spaces devoted to farms may omit food supplies (though they might stock it for variety.) Each 500 man-day supply is $1,000 and 1 ton. Gourmet supplies (suitable for first-class passengers) are 10× as expensive.

# AMMUNITION

Guns and launchers require ammunition. The mass of the specified gun or missile shots are included in weapon batteries, but extra ammunition can be carried as cargo. The cost of ammunition is *not* included.

The table shows the mass in tons per gun shot or missile, e.g., 1/4,000 of a ton means one ton will allow storage of 4,000 shots.

### *Super Missiles (TL11^)*

"Super missiles" with 100G+ accelerations may optionally be available (usually if similar accelerations are standard for spacecraft). Super missiles are 2× as expensive.

### *Conventional Warheads*

Missile and gun ammunition costs assume conventional warheads. A conventional warhead may either impact and penetrate the target, or be proximity fused to explode at a distance into a shotgun-like blast of high-velocity fragments. LC2.

### *Unconventional Warheads*

Missile and guns may also use other warheads. For unconventional warheads there is an extra cost assessed *per warhead* (per missile or shot) rather than per ton.

*Nuclear* (TL7): A typical fission or multi-stage fission-fusion warhead. Cost is $50K for 25 kiloton, $100K for 100 kiloton, $500K for 2.5 megaton, $1M for 10 megaton. Only heavy missiles or bombs may have 2.5 megaton or 10 megaton warheads.

*Antimatter* (TL10): A "clean" antimatter-catalyzed fusion warhead that is unaffected by nuclear dampers and may also be smaller in size than a standard nuclear warhead. Cost is $100K for 25 kiloton, $200K for 100 kiloton, $1M for 2.5 megaton, $2M for 10 megatons. Divide cost by 2 at TL11-12. Only heavy missiles or bombs may have 10 megaton warheads.

## *Unconventional Warhead Table*

| *TL* | *Warhead* | *Minimum Size* | *Cost* |
|---|---|---|---|
| 7 | 25 kiloton nuclear | 16cm | $50K |
| 7 | 100 kiloton nuclear | 20cm | $100K |
| 7 | 2.5 megaton nuclear | 40cm | $500K |
| 7 | 10 megaton nuclear | 56cm | $1M |
| 10 | 25 kiloton antimatter | 10cm | $100K |
| 10 | 100 kiloton antimatter | 16cm | $200K |
| 10 | 2.5 megaton antimatter | 24cm | $1M |
| 10 | 10 megaton antimatter | 40cm | $2M |

# DROP CAPSULES

These are designed to let their occupants enter atmosphere safely. They have small rocket engine clusters that provide limited maneuverability, but careful landing is a matter of good navigation. De-orbiting takes two or three rotations around a planet with an Earthlike atmosphere (more for a planet with a thinner atmosphere, such as Mars). During this time, radio, radar, and all passive sensors will be blinded due to plasma effects.

For more information, see ***GURPS Ultra-Tech*** (p. 232).

# Chapter Four
# Basic Space Combat

Spacecraft may contest the space around a planet, station, or jump point, or do battle in deep space. This combat system is intended to convey the feel of personal combat, but on a larger time scale and for vessels with multiple crews. It abstracts movement while focusing on crew tasks.

## The Engagement

Before combat can occur, opposing vessels must have maneuvered into the same area of space, typically within a few hundred to several thousand miles of each other. Use the space travel and detection rules in Chapter 3, and the combatant's relative courses and planned dispositions to determine if an encounter is likely. The GM may assume that neither side has detected the other, or may start the battle assuming detection has already occurred. The GM must also decide on encounter distance and turn length.

### Ambush and Surprise

In some situations, one side may be able to ambush the other. Situations that might let a spacecraft get close enough to avoid detection include:

- All of one side's spacecraft are using cloaking devices.
- A seemingly-friendly spacecraft suddenly attacks.
- A spaceship appears unexpectedly from inside a space station, asteroid base, etc.
- A spacecraft was masked by a planet, moon, asteroid, or large space station.

The GM may rule that an ambush does or does not take place on the basis of a roleplayed situation, a clever plan, or a Quick Contest of Tactics skill.

Vessels on an ambushed side will have surprised crews (see below), and the GM may also rule that the encounter will take place at a shorter distance than usual.

### Encounter Distance

Select the encounter scale that suits the type of vessels involved.

*Close Combat Scale*: Typical engagement range is 20 to 2,000 miles. This is suggested if most important vessels involved have delta-V reserves below 5 mps or if no weapons have ranges greater than Short. It shouldn't be used if vessels have 50G or more acceleration, as they'll race through the engagement area.

*Standard Combat Scale:* Typical engagement range is 200 to 20,000 miles. This scale works best for vessels with 0.5G to 500G acceleration, or if no weapons have ranges greater than Long.

*Distant Combat Scale*: Typical engagement range is 2,000 to 200,000 miles. This scale is suggested if at least some of the spacecraft involved use weapons with Extreme range or if very fast drives (50G and up) are used.

### Turn Length

Space battles are fought in *space combat turns* whose length depends on the encounter scale and spacecraft performance. The GM determines turn length by selecting a reference spacecraft acceleration from the *Scale Table* below, and cross-indexing it with the encounter distance. Ideally, all spaceships will fall into the same acceleration category. If not, the GM decides on the reference vessel – usually either the best-performing craft, one that's most typical of the encounter, or the most important craft (e.g., the PCs' ship).

### Scale Table

| Acceleration | Close Scale | Standard Scale | Distant Scale |
|---|---|---|---|
| Under 0.05G | 10-minute | 10-minute* | 10-minute* |
| 0.05G+ | 3-minute | 10-minute | 10-minute* |
| .05+ | 1-minute | 3-minute | 10-minute |
| 10G+ | 20-second | 1-minute | 3-minute |
| 50G+ | 20-second† | 20-second | 1-minute |
| 500G+ | 20second† | 20-second† | 20-second |

* Spacecraft with the reference acceleration or less can't significantly alter course during the fight – tactics will be dominated by gunnery and damage control, not maneuver.

† Spacecraft with the reference acceleration are properly moving too fast for this encounter scale to be optimum, although you may use this scale if you wish!

*Example:* The smuggler *Rose of Rigel* (with 2G acceleration) is boosting away from the planet Moonjam. In orbit is the hostile patrol ship *Shambleu* (4G acceleration). The GM decides it will be a standard scale encounter. Their drives both fall into the 0.5G+ category, so the GM cross indexes that with standard Scale and determines the space combat turn will be three minutes long.

## *Encounter Velocity and Fast Passes*

Based on decisions made before the battle begins, the GM should have an idea how fast vessels are moving. Using the table below, determine whether any spacecraft are making a *fast pass* – moving so quickly they'll flash right through the encounter area in a turn or two. Examine the table below, comparing turn length and encounter distance to find a threshold velocity.

## *Fast Pass Threshold Table*

| *Scale* | *Close* | *Standard* | *Distant* |
|---|---|---|---|
| 20-second turn | 50 mps+ | 500 mps+ | 5,000 mps+ |
| 1-minute turn | 15 mps+ | 150 mps+ | 1,500 mps+ |
| 3-minute turn | 5 mps+ | 50 mps+ | 500 mps+ |
| 10-minute turn | 1.5 mps+ | 15 mps+ | 150 mps+ |

Any spacecraft the GM decides has a velocity exceeding this threshold is making a "fast pass." Others are moving slowly enough to stay in the battle area. Otherwise, This is a fuzzy line: If a craft is within +/-50%, the GM can opt to treat it as fast or not, as desired.

*Example:* Continuing from the previous example, the GM decides the *Rose of Rigel* has just exceeded 7 mps, Moonjam's escape velocity, and that *Shambleu* is probably at orbital velocity, around 5 mps. Both of these falls under the 50 mps threshold for a standard scale encounter with 3-minute turns, so neither spacecraft is making a fast pass.

## *Pre-Battle Preparation*

*Current Delta-V:* If a spacecraft has already used a reaction drive before the combat began, note how much of its delta-V reserve remains available.

*Formations:* Spacecraft may be declared either to be in formation or docked, before an engagement begins. See *Formations* (p. 65).

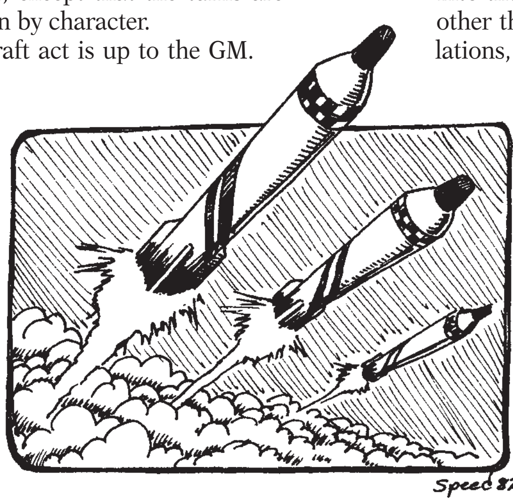
*Crew and Passenger Locations:* The GM should know where each PC and important NPC is in the spacecraft, and have a general idea where everyone else is as well. Some tasks can only be properly performed from certain systems (see *Character Actions*, p. 50). On SM+5-6 spacecraft, characters may only occupy cargo, control, hangar, habitat, or passenger seat systems. On larger spacecraft, characters may be in any system save armor or (non-empty) fuel tanks. For simplicity, you can assume everyone is at their duty station and passengers are in habitats.

*Surprised Crews:* If a vessel's crew are surprised (see below) some crew may be in the wrong place, e.g., not at their action stations. They may have to take one or more space combat turns to reach their actions stations – *see Internal Movement* (p. 63).

# SPACE COMBAT TURNS

Space combat is fought in a series of *space combat turns* that range from 20 seconds to 10 minutes long depending on the chosen time scale. Each spacecraft takes its turn in sequence, until all vessels have had their turn, then they start over. This is like personal combat, except that the turns are organized by spacecraft rather than by character.

The sequence in which spacecraft act is up to the GM. The default starting sequence is the Speed of each pilot who was controlling each vessel at the start of the battle. If pilots have the same Speed, the lowest SM spacecraft goes first; break further ties with a die roll. Alternatively, the GM can have the first actions go to all spacecraft on the side that won a Quick Contest of Tactics or which was able to perform an ambush.



Either way, the sequence is retained each turn, even if the pilot or situation changes (omitting vessels that were destroyed). If a new vessel enters the battle, add it to the end of sequence. If one is launched from a hangar bay, insert it into the sequence after the launching craft. Objects other than spacecraft, such as individuals or installations, can also take turns. E.g., a cluster of spaceport buildings on a planet or moon, with its own sensors, hangars, and weapon batteries, could be treated like a spacecraft.

On each spacecraft's turn, the important characters aboard it each take their own individual turns, performing tasks described below. After they have acted, the spacecraft's turn is over; proceed to the next vessel in the sequence. Once every spacecraft has had its turn, begin again, repeating the same sequence with surviving spacecraft acting in the exact same order as before.

## When Not To Use These Rules

These rules are intended to handle battles at great distances, often involving large crews. Don't use them where standard one-second combat turns and range calculations in yards are more appropriate! E.g., if a spaceship is strafing a party of adventurers on the ground, fighting an airplane, or boarded, feel free to switch to the standard ***GURPS Basic Set*** vehicle rules. Refer to the vessel's short-form statistic block (multiplying dDR by 10 and dST/HP by 10 to get the unscaled values) and use *Weapons in Ordinary Combat* (p. 66).

# Action During a Turn

On a spacecraft's turn, all player characters aboard, and any NPCs performing important roles, take their own turns, organized as shown below.

During the spacecraft's turn, PCs and other key characters decide what duties they'll perform, if they differ from last turn. If characters are moving about the vessel or staying put, this is also resolved now (including boarding of small craft).

Characters aboard a single spacecraft take their own individual turns in the order shown below. Following this ensures that the commander's skill rolls for handling the ship can affect the crew, that the engineer provides power to drives and weapons so the pilot and gunners can use them, and so on. However, this isn't a war game – the GM should feel free to vary the sequence as dramatically appropriate!

Characters may perform a single task without penalty, or, since each turn represents a lengthy period, may combine multiple tasks at a penalty; see *Multitasking* (p. 50). There's no need to try and do every task, e.g., the single crew member on a space fighter might decide to perform only a piloting and a gunnery task, ignoring everything else. Similarly, a space station or vessel that's out of fuel may omit piloting tasks.

*1. Command Tasks*: One character acting as commanding officer (and optionally one acting as executive officer) may perform *Command Tasks* (p. 50).

*2. Engineering Tasks:* One character acting as chief engineer may allocate power (if necessary) and optionally perform an extra action from the *Engineering Tasks* (p. 51).

*3. Navigation Tasks*: One character serving as navigator may perform *Navigation Tasks* (p. 52).

*4. Piloting Tasks*: One character serving as pilot may perform *Pilot Tasks* (p. 53). At the start of this phase, any attack vector or collision course results achieved by another spacecraft against the pilot's vessel are removed (but engagement or rendezvous results will remain) – see *Range* (p. 57). If no one is performing a pilot task, the spacecraft performs an Uncontrolled Drift (p. 56). If a collision course result is achieved, the pilot may opt to attempt a collision attack, but need not do so.

*5. Electronics Operation Tasks*: All characters acting as sensor or comm operators can perform *Communications Tasks* (p. 53) or *Sensor Tasks* (p. 52) for the systems they control.

*6. Gunnery Tasks:* All characters controlling functional weapons may perform *Gunnery Tasks* (p. 53), or may alternatively delay performing tasks until Step 7, after the piloting tasks have been performed and the range has (possibly) changed.

*7. Crew Tasks:* Other crew members may perform tasks or other actions. The only activities given special rules here are *Damage Control Tasks* (p. 54), but there are plenty of opportunities for other activity. Medics can treat the injured in their system, stewards can try to calm passengers, boarding parties can rally at airlocks or fight aboard ship, passengers can hide in cabins, don space suits, or try to hijack the ship, etc.

## Character Actions

Since each turn is longer than one second, characters don't take maneuvers. Instead, they perform *tasks* that represent multiple maneuvers over a period of time.

Character actions are divided into several task categories, such as Command or Gunnery, which determine when tasks are performed. These are often assigned to specific people (e.g., the pilot performs Piloting tasks) but a title isn't necessary, e.g., the ship's cook could run to a control station and take over the ship's helm.

Sapient computer programs (see ***GURPS Ultra-Tech***) that are running on the spacecraft's computer network may perform certain tasks, if so noted. Aside from existing in the computer network, they use the same rules as other characters.

### *Multitasking*

Characters can try to perform more than one *different* task in a turn, with certain restrictions. A character can only perform those tasks possible from the system he spent the entire turn in. The same task can't be performed multiple times in a turn.

There is a skill penalty for multitasking, which is applied to *all* tasks:

- -2 per added task after the first, if it's part of the same category, e.g., two different Command tasks.
- -4 per added task after the first of a different category, e.g., both a Command and a Piloting task.

If a character will multitask, indicate it when they perform the *first* task, so that the penalty can be applied to *all* tasks they perform during the turn.

### *Command Tasks*

*"Chief engineer, I need those engines on line now! Get me more power!"*

No more than two crew (usually a captain and either an executive or tactical officer) may perform command tasks aboard a spacecraft in a given turn. Their authority must be recognized by the crew under them. Command tasks may be performed from a functional control station or by a sapient program capable of interacting with the crew.

A commanding officer may tell the other key crew members what to do! Since each turn represents several seconds to 10 minutes, this is a free action. You can also spend time talking via communicator with someone outside the vessel, such as another spacecraft commander, using social skills such as Diplomacy or Intimidation. This will rarely count as a task unless it takes the entire turn.

In addition to talking and giving orders, you may perform any of the following tasks during the turn. Unless noted, all effects last until your next turn.

Tasks other than motivate crewman can only be attempted once *per spacecraft* per turn. Motivate crewman can only be performed once per enemy spacecraft per turn.

### *Leadership Task*

The spacecraft's commander or executive officer (but not both) may spend the turn inspiring all of his subordinates. This is a use of Leadership skill to improve morale and self-control, as described on p. B204. In addition to the bonuses on p. B204, a roll that succeeds by five or more, or is a critical success, will add +1 to the average Spacer skill of subordinates (but not the character performing the task).

### *Motivate Crewman Task*

Motivate a *single* subordinate who you believe is performing an important task, such the pilot or engineer. Roll against your Shiphandling skill. Success gives them a +1 on any tasks they perform through the turn. Failure means you're distracting them, giving them a -1 penalty. Double this on critical success or failure! Modifier: -2 if you are in different systems (unless either of you are computer programs).

### *Shiphandling Task*

Enable a subordinate to perform Piloting tasks with Spacer instead of Piloting skill by directing him. Use the lower of their Spacer or your Shiphandling skill in lieu of Piloting skill. You'll tell them what to do – it's up to the GM which of you makes the skill roll. Unless either of you are computer programs, you must both be in the same system. The main advantage of this task is that it's a command task rather than a piloting task: you can "steer the ship" while doing another command task with a -2 rather than -4 penalty.

### *Space Tactics Task*

Pick a *single* enemy spacecraft or formation, predict what it will do, and relay that plan to any subordinates. You may choose "offensive tactics" (reduces your target's dodge by 1) or "defensive tactics" (increases your pilot's Dodge by 1 against that target). To do so, roll against your the lower of your Navigation (Space) or Tactics skill (or their defaults). Add +1 in a 1 minute turn,+2 in 3 minute turn, +3 in a 10 minute turn. *Exception:* If the target vessel (or formation's leader) had someone performing the Space Tactics task last turn, whether focused on your vessel or not, success requires a Quick Contest of skill against him (if so, don't bother modifying for time). A critical failure mean a bad plan that gives your foe the benefit; a critical success doubles the bonus.

## Functional Systems and Control Stations

Some tasks refer to systems or control stations being "functional" as a prerequisite. A functional system has not been disabled or destroyed. If the system is a high-energy system, it must also have a Power Point assigned to it (or multiple Power Points, if it requires them). Subsystems such as control stations or weapons are functional if the system they are installed in is functional.

## Pre-Battle Turns

Each spacecraft's first turn is a pre-battle turn, which represents what it was doing just before the combat started. There are certain restrictions on tasks during a pre-battle turn:

- Pilots cannot perform Closing or Retreat maneuvers.
- Gunners may not perform Aim and Attack or Launch tasks.
- A spacecraft may not activate a stardrive (save for warp drives used for maneuver).

If combat is expected, pilots should usually choose Hold Course or Evasive Action as their pre-battle maneuver, and gunners take Wait (Point Defense) tasks to avoid nasty surprises.

*Surprised Crews*: If the GM judges that surprise has occurred (see *Ambush and Surprise*), the GM may rule that some or all crew members are elsewhere aboard the vessel. They may have to use their pre-battle turn for internal movement (p. 63). Space warships normally make sure at least some of their crew on duty at all times, but other vessels may not be as vigilant.

## *Engineering Tasks*

*"Allocate power to main disintegrator weapon, force field, and two engines!"*

These tasks involve allocating Power Points and upgrading the efficiency of engines or power plants. Only one character aboard a spacecraft may perform an Engineering task in a given turn – he's operating the vessel's main engineering console (On large vessels a dedicated chief engineer will do so). He must be at a functional control station or be a sapient computer program. (References to Power Points apply to Cosmic Power Points if the spacecraft is using them instead.) The following tasks can be performed. Each tasks can only be attempted once per turn.

### *Allocate Power Task*

If a spacecraft has fewer Power Points than it does high-energy systems, you can reallocate these Power Points, deciding which systems to "power up." This also includes the control of any systems "on" (when powered) or "off" (when not): force screens, jump gates, nuclear dampers, some stardrives, and stasis webs. It also includes angling of adjustable force screens. No skill roll is required. Power allocation counts as a task for multitasking only if allocation (and/or force screen angle) changed from last turn, or if the spacecraft gained or lost Power Points (e.g., due to power plant damage).

### *Increase Power Task*

If a spacecraft has one or more Power Points available, you may try to increase their efficiency. Make an Electrician skill roll. Success means that careful switching and husbanding of power gives *one* extra Power Point to use this turn. Failure means it doesn't; critical failure overloads the system, halving (round *down*) Power Points available this turn. If you attempt this task, roll before allocating power.

### *Emergency Power Task*

You may dangerously overstress one or more identical reactor or chemical power plant systems. Roll against the repair skill listed for that power system. Success *doubles* the Power Points it can provide this turn, but unless you get a critical success, also stresses it: any attempt to use it to increase power any time in the next hour is at -4. Failure doubles the Power Points but disables the power plant at the start of your next turn. Critical failure disables it immediately without gain. If you attempt this task, roll before allocating power.

### *Emergency Thrust Task*

You may overload the engines of one or more engine systems (except for chemical rocket, HEDM rocket, lightsail, or magsail). Use the same procedure as emergency power, except instead of doubling power, the acceleration doubles. A high-energy system whose thrust is doubled requires doubles the Power Points; a reaction drive will require delta-V commensurate with its increased acceleration. It's up to the GM whether a stardrive can benefit from this – usually a warp drive can, but not other types.

## *Navigation Tasks*

*"Just give me another six minutes to plot the course, captain!"*

Navigation and sensor operation are closely related aboard a spacecraft, so the same character can perform both activities with only a -2 multitasking penalty.

To perform these tasks, a character must be occupying a functional control station or be a running sapient computer program.

Navigation can always be attempted until the vessel is actually destroyed (even if it requires looking out viewports), but is at -2 or worse (GM's option) if the vessel is reduced to 0 or fewer dHP. Enhanced, science, tactical, or multipurpose arrays can only use their bonus if functional. A spacecraft is also limited to performing no more than one of these tasks per turn per Array (i.e., one task if it has a basic array, or two if it has a basic and another array, etc.) regardless of the number of navigators or sensor operators. Each task can only be performed once per turn.

### *Tactical Navigation*

This involves assisting the spacecraft's pilot in plotting the best course around obstacles or threats. Roll against the *lower* of the navigator's Electronics Operation (Sensor) or Navigation (Space) skill. Success gives +1 to the pilot's Piloting skill (or Shiphandling or Spacer, if that's used instead) this turn. Failure by only 1-3 has no effect; failure by 4 or more results in a -1 penalty. Double effects on critical success or failure.

### *FTL Navigation*

Activating a stardrive involves allocating power to the drive. However, some stardrives (especially hyperdrives and some jump drives) require the navigator first plot an interstellar course, which may take several turns and require a skill roll. If performed in combat, this a navigation task; see *Hyperdrive,* p. 40 for an example.

## *Sensor Tasks*

*"Fusion drive flare at six o'clock!"*

Navigation and sensor operation are closely related aboard a spacecraft, so the same character can perform both activities with only a -2 multitasking penalty.

To perform these tasks, a character must be occupying a functional control station or be a running sapient computer program. Enhanced, science, tactical or multipurpose arrays can only use their comm/sensor level if functional; the basic array is always functional.

A character can perform multiple sensor analysis tasks on *different* targets by multitasking, but the vessel is limited to a maximum of one sensor detection task per array that it has per turn.

### *Sensor Detection Task*

A character performing this task is using the spacecraft's comm/sensor array to actively look for objects of interest that have yet to be detected. Detection in space usually uses passive sensors. A single task allows the character to roll to detect each significant object that has *not yet been detected,* using the *Detecting Spacecraft with Passive Sensors* rules on p. 44. Once an object has been detected it is automatically tracked by the spacecraft's navigation system; a task is no longer needed to look for it.

Alternatively, you can use active sensors (p. 45) although this is rarely as useful.

### *Sensor Analysis Task*

Attempt to analyze sensor data of a detected object to determine details. For either task, roll at -6 in a 20-second turn, +1 in a 3-minute turn, or +3 in a 10-minute turn. Repeated attempts in successive turns are possible. A critical success may reveal additional details, a critical failure provide misinformation.

*Engineering Analysis*: Roll against your Engineer (Spaceships or Starships) skill. Add +3 if your sensors incorporated a multiscanner. Success reveals the basic system type (e.g., "habitat" or "chemical rocket engine") of all six hull systems [1-6] on the hull section facing your vessel, and whether they are functional, disabled, or destroyed. Only the first, outer armor layer's composition is revealed. Details that vary from system to system are not revealed: you would not know what type of weapon was in a spinal weapon system, or the exact types of cabins in a habitat. Cores systems are hidden. Success by 5+ is required to detect any weak points in the hull that can be targeted.

*Bio Analysis*: If using a multiscanner, you can roll against Biology skill to analyze sensor data and determine number and species (if known) of life forms aboard the vessel. This will also reveal the presence of any living systems (gardens, organic hulls, etc.).

Exception: Neither task may be performed if the target is using a powered-up cloaking device, opaque force screen, or stasis web, even if sensors did detect the target.

## *Piloting Tasks*

*"Evasive action at 3G!"*

These tasks involve maneuvering the spacecraft. Only *one* character – the spacecraft's pilot – performs Piloting tasks during a spacecraft's turn (aside from dodging, which doesn't count as a task) and he can only perform one such task. On vessels without maneuver drives, this can involve using attitude controls or gyros used to change facing.

Usually the spacecraft's Piloting skill is used. A DX-based Spacer roll can be substituted if the crewman performing the piloting task is supervised by a supervisor using the Shiphandling command task; the crewman's skill cannot exceed the commander's Shiphandling skill.

A pilot must be in a functional control station or be a running computer program.

### *Move Maneuvers*

You're controlling the vessel. In the basic combat system, pick a "piloting maneuver" (p. 55) such as Closing or Evasive Action for your spaceship, assigning the spacecraft's acceleration and facing as per the maneuver.

Spacecraft whose Closing maneuver achieved a collision course may elect to ram: if so, resolve this immediately using the Ballistic Attack (p. 61) rules. The attempt may be interrupted by Point Defense Fire if the target's gunners took a Wait (Point Defense) task last turn.

### *Other Actions*

If the spacecraft has robotic arms, robotic legs, or external clamps, and is in position to use them, you can control them to move, clamp, or manipulate things (using Ready maneuvers, etc.) based on whatever work could be done over the length of the turn.

## *Gunnery Tasks*

*"Forward laser battery will target the frigate **Prospero.**"*

*"Load launchers one and two with nuclear missiles with 100-kiloton nuclear warheads. Load launchers three and four with conventional missiles . . . launch!"*

A gunnery task allows a character to control *one* of the following: a single turret weapon; a single spinal weapon; all *identical* fixed mount weapons in a major, medium, secondary, or tertiary battery. The character must be in a functional control station, or alternatively, a computer program running on the spacecraft's network. Alternatively, the character may occupy and control a turret using its dedicated controls. The character may perform one of the following tasks with the weapon or weapons controlled:

A single character may never perform more than one gunnery task per turn (with the exception of spreading fire). Multiple gunners can't control the same weapons.

### *Aim and Attack*

You aim and fire at a specified target or targets. You are assumed to be making All-Out (Deliberate) Attacks after three or more seconds of aim; this is factored into the combat tables. Resolve the attacks immediately, using the *Weapons Fire* rules (p. 57). High-energy systems may only fire if their system was powered. (Exception: If a weapons battery contains conventional guns or missile launchers, these do not require power.) The rate of fire of weapons is scaled with turn length. An attack represents sustained firing over the turn.

### *Wait (Aim and Attack)*

You delay your attack. You may attack a single target during its own turn, firing in the target's own gunnery phase. If the target also fires, your attack is considered to be *simultaneous* with the target spacecraft for purpose of damage (You can resolve it in any order). The advantage is this lets you attack after an enemy has moved closer to your vessel; the disadvantage is that it gets to shoot back (or move away). You must specify the target you are waiting for. (You may decide to change targets and instead attack another target, but you will suffer a -2 penalty.)

### *Wait (Point Defense)*

You may reserve the weapon or weapons you are controlling for defensive fire against incoming ballistic attacks. If, during the period until your next turn, any incoming missiles or vessels successfully attack your spacecraft (or one you are in formation with), you may immediately interrupt fire at them using the Point Defense rules (p. 59). You can opt to use only some of your RoF; if so, you may attack again with unused shots against further incoming ballistic attacks before the start of your next turn.

## *Communication Tasks*

*"Comm officer: I'm enhancing the alien signal. Putting it on audio . . ."*

Anyone with access to a spacecraft's control station (or a sapient computer program) can engage in routine chatter on communications channels and keep a channel open for incoming messages. See Chapter 3 for the vessel's communication systems. Comms have no difficulty communicating with targets at battle ranges. Skill rolls for using comm systems are only made for emergency or abnormal uses of the skill (see p. B189).

To perform such communications tasks, you must be in a functional control station. This is *not* a singular position – a spacecraft may have enough channels to allow multiple crew to perform comm tasks, although this is typical only of command ships, orbital ports, or fighter carriers. The following special tasks can be performed:

## Keeping it Simple: NPC Crew Actions

The full Character Action rules are intended for situations where PCs and important NPC characters are involved. Otherwise, streamline procedures.

Give an NPC-run spacecraft crew an average skill level – typically 10 for rookie, 11 for average, 12 for experienced, 13 for veteran, or 14 for elite crews. Simplify crew tasks as follows:

*Command*: Don't worry about this! Assume the enemy commander is busy giving orders.

*Engineering*: Allocate power if necessary; ignore the other options.

*Piloting*: Use the full rules.

*Gunnery:* Use the full rules.

*Damage Control:* Use the normal rules, assuming a spacecraft has access to one damage control party for every engine room system it has.

*Other Tasks:* Ignore them unless the GM thinks they're important to the situation, e.g., Sensor Detection if opposing vessels haven't yet been spotted.

### Supervise Damage Control Task

Advise and coordinate a damage control party by using damage report data from the control station. Roll against the lower of your Electronics Operation (Comms) or Spacer skill. Success adds a +1 bonus to that team's damage control rolls this turn (+2 on a critical success). Failure has no effect; critical failure means you distract them: a -1 penalty. Can only be performed once per party.

### Signal Enhancement Task

If a message is too weak, garbled, or static-filled, make an Electronics Operation (Comms) roll to interpret it. This may require a Quick Contest with another comm operator's Electronics Operation (EW) if he's jamming you. Each spacecraft may add their comm/sensor array level. You can also use this for Signal Detection (p. 45).

### Signal Jamming Task

If the spacecraft has a tactical or multipurpose array, you may use it to jam broadcast radio signals (and FTL radio, if you have that technology) within up to 1% of communication range. Your jamming is automatically successful, but another comm operator who is performing signal enhancement task can get through if they win a Quick Contest (as described above). This can only be performed once per array per turn.

## Damage Control Tasks

You're trying to fix something or rescue someone, by yourself or leading a team. Damage control doesn't take place in a fixed location: you can move from system to system, but can only perform damage control if in the system that is disabled or (in the case of rescue activities) destroyed. There are four damage control tasks:

*Emergency Repairs:* Perform emergency repairs to a specific disabled system the team is occupying. A destroyed system can't be repaired.

*Halt Catastrophe:* Attempt to shut down a disabled or destroyed volatile system (such as an antimatter reactor) before it explodes.

*Rescue:* Attempt to rescue occupants trapped in a destroyed compartment. See *Rescue, p.* 64.

*Structural Repairs:* Perform lasting repairs to fix general dHP loss. This is usually only attempted during 10 minute turns. Destroyed system can't be repaired.

These procedures are covered in detail under *Damage Control (p.* 64).

# Space Movement

If the pilot performed a Move maneuver as his piloting task, he must further specify which single *pilot maneuver* detailed below will be used. Each option represents in abstract fashion how his spacecraft is moving relative to the other combatants. The maneuvers are Closing, Controlled Drift, Evasive Action, Hold Course, and Retreat.

If no one was piloting the vessel (or it's unable to change course) the spacecraft's movement defaults to Uncontrolled Drift. See Pre-Battle Turns for other restrictions.

## Fast Pass Status

If a spacecraft begins its turn with Fast Pass status, it will race out of combat range and leave the battle at the *start* of its *second* turn. This means it gets the pre-battle and *first* turn, and opponents get their own turn to maneuver and attack it.

After the spacecraft leaves the battle area, the GM may use the rules in Chapter 3 to determine how long it takes to decelerate and return to the battle, based on its velocity. In many instances it may take hours or even days to reverse course, depending on how quickly the vessel was going and the combat's turn length. It's usually easiest to assume the vessel is out of the fight! If there are no other foes, the battle ends (for the moment).

## Acceleration Bonus

All maneuvers except Drifts provide the option to accelerate to gain an *acceleration bonus*. This is enough acceleration for a long enough period to achieve a significant position change during the turn. It depends on turn length and encounter scale.

*Acceleration:* To achieve an acceleration bonus, the spacecraft must be able to accelerate. This requires at least one functional maneuver drive (engine or sail) or a warp drive. Drives are rated for maximum acceleration; high-energy system [!] drives may only be used if they were allocated power.

*Burning Fuel:* Reaction drives have a limited delta-V reserve. To sustain acceleration through the space combat turn, a reaction drive spaceship must also spend some of its delta-V reserve, using up the reaction mass in its fuel tanks.

The table below shows the acceleration required to get a +2 acceleration bonus, and in parenthesis, the delta-V cost per +2 bonus that reaction engines pay from their fuel tank's delta-V reserve. A spacecraft using a reaction drive must meet both requirements.

### *Acceleration Bonus Table*

| *Close-Scale Encounter* | *Requirements* |
|---|---|
| 20-second turn | 10G (and 1 mps) per +2 |
| 1-minute turn | 1G (and 0.3 mps) per +2 |
| 3-minute turn | 0.1G (and 0.1 mps) per +2 |
| 10-minute turn | 0.01G (and 0.03 mps) per +2 |
| ***Standard-Scale Encounter*** | ***Requirements*** |
| 20-second turn | 100G (and 10 mps) per +2 |
| 1-minute turn | 10G (and 3 mps) per +2 |
| 3-minute turn | 1G (and 1 mps) per +2 |
| 10-minute turn | 0.1G (and 0.3 mps) per +2 |
| ***Distant-Scale Encounter*** | ***Requirements*** |
| 20-second turn | 1,000G (and 100 mps) per +2 |
| 1-minute turn | 100G (and 30 mps) per +2 |
| 3-minute turn | 10G (and 10 mps) per +2 |
| 10-minute turn | 1G (and 3 mps) per +2 |

(Each +1 bonus is half the required acceleration and delta-V).

*Example One*: During a standard-scale encounter fought in 3-minute turns, the privateer *Revenge*, equipped with fusion torch drives, is using a Closing move to chase the retreating merchant *Innsmouth*. The *Revenge* knows *Innsmouth* accelerated at 1G last turn for +2 acceleration bonus. The *Revenge* wants to be faster. It has three high-thrust fusion torch engines with 3G total acceleration, and only 12 mps of delta-V left in its tanks; as this is a reaction drive, it must pay the delta-V cost and minimum acceleration. It goes for a +6 bonus, which requires 3G and 3 mps. This leaves only 9 mps in its tanks!

*Example Two:* During a distant-scale encounter fought in 10-minute turns, the mining ship *49er* would like to Retreat. However, she has only 0.01G acceleration from her mass driver engine, and that's below the 0.5G for significant maneuver in this scale. *49er* won't be able to perform any maneuvers that require an acceleration bonus.

# Pilot Maneuvers

A pilot who takes a Move maneuver must specify which of these pilot maneuvers he is performing: Closing, Controlled Drift, Evasive Action, Hold Course, or Retreat. Some maneuvers have specific prerequisites. If a spacecraft isn't piloted, it defaults to Uncontrolled Drift. A spacecraft pilot can only perform one maneuver in a turn.

On the first turn of a battle, you may not choose a Closing maneuver unless you have fast pass status.

### *Maneuver Modifiers*

Some maneuvers involve Quick Contests of skill. In addition to the specific modifiers listed, the following modifiers may apply to each pilot in the contest:

Acceleration bonus (p. 54) if their spacecraft accelerated.

Handling of the spacecraft.

Multitasking penalties (p. 50).

-6 if engaged in a Quick Contest of Skill with a target that you have not detected.

Any relevant modifiers to skill due to appropriate tasks performed to assist the pilot (tactical navigation, etc.).

The modifiers of the maneuvering spacecraft are based on this turn's situation, while those of the target spacecraft are based on its situation in its own last turn. The GM will need to keep track of the maneuver (and acceleration) a spacecraft used on its last turn.

### *Facing*

Facing is which of your hull sections – front, central, or rear – face your opponents. A pilot chooses facing within the limits specified for the maneuver he picked. It remains until his next turn. The major effects are:

- Facing determines which weapons on the spacecraft can fire – see *Bearing* (p. 57).
- Only the hull section that faces your opponents can be targeted by enemy fire aimed at the spacecraft's hull, though certain other exposed systems can also be attacked.

## *Closing Maneuver*

You are attempting to maneuver your vessel close to a particular target. Select a vessel (or other object, such as an asteroid or spaceport) as the target of your maneuver.

You must accelerate fast enough to receive an acceleration bonus (p. 54) or be making a fast pass (p. 54). If your target's last maneuver was Controlled Drift or Uncontrolled Drift, roll against your Piloting skill (adding Maneuver Modifiers (p. 55)) to succeed. Otherwise, success requires winning a Quick Contest of Piloting Skill with the target's Pilot; you both add Maneuver Modifiers. If the target's last maneuver was Evasive Action, he receives double his acceleration bonus.

If you succeed and were not already engaged with that target, your vessel can either achieve an "attack vector" (p. 57) against that target – a quick, close approach – or choose to be "advantaged" (p. 57) against the target, outmaneuvering it. If you succeeded by 10+, you may combine advantaged and an attack vector, or instead of doing so, choose either to be "engaged" (closing and matching velocity) or make a "collision course" (p. 57) – a very close approach – to the target.

If you were already engaged against that target at the start of your turn, success lets you choose to be advantaged against it or perform a collision course; success by 10+ lets you combine both, or opt instead to "rendezvous" (p. 57) with the target (for docking).

*Facing:* If you accelerated, your front hull faces all opponents. Otherwise, decide whether your front, central, or rear hull faces all opponents. Exception: If you *lost* the Quick Contest against a foe who was advantaged against you on his last turn, then his vessel is still advantaged against you and he may choose your facing toward him.

### *Closing Strategies*

You may modify a closing maneuver by choosing one of these options:

*Dedicated*: You are at +3 on your Piloting skill when performing a Closing maneuver, but your spacecraft cannot Dodge until your next turn.

*Ambush:* You may use this option against a target that performed Hold Course or a Closing maneuver on its last turn, but only if your vessel was not yet Detected, or if the GM rules that sufficient cover exists (e.g., in crowded orbital space, a cinematic asteroid belt, the upper atmosphere of a gas giant, etc.) to make this possible. You need not accelerate – instead, you ambush the opponent as it passes you by. You both may opt to substitute Tactics for Piloting, and the effects of both your own and your target's acceleration bonus are halved (rounding down); otherwise, use the normal Closing rules.

## Hold Course

You are maneuvering on a steady course without getting near any particular vessel. You must accelerate, but may not exceed a +3 acceleration bonus.

If you began your turn engaged with any vessels or other objects, you're still engaged to them, but rendezvous status is lost (unless a vessel is clamped to you – see *External Clamp* (p. 15)).

Any opponent Closing with you before your next turn will need to win a Quick Contest of Piloting skill with you (and you'll add your acceleration bonus) – see *Closing* (p. 55).

*Facing:* Your front or central hull must face all opponents not advantaged against you (your choice).

## Retreat

You're trying to escape! Your last turn's maneuver must have been Evasive Action or Retreat. If your last maneuver was Evasive Action, your spacecraft must also accelerate fast enough to receive an acceleration bonus (p. 54).

Any opponent Closing with you before your next turn will need to win a Quick Contest of success to close the range; you'll add your acceleration bonus (see *Closing,* p. 55).

You automatically break away from any vessels or other objects engaged or rendezvoused with you. You (and they) lose this position.

You can still be attacked by enemy vessels, until the start of your *next* turn. At that point your vessel escapes the encounter area! Vessels that were Closing may follow you (see *Closing, p.* 55) All others will be left behind. Should multiple spacecraft choose to retreat and escape, they may choose to escape in the same direction. If so, they and any successful pursuers form the same new engagement (GM's option).

*Facing:* Your vessel's rear hull faces all opponents not advantaged against you if you accelerated; if you did not, choose whether your front hull, central hull, or rear hull does.

## Controlled Drift

You don't accelerate, but can use your spacecraft's attitude controls (gyros or reaction thrusters) to change your vessel's facing. If you were engaged or rendezvoused with any spacecraft or other objects at the start of your turn, you remain so.

*Facing:* You can decide whether your front, central, or rear hull faces all opponents; if you don't specify, assume it's your central hull. Optionally, you may be tumbling: if so, *all* hull sections face all opponents. Beam or gun attacks you make while tumbling are at -4. Any opponent may choose which section to target (taking the -4 penalty) or roll randomly (1-2 front, 3-4 central, 5-6 rear) when he scores a hit.

## Evasive Action

You are maneuvering to make it more difficult for opponents to close with or attack your vessel, or to set up a future Retreat maneuver. You must accelerate fast enough to get an acceleration bonus (p. 54).

You automatically break away from any vessels or other objects engaged or rendezvoused with you. You (and they) lose this position.

You don't make any skill rolls now, but until your next turn will add *twice* your acceleration bonus to any Quick Contest made to avoid an opponent closing on you (see Closing). You'll also get +1 to Dodge.

*Facing:* Your central or rear hull face all opponents not advantaged against you – decide which.

## Uncontrolled Drift ("Drift")

This is the *absence* of deliberate maneuver. An uncontrolled drift occurs if a spacecraft begins its piloting turn with no one piloting it. You can't dodge.

The GM should also assign Uncontrolled Drift to any locations or objects such as asteroid bases, lost spacers, drifting life pods, etc., that are important to the situation. They may take a turn in the sequence (during which people on them can act).

Uncontrolled Drift is treated exactly as a Controlled Drift maneuver except for facing.

*Facing*: Whatever facing you had on your last turn continues to face all opponents not advantaged against your vessel.

# Range

Range measures how far apart two spacecraft (or formations) are. In the basic combat system, range is simplified: it is relative to the situation between the attacking or scanning vessel and the target, as determined by the results of the last maneuver of the vessel whose turn it is. Refer to the *Range Table* below.

*Rendezvous:* Use this whenever spacecraft are docked with or grappled to one another, or achieve a Rendezvous result.

*Collision Course:* If your spacecraft achieved a collision course result against the target use this column to find the range toward the target and any vessel it was in formation or rendezvoused with.

*Attack vector:* If your spacecraft achieved an attack vector against a target this turn, use this column to calculate your range toward it. The range also applies to any vessel it was in formation, rendezvoused, or engaged with. This status remains until the piloting step of each target's turn.

*Engaged:* If your spacecraft engaged a target this turn, use this column to calculate your range toward it and any vessel it was in formation, rendezvoused, or engaged with. Each vessel remains engaged unless their own next maneuver indicates engagement is broken.

*Neutral:* This is the default column. Use this column to calculate range if your vessel failed to succeed with a Closing maneuver this turn, or if its own last maneuver was Evasive Action, Controlled Drift, Hold Course, Retreat, or Uncontrolled Drift.

*In Formation or Incoming:* All vessels in formation with one another are at point-blank range to each other, as are incoming ballistic attacks.

Attack run and collision course positions last until the piloting task phase of the subject's turn. This status remains until the piloting turn of each target.

Engagement or rendezvous positions may continue from turn to turn unless broken by the target's own maneuver.

## Range Table

| *Situation* | *Close scale* | *Standard scale* | *Distant scale* |
|---|---|---|---|
| Rendezvous | Zero | Zero | Zero |
| In Formation or Incoming | Point-blank | Point-blank | Point-Blank |
| Collision Course | Point-blank | Close | Short |
| Attack vector or Engaged | Close | Short | Long |
| Neutral | Short | Long | Extreme |

*Example:* The battleship *Ares* performs a Closing maneuver and succeeds in achieving a engaged result against the assault ship *Logic of Empire*. The battle is being fought in the standard combat scale, so in *Ares'* turn the range to *Logic of Empire* is Short. The *Logic of Empire* was in formation with the destroyer *Terrible Beauty* so the range toward *Terrible Beauty* is also Short. A third enemy cruiser, the *Talon*, is also in the battle; since it wasn't in formation with either, it's neutral and so is at Long range to *Ares*.

On its turn, the *Logic of Empire* performs an Evasive Action maneuver. This breaks engaged status; it's now neutral to *Ares*, and is at Long range toward it. However, *Terrible Beauty* on its turn chooses a Controlled Drift – which means that without any need for a skill roll, it automatically remains engaged to *Ares* and is at Short range to it.

# Advantaged Status

If you achieved this result against an opponent, it means you outmaneuvered it. Your advantaged vessel may opt to approach its target from a *different* facing adjacent to the one that normally faces him: he may choose front or rear instead of the central hull, or choose the central hull instead of front or rear. If the target's last maneuver was Uncontrolled Drift, advantage allows him to approach any face (e.g., he may approach from the rear even if the target's front was facing all opponents, or vice versa.) Advantaged status confers no benefit against a tumbling target.

The advantaged status you gained only lasts until your opponent's next turn – it goes away as soon as he chooses a maneuver. (Exception: if he chose Uncontrolled Drift, or failed badly on a Closing maneuver it persists until the start of your own next turn.)

# Weapons Fire

Weapons may fire using an Aim and Attack task. They may also fire as point defense at an incoming missile, shell, or ramming vessel if the gunner chose a Wait (Point Defense) task.

## Bearing

The facing of the firing vessel toward the target determines what weapons can fire.

*Spinal battery* weapons can only fire at a target their spacecraft's front hull is facing (unless the weapon faces the rear; then the rear hull must face the target).

*Fixed mount* weapons can only fire at a target if the weapon is in installed in a hull section facing the enemy.

*Turret weapons in the front hull* can fire at targets that the attacking vessel's front or central hull is facing.

*Turret weapons in the rear hull* can fire at targets that the attacking vessel's rear or central hull is facing.

*Turret weapons in the central hull* can fire at any target.

## Rate of Fire

Each weapon's RoF includes time aiming or programming weapons and time for beams to cool and guns or missiles to reload between shots. The table shows RoF per weapon. All identical fixed mount weapons in the same battery may be fired simultaneously – multiply RoF by number of fixed mounts:

## RoF Table

| Class of Weapon | 20-second | 1-minute | 3-minute | 10-minute |
|---|---|---|---|---|
| Launchers | 1* | 3* | 10* | 30* |
| Beam or Gun† | 1* | 3* | 10* | 30* |
| Rapid Fire Beam or Gun† | 10 | 30 | 100 | 300 |
| Very Rapid Fire Beam or Gun† | 100* | 300* | 1,000* | 3,000* |

* Beam or gun RoF is doubled for "improved" beam or gun weapons.
† If a fixed mount, multiply RoF by the number of fixed mounts in the battery.

*Example:* A medium battery with three fixed mounts each with rapid fire improved lasers firing in a 3-minute turn has RoF 100×2×3 = RoF 600.

If a weapon has RoF 2+, the gunner must specify how many shots will be fired, up to the maximum of the weapon's RoF. Guns and launchers are limited by the total number of shots remaining (especially at 3-minute and 10-minute scales!).

## Targets

A gunner must indicate the target before attacking. The target must be within range and within the weapon's bearing. It can be:

- A spacecraft or other object in space.
- An object on a world (or within atmosphere) – see *Ground Fire* (p. 65).
- In point defense, a salvo of one or more incoming missiles or shells, or a spacecraft attempting to ram, that is targeting either the attacker's own vessel or another vessel that he is in formation or rendezvoused with.

### Hull Section

An attack on a spacecraft is ordinarily assumed to be targeted against the target's hull section that faces the attacker.

If the target's front or rear hull is facing the attacker, this must be targeted.

If the target's central hull is facing the attacker, the attacker may target the central (the default target), front, or rear hull.

An attacker may specify a more precise location in the hull using the Precision Attacks (p. 66) rules. Certain large exposed systems or features, such as lightsails, can also be targeted instead of the hull: see *Targeting Exposed Systems* (p. 66) or Spreading Fire (below).

### Spreading Fire

A gunner may choose to divide his shots among *different* targets, either attacking multiple targets, or firing at different parts of a single vessel. All targets must be specified before rolling to hit. It imposes an extra -2 penalty per different target engaged (applied to all attack rolls) when firing beams or guns, or a -1 penalty per target if firing missiles. One attack roll is made for each target.

Note that a salvo of multiple incoming missiles or gun shells launched as a single attack do *not* count as a different targets – all shots in the attack are a single target.

# Beam Fire

Beams can attack targets out to their specified maximum ranges e.g., Point-blank (P), Short (S), Long (L), or Extreme (X). Two ranges separated by a slash are a half damage range, e.g., S/L means full damage to Short range, but half damage at Long range.

Only detected targets can be attacked. Beam weapon ranges are shown on the *Beam Damage and Range Table* (p. 67).

## Beam Attack Rolls

Roll 3d against effective skill to hit. Use Gunner (Beams) for most beam weapons or Artillery (Beams) for ghost particle beams, or for any beam fire being directed from space against unseen surface targets by a forward observer. Figure the effective skill by taking that base skill and applying the modifiers shown below. Note that these modifiers combine aiming, targeting systems, and range penalties to get manageable numbers; see *Space Weapons in Ordinary Combat* (p. 66) for specifics.

**Target Size**: Add the target's SM.

**sAcc:** Add the Space Accuracy of the weapon. This is 0 for most weapons, -3 for particle or ghost particle beam, -6 for plasma beams. Add +1 for 1GJ or larger weapons.

**Space Range:** +20 at zero, 0 at Point-blank, -4 at Close, -8 at Short, -12 at Long, -16 at Extreme.

**Visibility:** -10 if the target is using a Cloaking Device (-4 if your sensors have detected him but he's still cloaked).

**Spinal or Fixed Mount:** +2 if firing any spinal or fixed mount.

**Damage:** -2 if the attacker has 0 HP or less (from damage to its distributed sensor and computer network).

**Target**: -1 if attacking streamlined target's front or rear hull. -5 if aiming for a specific spacecraft hit location (see *Precision Attacks, p.* 66); -10 if aiming for a weak point in armor. -2 per defensive ECM system (-1 if attacker has a functional tactical or multipurpose array).

**Surface Targets**: If attacking surface targets during space combat, apply any relevant Target or Visibility modifiers from p. B548, e.g., for cover.

**Multitasking:** Apply any multitasking penalties (p. 50). This includes a -2 per target penalty for dividing rapid fire among multiple targets.

**Point-Defense**: If firing in point-defense against any ballistic attack with a relative velocity of 300 mps or more, apply the following modifier: -3 if 300 mps, -6 if 1,000 mps, -9 if 3,000 mps, -12 if 10,000 mps, -15 if 30,000 mps, -18 if 100,000 mps+.

**Rapid Fire**: If firing multiple shots at the same target apply a "shots fired" modifier from the table below.

### *Rapid Fire Table*

| *Shots* | *Bonus* | *Shots* | *Bonus* |
|---|---|---|---|
| 2-4 | 0 | 50-99 | +6 |
| 5-8 | +1 | 100-199 | +7 |
| 9-12 | +2 | 200-399 | +8 |
| 13-16 | +3 | 400-799 | +9 |
| 17-24 | +4 | 800-1,599 | +10 |
| 25-49 | +5 | etc. | etc. |

(This expands the rapid fire modifier on p. B548.)

### *Successful Attacks*

A roll of the effective skill number or less means the target was hit. If firing multiple shots at a particular target, score one extra hit per full multiple of Recoil by which you made your attack roll, to a maximum of the number of shots that were actually fired. Recoil is 2 for plasma beams, 1 otherwise.

GMs may optionally add +1 to Recoil in 3-minute or 10-minute turns (as in ***GURPS Interstellar Wars***) to represent the fact that weapons are taking pauses to aim and assess the situation; this will reduce hits, which can improve playability!

As usual, critical success means the target cannot dodge and critical failure means no hits occur. Assume the firing system malfunctions on a critical failure (treat as a disabled system but with no crew casualties).

Beam attacks may be avoided – see *Dodge* (p. 60).

## Ballistic Attacks

Guns, missile launchers, and ramming spacecraft all use these rules. Since the attacker is steering or homing on the target, range modifiers are irrelevant – what matters is the relative velocity. If firing a missile launcher or gun, be sure to specify the type of warhead used if different types are carried.

### *Proximity Detonations*

The gunner making a missile or gun attack may opt to fuse the missiles or shells used for *proximity detonation*. This will significantly increase the chance of a hit, but reduces damage (if a nuclear or antimatter warhead) or armor divisor (if a conventional warhead). All shells or missiles in the attack must have the same fusing.

### *Relative Velocity*

In the basic combat system, this is simplified to an "average" value that is based on the scale chosen and the weapon used. Compare the time and distance scales to find the typical base velocity. If the vessel has a rendezvous or engaged position toward the target, use that value instead. If the attack is a gun shell or missile, and this is less than the minimum velocity of the weapon used, raise it to that value.

*Example:* It's a 3-minute turn in close combat scale, so the typical velocity is normally 1 mps. However, the attacker is using a missile, so the velocity is raised to 10 mps.

### *Base Relative Velocity Table (mps)*

| *Scale* | *Close* | *Standard* | *Distant* |
|---|---|---|---|
| 20-second turn | 10 | 100 | 1,000 |
| 1-minute turn | 3 | 30 | 300 |
| 3-minute turn | 1 | 10 | 100 |
| 10-minute turn | 1/3 | 3 | 30 |
| If rendezvous | 0 | 0 | 0 |
| If engaged | 1/3 | 1 | 3 |

| *Weapon* | *Minimum Velocity** |
|---|---|
| Conventional gun | 1 |
| Electromagnetic gun | 3 |
| Grav gun | 10 |
| Missile, TL7-8 | 3 or 5† |
| Missile, TL9-12 | 5 or 10† |
| Missile, super | 50 or 100† |
| Warp missile | 180,000** |

If a spacecraft is making a fast pass, use the actual velocity.

* If firing a gun or missile listed above and the minimum velocity shown is greater than the typical velocity, raise it up to the minimum.

† Use the first, lower, value if the target is at Point-blank or Short range, or if the attacking spacecraft's last turn's maneuver was to Retreat.

** Pseudo-velocity: used when making the attack (and if anyone tries to shoot the missile). Treat the actual velocity for damage as 10 mps or the base relative velocity, whichever is greater.

*Point Defense Fire and Relative Velocity*: When firing missile launchers or guns in point defense against an incoming ballistic attack, the relative velocity is simply the relative velocity *of* the ballistic attack.

## Point Defense Attacks

A defender who took a Wait (Point Defense) maneuver may interrupt to fire against any incoming missiles, gun shells or any spacecraft that is about to ram.

Point Defense attacks are announced and resolved immediately after a successful ballistic attack roll is made but before the target performs its Dodge roll.

After an attack roll is made, any gunners on the target vessel who chose perform Wait (Point Defense) maneuvers may opt to fire as detailed in the Wait (Point Defense) task (p. 53). Targets of point defense fire may not themselves Dodge (or use Point Defense).

### *Ballistic Attack Roll*

Base skill with a ramming attack is your Piloting skill. The base skill otherwise is Artillery (Guided Missile) for missiles or Artillery (Cannon) for guns. Exception: for fire at point-blank range with guns, use Gunner (Cannon) instead.

Figure effective skill by taking the base skill and applying the modifiers shown below. Note that these modifiers combine aiming, targeting systems, and range penalties.

**Target Size**: Add the target's SM. If ramming, use the greater of your own or the target's SM – it's easier to squash small vessels if you're gigantic!

**Handling or sAcc:** Add the attacking gun or missile's sAcc (see *Guns and Launcher Table*, p. 68) or, if ramming, the attacking spacecraft's Handling.

**Visibility:** -10 if target using Cloaking Device (-4 if your sensors have detected him but he's still cloaked).

**Target**: -1 if attacking streamlined target's front or rear hull. -5 if aiming for a specific spacecraft hit location (see *Precision Attacks, p.* 66), or -10 if aiming for a weak point in armor. -2 per defensive ECM system (-1 if attacker has a functional tactical or multipurpose array)

**Proximity Detonation:** If using a warhead fused for proximity detonation, add +4 to hit.

**Surface Targets**: If attacking surface targets apply any relevant Target or Visibility modifiers from p. B548, e.g., for cover.

**Relative Velocity:** Based on the relative velocity of the collision: +6 if 0, +3 if 0.3 mps, 0 if 1 mps, -3 if 3 mps, -6 if 10 mps, -9 if 30 mps, -12 if 100 mps, -15 if 300 mps, -18 if 1,000 mps, -21 if 3,000 mps, -24 if 10,000 mps, -27 if 30,000 mps, -30 if 100,000 mps+.

**Rapid Fire or Multiple Incoming**: If firing multiple gun shots or missiles apply a "shots fired" modifier from the table below.

### *Shots Fired or Incoming Table*

| *Shots* | *Bonus* | *Shots* | *Bonus* | *Shots* | *Bonus* |
|---|---|---|---|---|---|
| 2-4 | 0 | 17-24 | +4 | 200-399 | +8 |
| 5-8 | +1 | 25-49 | +5 | 400-799 | +9 |
| 9-12 | +2 | 50-99 | +6 | 800-1,599 | +10 |
| 13-16 | +3 | 100-199 | +7 | etc. | etc. |

#### *Successful Attacks*

A roll of the effective skill number or less means the target was hit. If firing multiple shots at a particular target, or if a proximity fused conventional warhead explodes, score one extra hit per full multiple of Recoil by which you make your attack roll, to a maximum of the number of shots that were actually fired (or 10× that if using a proximity-fused conventional warhead).

Recoil is 1 for missiles; for guns, see the *Guns and Launchers Table* (p. 68). Add +1 to effective Rcl. if any nuclear or antimatter warheads were used in the attack due to fratricide – the warheads destroying one another if shots are spaced too closely together.

GMs may optionally add +1 to Recoil in 3 minute or 10 minute turns.

Critical success means the target cannot dodge and critical failure means no hits occur.

## Dodge

A spacecraft may attempt to dodge a beam or ballistic attack, provided its most recent movement was one other than Controlled or Uncontrolled Drift. (A pilot also may not dodge if his spacecraft's last maneuver was Closing with the Deliberate option.)

Roll to dodge once per attack. If multiple hits were scored by the attack, the margin of success on the dodge roll determines the number of additional hits that were dodged.

**Dodge = (Piloting skill/2) + Handling + dodge modifiers.**

*Piloting skill/2* is half the skill (round up) of the pilot. If no one is piloting the spacecraft or the spacecraft did not achieve at least a +0 acceleration bonus, it can't dodge. Combat Reflexes or Enhanced Time Sense add +1 to Dodge.

Dodge modifiers are:

*Defensive Tactics, Offensive Tactics, Tactical Navigation*: These command or navigation tasks may modify your dodge or that of your opponent's.

*Turn Length:* +1 during 1-minute turns, +2 in 3-minute turns, +3 in 10-minute turns.

*Defensive ECM:* +1 defense bonus per system installed, to a maximum of +3; the ECM must be of a TL equal or higher than the attacker's.

*Evasive Action Maneuver:* +1 to Dodge.

A ballistic attack (ramming spacecraft, incoming shell or missile) can't dodge point defense fire.

# Damage

All damage inflicted using these rules is decade-scale (i.e., in multiples of 10 points of damage). Roll the basic damage for every hit scored against a target.

Exception: If firing in point defense against incoming missiles or shells, don't bother rolling damage – each weapon hit (including tractor beams) kills one missile or shell.

If the target has a functional and operating stasis web, it is immune to damage as long as the field is up – don't bother rolling damage vs. a target with an operating stasis web.

## Beam Damage

The *Weapon Beam Damage and Range Table* (p. 67) gives the basic damage of beam weapons other than tractor beams, based on their output. If beam weapons fire at a target that is at or beyond their half-damage range, halve basic damage (rounding down). The *Beam Weapon Table* (p. 67) indicates the type of damage inflicted by different weapon types. Tractor beams have a special effect – see *Tractor Beams in Combat* (p. 66).

## Ballistic Attack Damage

Use these rules for missiles, gun shells, and collisions.

### *Nuclear and Antimatter Warheads*

Damage depends on the warhead's yield, as shown on the *Nuclear and Antimatter Warhead Damage Table* (p. 68).

### *Collisions and Conventional Warheads*

Guns and missiles with conventional warheads and for spacecraft that ram or accidentally collide with objects inflict decade-scale damage based on the relative velocity of the collision.

In a collision, *both* parties involved take the same dice of damage. If a gun shot or missile hits something, the shell or missile is destroyed, but it inflicts damage on the target.

*Gun or Missile:* A hit from a gun or missile with a conventional warhead inflicts d-damage using the formula below.

*Ramming or Colliding Spacecraft:* A collision inflicts crushing d-damage using the Collision formula shown below.

**Gun or Missile = weapon d-Damage × V.**

**Collision = 6d × 3 × lesser dST × V.**

Round to the nearest die.

*Lesser dST* is that of the object with the least dST (or basic dHP), or either, if identical. For example, if a 30-ton fighter with dST 20 collides with a 10,000-ton freighter with dST 150 they each inflict damage to the other based on dST 20; if a spaceship crashes into a world or other immovable object, use the ship's dST.

*Weapon d-Damage* is found on the *Conventional Warhead Damage Table* (p. 68).

*V* depends on relative velocity in miles per second (mps) as calculated under *Ballistic Attacks* (p. 59). Adjust this to a "real" velocity if using pseudo-velocity (p. 33) rules.

## Hull Damage and Hit Location

Attacks may strike various locations on a vessel:

#### *Hull Section*

An attack normally strikes a particular hull section (front, central, or rear hull). If so, determine the specific location struck. Systems in each hull section are numbered [**1**] to [**6**]. Roll 1d to determine which system in the attacked hull section was hit. Destroyed locations can be hit (the damage will pass through and affect another system as detailed below).

Exception: If *every* system in a hull section was *destroyed*, the attack instead hits the same numbered system in the *adjacent* hull section: front or rear hull are adjacent to central; otherwise roll 1d: 1-3 front, 4-6 rear. The attack ignores all armor dDR!

If making a precision attack (p. 66), the attacker can specify which of the six hull locations is hit.

#### *Exposed Systems*

If attacking an exposed system, see the rules for *Targeting Exposed Systems* (p. 66).

### *Damage Resistance*

Spacecraft damage resistance is decade-scale, abbreviated dDR. Many spacecraft weapons have armor divisors, e.g., (2) as indicated for beams in the *Weapon Effect Table* and in the rules for ballistic attacks. Divide dDR by the armor divisor, rounding down. Hardened armor or screens may negate armor divisors (see p. B47). Spacecraft may have several types of defense that provide DR, which protect in the following order.

#### *1. Force Screens*

If the target is protected by a functional force screen, subtract the screen's dDR. Force screens normally protect the entire vessel, but are semi-ablative: every 10 points of basic d-damage rolled reduces the screen's dDR by 1. Design switches may change this!

#### *2. Armor*

If a location on a hull section was hit, subtract the cumulative dDR of its armor systems from the damage. (This combined dDR will be noted in the spacecraft's DR statistic.) Exception: If the initial system hit location roll happens to be a *destroyed* armor system, ignore that system's dDR. Disabled armor systems protect normally.

Armor does not protect exposed systems.

#### *3. Penetrating Damage*

If any basic damage remains after subtracting screen and armor dDR, this is the penetrating d-damage. If no basic damage remains, the hit failed to penetrate.

If a location on a hull section was hit, see *Damage to Hull Sections* (above).

For exposed systems, see *Targeting Exposed Systems* (p. 66).

### *Damage to Hull Sections*

Penetrating damage reduces the spacecraft's dHP. If the damage was great enough, it may also disable one or more spacecraft systems.

If the penetrating damage was at least 10% but less than 50% of dHP, the system hit is *disabled*. A system that was already damaged is *destroyed*. If it was already destroyed, the next undestroyed numbered system in that hull section is damaged, counting upward. E.g., if system [4] is rolled but both it and system [5] had already been destroyed, system [6] is disabled (or destroyed, if already disabled) instead. After system [6] go on to any undestroyed [core] system if one exists in that section; if not, start again with system [1].

If the penetrating damage was at least 50% of dHP, the system hit is destroyed, whether or not it was originally damaged. If it was already destroyed, the next-numbered undestroyed system will be destroyed, as described above. In addition, one other random system in that location suffers a damage result: roll hit location, skipping upward for systems already destroyed as described above.

If the penetrating damage was enough to reduce the reduce the vehicle's dHP to -1 × dHP or worse, check to see if the vessel was destroyed; if it was, don't bother applying individual system damage. If it wasn't destroyed, apply the results detailed above.

#### *Negative HP and Destruction*

Vessels that are reduced to 0 or lower dHP are badly damaged, but may still function. Due to the detailed damage location system, do not make HT rolls to see if the vessel is still working – that's simply determined by the specific systems that remain intact.

However, when a spacecraft reaches -1 × basic dHP, it has suffered such damage to its structural integrity that it must make a HT roll to avoid destruction. On a failure, it is destroyed. If it survives, further HT rolls are required each time the spacecraft is reduced to another multiple of -1 × basic dHP. At -5 × basic dHP the vessel is automatically destroyed.

A destroyed vessel is just wreckage, but some types of systems might still be functional. Armor, cargo, habitats, hangars, missile batteries, open space, passenger seating, and upper stages are still functional if they haven't yet suffered damage. All other systems stop functioning as data, power, and fuel lines are cut. If further damage reduces a destroyed vessel to -10 × basic dHP, it is vaporized.

### *Effects of 0 dHP*

A vessel at 0 dHP or less suffers these penalties as a result of damage to distributed systems:

All comm/sensor array levels are -1.

Its Handling is reduced by 2.

Its gunners have a -2 to hit when making beam attack rolls.

### *Upper Stage*

If a spacecraft with an attached upper stage system takes damage to its front hull, apply it to the upper stage spacecraft, rather than to the rest of the spacecraft. If the upper stage separates, the front hull section of the lower stage is treated as destroyed for damage purposes. It has no armor dDR and system damage goes to the central hull.

## *Disabled Systems*

If a system is disabled it is normally no longer functional. The various capabilities that are described in Chapter 2 for the systems won't work. The system can't be used for any task that is described as requiring a "functional" system. If there are occupants in a disabled system, check for injury: see *Casualties* (below). There are some special cases:

### *Disabled Armor*

If an attack targets weak points in the armor, attacks to that hull section (not just that location) completely ignore the armor system's dDR. (Other armor dDR is still halved.)

### *Disabled Cargo*

If a cargo hold is disabled, half of the cargo in the hold is destroyed. Certain types of hazardous cargo (e.g., ammunition, antimatter, etc.) may be considered volatile systems (below) at the GM's option.

### *Disabled Controls*

When controls are disabled, only half (round *up*) of the control stations cease to function and the vessel's computer network's Complexity is reduced by 1. The remaining control stations are only lost when the system is destroyed.

### *Disabled Habitat or Passenger Seats*

If disabled (or destroyed), in addition to rendering facilities in it non-functional, life support will be affected as various cabins, seats, etc., are lost. See *Overloading Life Support* (p. 46) in Chapter 3. Usually there's no immediate effect (a few hours of residual air, etc.), so don't worry about it until later. There's a 2-in-6 chance any cells or cages will open, allowing survivors to escape.

### *Disabled Fuel Tank*

If a fuel tank that provides delta-V reserve is disabled (or destroyed) the spaceship loses **N/F** of its *remaining* delta-V reserve, where *N* is the number of fuel tanks that were just disabled or destroyed, and *F* is the number of functional fuel tank systems (with that type of reaction mass) that it had left before the damage.

*Example:* A spaceship with four fuel tanks of hydrogen has a delta-V reserve of 63 mps. One of its four fuel tanks is hit and disabled, so it loses 1/4 (rounded up) of its total remaining delta-V reserve, or 16 mps. It is now down to a delta-v reserve of 47 mps. Suppose it used up 17 mps while accelerating, leaving 30 mps, and then is hit again, this time losing *two* fuel tanks. It now loses two of three tanks, so it loses 2/3 of its 30 mps of delta-V reserve, or 20 mps; this leaves it with only 10 mps left in a single remaining tank.

Emergency repairs to a fuel tank won't restore delta-V reserve, but will let the tank be refueled.

### *Disabled Hangar Bays*

All vehicles are unable to launch.

### *Disabled Medium, Secondary, or Tertiary Battery*

Disabling it renders half (round up) of the turrets or fixed mounts in the system non-functional. The others still function.

## *Destroyed Systems*

A system that is disabled again is destroyed. The system stops working, and cannot be fixed. Some special cases:

### *Destroyed Armor*

A destroyed armor system still provides dDR to the hull section – the holes aren't that big. Exception: any *initial* hit location roll against that location ignores its dDR.

### *Destroyed Volatile Systems*

See volatile systems (p. 62).

### *Destroyed Hangar*

All vehicles and cargo in the hangar are also destroyed, unless there is a reason to believe that won't happen (e.g., a small craft with an activated stasis web).

## *Volatile Systems*

Certain systems are highly *volatile*: any system holding missiles, or missiles or gun shells with antimatter warheads; any fuel tanks with antimatter-boosted hydrogen, matter-antimatter, fissionable saltwater, or HEDM fuel; an antimatter power plant; a cargo hold whose contents the GM determines are volatile (e.g., full of explosives).

If a volatile system is disabled, roll against the spacecraft's HT. A failed roll means the spacecraft will explode (reduced to -10× HP) at the *end* of its next turn. A critical failure means it explodes immediately (unless PC-occupied). If a volatile system is destroyed, roll at -5!

If a spacecraft explodes, it inflicts (6d × basic dHP) crushing explosion damage to any spacecraft docked with it; multiply by 10, change this to burning damage, and add surge and radiation modifiers if antimatter warheads, power plants, or fuel are exploding!

## *Casualties*

If people are inside a system when it is disabled or destroyed, they may be injured. If the entire vessel is destroyed by a single attack, "destroyed" applies to everyone aboard.

*Most NPCs:* Assume half (round up) of NPCs in a disabled system are incapacitated (reduced to 0 HP or less) or dead. All NPCs in a destroyed system are seriously injured or dead. The rest have light or no injuries. Animals, plants, etc. suffer comparable casualties.

*PCs and Major NPCs:* Roll 1d on the Casualty Table for each character in a disabled or destroyed system:

If a system is destroyed, survivors will be trapped in the wreckage (unless accidentally blown outside) until rescued.

## Casualty Table

| Roll | Effect |
|---|---|
| 2- | No effect |
| 3 | 2d-1 lethal electrical damage |
| 4 | 3d-2 cutting damage |
| 5 | 3d-2(10) burning damage |
| 6 | 6d×6 crushing damage |
| 7 | Blown outside the spacecraft; also roll again with no modifiers |
| 8+ | 3d×5(10) burning damage |

Add +1 if the system (or entire vessel) was destroyed rather than disabled or +5 if the system or vessel was vaporized (-10× HP). Subtract 1 if in a core system. DR from advantages or armor protects normally.

A character who is blown out also rolls 1d again on the table (with no modifiers) to determine if he also took any damage as he was blown out. He (or his corpse) will be floating 1d×10 yards outside the vessel and can be assumed to be drifting away from the spacecraft at a velocity of (1d) yards/second. He is otherwise traveling in the same direction and speed as the spacecraft, but will be left behind if it accelerates before he can get aboard. If the spacecraft accelerates, he has time equal to the length of the space combat turn to be rescued or get back himself (usually only possible if he has a thruster pack, line gun, etc.) – if not, he'll be left behind!

Anyone who is blown out of a spacecraft or in a system that is *destroyed* is exposed to vacuum, and, if the ship was not already depressurized, explosive decompression. See p. B437. All crew and passengers usually suit-up in dangerous situations.

Ignore these special effects if the spacecraft isn't in vacuum.

If a spacecraft is vaporized (-10× HP) all survivors are also floating in space.

## Damage Modifiers

Certain damage modifiers cause special effects. The GM may skip these rules to speed up combat.

### Surge (Sur) Damage Modifier

Weapons with this damage modifier can fry electrical systems. If a surge attack does any penetrating damage, the ship must roll vs. HT. On a failure, make one extra system damage roll in that hull section: Ignore the result if the system rolled is armor, cargo hold, engine room, hangar bay, fuel tank, soft landing system, or a previously disabled system. On a critical failure, all systems in that section *except* those mentioned above are disabled! Surge damage can be fully repaired by emergency repairs and disabled systems can still be damaged normally (physically disabled on the first roll, destroyed on the second). Personnel occupying a system taking surge damage do not roll for injuries.

### Radiation Damage Modifier

If a system damage roll resulting from an attack with a radiation (rad) damage modifier indicates an occupied system is damaged, occupants also suffer 3d × 10 rads. The vessel's radiation PF does not apply – this is scatter from the penetrating beam itself.

### Explosive (Ex) Damage Modifiers

Except as noted for nuclear and antimatter warheads and ghost particle beams, ignore explosion modifier – the blasts are too small to catch anyone else at space combat scale. Ex and incendiary modifiers are listed for use during attacks on ground targets, etc.

# Action Aboard

This section covers activities that involve moving about or leaving the spacecraft.

## Internal Movement

The length of a space combat turn determines whether or not movement in the spacecraft counts as a character's task for the turn.

## Internal Movement Table

| Hull/Turn: | 20-second | 1-minute | 3-minute | 10-minute |
|---|---|---|---|---|
| SM+5 to +7 | 1 | 0 | 0 | 0 |
| SM+8 to +9 | 2 | 1 | 0 | 0 |
| SM+10 to +12 | 5 | 2 | 1 | 0 |
| SM+13 & up | 10 | 3 | 1 | 0 |

Cross-index spacecraft SM with the turn length.

Time (if 1 or more) is doubled if moving to a *different* hull section.

*0*: The character can move without taking a space combat turn, but must specify which spacecraft system he occupies at the start of each turn.

*1-10*: The number of space combat turns the character must spend moving between parts of the spacecraft. He cannot perform other actions. Double the time required if moving from to a different hull section. If space combat is likely to use 20-second turns, you don't want to be caught in your cabin's bathroom!

If a spacecraft is in microgravity a Freefall skill roll is required to navigate through the vessel. A failed roll means the character doesn't reach his destination in time.

If a spacecraft was accelerating at 3× or more a crewman's home gravity, the crewman won't be able to move unless provided with assistance (e.g., exoskeletons) or the spacecraft has gravitic compensators (or the equivalent).

Movement is dangerous if the spacecraft is dodging! If the craft performs a Dodge any time the character was in transit, roll against the moving character's Spacer skill. Success means the character is able to secure himself; otherwise he suffers the equivalent of a 10-yard fall (20 on a critical failure) per G of acceleration the spacecraft was using (modified for gravitic compensators (p. 29)).

Characters can use airlocks or cargo hatches to enter or leave the spacecraft (possibly boarding a docked spacecraft). This takes an entire turn. If a character is outside the vessel, specify which system he is outside. If that system is the first location to be hit by an attack, the character suffers the *full* damage of the attack.

# Damage Control

A damage control party may perform four different tasks: emergency repairs, rescue, structural repairs, or halt catastrophe. No more than one party can work on the same system, perform structural repairs, or try to avert the same catastrophe in a given turn.

In small spacecraft the damage control "party" may be a single character. On large spacecraft, a damage control party of several characters is usually used. If a party is involved, skill rolls will be made by the team leader, against the lower of his skill (usually the required Repair skill) or the average skill of the team. When calculating their average skill, team members use either Spacer-2 or their Repair skill, whichever is best.

## *Damage Control Party Size Modifier*

| *Party/SM* | *+5-9* | *+10* | *+11* | *+12* | *+13* | *+14* | *+15* |
|---|---|---|---|---|---|---|---|
| One crew | 0 | -3 | -5 | -7 | -9 | -10* | -10* |
| 2-5 crew | +1 | 0 | -3 | -5 | -7 | -9 | -10* |
| 6-19 crew | +1 | +1 | 0 | -3 | -5 | -7 | -9 |
| 20-59 crew | no | +1 | +1 | 0 | -3 | -5 | -7 |
| 60-199 crew | no | no | +1 | +1 | 0 | -3 | -5 |
| 200-599 crew | no | no | no | +1 | +1 | 0 | -3 |
| 600+ crew | no | no | no | no | +1 | +1 | 0 |

Cross-index the number of people in the party with the SM of the spacecraft to find the modifier. "No" means the party is too large to fit into a system. Only *one* party can attempt to fix a given system in a single turn.

* Can be only attempted by PCs or PC-led parties in cinematic games.

## *Emergency Repairs*

It is possible to quickly repair disabled systems by swapping in parts, switching to backup systems, and replacing blown electronics. The required repair skill is shown in the system descriptions in Chapter 2.

Apply the Damage Control Party Size Modifier (above) and the Damage Control Time Modifier (below). Other functional spacecraft systems can help by providing parts: Add +1 per fabricator or robofac system the spacecraft has; +2 per nanofac or replicator.

If emergency repairs succeed, the system is jury-rigged and no longer disabled – it will be functional again at the start of the spacecraft's *next* turn. Critical success means it's fixed immediately. Failure means it's not fixed yet, but you can try again on later turns. Critical failure means the system can't be fixed without major repairs – there's no chance of doing so until after the combat is over.

A jury-rigged system is fixed, but counts as two systems for the purpose of maintenance until fully repaired. Repairs will hold for at least a few hours, but at the start of any *future* combat or other stressful situation in which a jury-rigged system is used, roll against the spacecraft's HT: failure means the system is disabled. (Roll only when the system is first used, and only once for the entire combat.) Assume it's fully fixed only after all lost dHP suffered by the vessel are repaired.

## *Damage Control Time Modifier*

| *Turn Length* | *Jury-Rig* | *Structural Repairs* | *Rescue* | *Halt Catastrophe* |
|---|---|---|---|---|
| 20 seconds | -10* | No | -9 | 0 |
| 1 minute | -9 | -10* | -3 | 0 |
| 3 minutes | -3 | -9 | 0 | 0 |
| 10 minutes | 0 | -3 | +1 | 0 |
| 30 minutes† | +1 | 0 | +3 | n/a |

The table shows the modifier for damage control tasks during different turn lengths.

* Can be only attempted by PCs or PC-led parties in cinematic games.

† For repairs performed out of combat.

## *Structural Repairs*

Usually performed after combat is over, this represents generalized repair to the vessel's structural integrity, and is normally performed by teams working throughout the vessel. Use Mechanic (Vehicle type) skill. Apply the same modifiers are for emergency repairs using the Structural Repairs column of the Damage Control Time Modifier Table, with an additional -2 penalty if the spacecraft is at 0 dHP or less. Success restores dHP × margin of success.

## *Rescue*

Survivors of a *destroyed* system that remain in the spacecraft will be trapped in the wreckage and may need medical attention. A damage control team may attempt to get them out. The leader rolls against the team's average Spacer skill with the party size and time modifiers. Critical success rescues everyone. Success rescues half (round up) of the victims. On a failure, no victims are rescued; on a critical failure, a disaster injures or kills half (round up) of the survivors; for PCs and important NPCs roll again on the Casualty Table.

## *Halt Catastrophe*

It's possible to try and prevent the ship from blowing up due to a destroyed volatile system. The damage control party must be in the volatile system or the same hull section. Roll vs. the repair skill required for that system (for volatile cargo, it's the GM's decision) with the party size modifier and a -4 if in the same section but a different system; the time modifier is always 0. Success means the disaster is averted. Failure means it isn't . . .

## Boarding

A drifting spacecraft can be boarded if another spaceship's pilot has achieved a Rendezvous position with it. This means the spacecraft have matched velocities at zero or near-zero range and may be any distance from in contact to several miles of each other (default 100 yards).

On future turns, boarding is possible – see *Access* (p. 41) for various methods to get in. Boarding actions should use the normal combat rules. If boarding action takes place, pause the space combat until the action is resolved or the time represented by the turn length has passed.

Deliberate attacks, sabotage, stray shots, etc. may damage, disable, or destroy systems from inside. Use the normal rules for damage to objects. Remember to convert between decade-scale and normal scale. Assume spacecraft have only DR 2 vs. internal attacks, but since spacecraft HP are decade-scale, divide damage by 10 before applying it to dHP. If enough damage is done by internal attacks to force a system damage roll, instead of rolling apply the damage to the system where the fighting or sabotage is occurring.

## Launching Small Craft

*"The reactor's going to blow! Everyone to the lifeboats!"*

Occupants may board spacecraft or inside a hangar bay in the same time it takes to move to a new system. That means that in a long-enough turn, it's possible to board a vessel or and launch in only one turn.

Spacecraft can maneuver out of an open hangar bay during the pilot task phase of their vessel's turn. When a new spacecraft is launched, it is added to the turn sequence. Instead of acting in accordance with pilot Speed, it takes its turn immediately after the launching spacecraft and begins in formation with that spacecraft.

Hangar bays have a launch rate that limits the maximum number of vessels that can launch or recover in a minute (represented by surface area considerations). To get turns, divide minutes by three in 20-second turns, multiply by three in 3-minute or 10 in 10-minute turns. Minimum time required is one turn.

A pilot in formation with a larger spacecraft with an open hangar bay may use his turn to maneuver into the bay, provided it has sufficient capacity to accept his vessel. Again, the time required depends on the launch rate of the hangar bay.

A Piloting skill roll is required for recovery operations. Out of combat, spacecraft usually use the Extra Time rules (p. B346) – a commercial ship often spends 30× time (for +5 to skill) while docking! Failure results in an "abort" – no recovery takes place. Critical failure results in a 0.5 mps collision. The GM may ignore critical failures if the character would succeed on a roll of 16 or less, treating them as aborts instead.

# Special Rules

These rules cover a variety of special situations.

## Formations

A spacecraft may maneuver in formation with another friendly spacecraft ("the leader"). To enter formation, its pilot must declare it is doing so, and must choose the *exact* same movement option and acceleration on its own turn as the formation leader did. If the formation leader was Closing, the pilot must also do so, selecting the same target (or its wreckage, if the target was destroyed!). He must also achieve the same result against that the target that the formation leader did. If a spaceship fails to follow any of these requirements, it is not in formation.

These rules apply to all spacecraft as long as they are in formation:

- Attack Run, Rendezvous, and Engaged results on one member are assumed to have applied to every member of the formation.
- They are treated as point-blank range to other vessels in their formation, which means they may be able to fire defensively against incoming missiles or ram attempts.

## Ground Fire

If the battle is taking place in the vicinity of a planet, moon, or asteroid, vessels in orbit may direct fire down onto it, or vice versa.

If the body has more than a trace atmosphere, certain beam weapons firing in either direction may have trouble penetrating the atmosphere: X-ray lasers, grasers, antiparticle beams, and particle beams cannot fire from space through an atmosphere.

The distance from low orbit to the surface is Short Range. Higher orbits may be at Long Range.

GMs may decide that clouds block fire on a particular target. This depends on climate and weather, but may occur occasionally on planets with standard atmospheres, often for dense atmospheres, and perpetually for very dense or superdense atmospheres. Radar can see through clouds, but passive and ladar sensors cannot, making precise identification of targets problematic without someone on the ground; this requires them to use Forward Observer skill and the gunner to use Artillery (Beams) instead of Gunner (Beams).

Clouds additionally provide a dDR vs. laser fire of 20× the planet's atmospheric pressure measured in atmospheres; e.g., dDR 20 on Earth.

## Main Radiators in Combat (Optional)

If spacecraft have main radiators (see *Exposed Radiators* design switch), they can retract them to reduce their vulnerability in combat. Retracting the radiators does not require a task, but the radiators are not considered retracted until the start of the spacecraft's *next* turn.

If a spacecraft's main radiator was disabled, destroyed, or has been retracted, its fusion, antimatter, and total conversion power plants have 30 minutes before they overheat and must shut down after 100 turns at 20-second scale, 30 turns at

1-minute scale, 10 turns at 3-minute scale, or 1 turn at 10-minute scale. This can be extended: each Fuel Tank that is filled with coolant instead of fuel adds 100% to the operating time of a single system (your choice) after which the coolant is used up.

Each turn functional main radiators are extended reduces accumulated time to overheat by one turn. If they overheat, the spacecraft must shut down these systems until radiators are repaired or redeployed.

## Tractor Beams in Combat

Tractor beams may be used at their listed range as shown on the *Beam Damage and Range Table* (p. 67). Roll against the Gunner (Beam) skill of the tractor bay operator. Success does not inflict damage. Instead, it exerts a force on the target measured in gravities (G):

**Tractor force = 0.1 ton per MJ of output.***

**Tractor pull (G) = (tractor beam output MJ/target mass).**

* i.e., 100 tons per GJ, 100,000 tons per TJ, or 100,000,000 tons per PJ.

Multiple beams working on the same target combine their force. For example, if 10 tractor beams each with 3GJ output (300 tons force each, so total of 3,000 tons) lock onto a freighter massing 10,000 tons the tractor beams together will exert a pull of 0.33G. This has no immediate effect . . . but on the target's *next* turn, it must subtract the acceleration of the tractor beam from any acceleration that it uses before calculating its acceleration rating. If it does not accelerate, or if it uses less acceleration than the beam imparts, it's captured; the tractor beam operator may choose the captured spacecraft's next move, using the excess acceleration, his own skill of Gunner (Beams)-4 instead of the target's Pilot skill.

Note: These rules assume the tractor beam is operating in space, where it exerts thrust. In a gravity well, it's more useful to calculate the ST of a beam. To work out the ST of a beam, find the square root of the tractor force (tons) and multiply by 100.

## Precision Attacks

Any attack (ramming, gunnery, or missile) may be targeted at a specific hull system [1-6] location in the facing hull section (e.g., "location 3 in front hull") at a -5 to hit. The gunner may not know what system is in that location unless he's at zero, close, or point-blank range, performed an engineering analysis task, or has blueprints of the target.

A gunner performing a precision attack may also target weak points in a spacecraft's armor (such as hatches, ducts, etc.) at -10 to hit. This can only be performed at zero, close, or point-blank range or if a successful engineering analysis task was performed against that target. The GM may allow precision attacks without these prerequisites against a vessel whose blueprints are on file ("we have the plans of the enemy monitor – aim for the exhaust duct!"). Use half the armor sDR (round down), then apply any armor divisors. Exception: if the target has disabled or destroyed armor systems in the attacked hull section, their dDR is completely ignored when targeting weak points.

### Weapons in Ordinary Combat

All weapon statistics are scaled for space combat. If using these weapons in ordinary combat with one second turns (e.g., if the spaceship is fighting in the air or while in port, is attacked by a super being, etc.) make these changes:

*Damage* is dDamage multiplied by 10.

*Accuracy* is sAcc+18.

The space range modifiers assumes an Acc 18 weapon fired by a gunner performing All Out (Dedicated) aimed attack with 3+ seconds aim assisted by a +9 vehicular targeting system for a net +30. As point-blank range is actually assumed to be 100 miles for a -30 range modifier, the sAcc and Point-Blank modifiers are assumed to cancel out providing a net 0 modifier for Acc 18.

*Range* will vary, as these values are abstractions, but P is about 100 miles, P/C is about 100/300 miles, C range is 100/300 miles, C/S 300/1,000 miles, S 1,000/3,000 miles, S/L about 3,000/10,000 miles, L about 10,000/30,000 miles, L/X is about 30,000/100,000 miles, X about 100,000 miles.

*Ghost Particle Beams:* A ghost particle beam gunner may opt to fire at *any* of the target's hull sections – not just the section facing his spacecraft. A ghost particle beam gunner can also opt to target precise locations in any hull section with the usual -5 penalty for precision attacks, but may additionally choose to target core rather than hull sections by taking a further -3 penalty (total -8).

*Near Miss and Hit Location:* If an attack that took a penalty for a precision attack misses by only 1, a single shot still hits a random location on the hull section facing the attacking spacecraft.

## Targeting Exposed Systems

Deployed main radiator arrays (p. 65), as well as magsails, lightsails, and solar panel systems are *exposed systems.*

They can be targeted separately by beam or gun fire. Use the spacecraft's SM+3 for lightsails, solar panels, or magsails. For main radiator arrays, use SM if the central hull is facing the attacker, or SM-5 otherwise.

If hit, armor dDR does not protect, but due to the large size and diffuse construction of these features, any damage that is less than 10% of spacecraft dHP is ignored. Damage equal to or greater than the spacecraft's dHP will disable the system or main radiator, or destroy it if already disabled. No other damage is done to the spacecraft.

A successful attack with a nuclear or antimatter warhead will *automatically* destroy any deployed exposed systems in addition to its other effects.

# Weapon Tables

## Beam Weapon Tables

Damage dice and range are listed on the *Beam Damage and Range Table*, since they vary depending on beam output. RoF depends on the battery system and Shots are unlimited as weapons draw power. Other statistics are given here.

(Note that the table extends beyond the standard range of weapon outputs to make it possible to extrapolate vessels built with SM+16 or larger hulls and systems.)

### Beam Damage and Range Table

| Output | dDam2 | dDam1 | Range3 | Range2 | Range1 | Range0 |
|---|---|---|---|---|---|---|
| 3 kJ | 1d-2 | 1d-4 | C/S | C | P/C | P |
| 10 kJ | 1d-1 | 1d-3 | C/S | C | P/C | P |
| 30 KJ | 1d+1 | 1d-2 | C/S | C | P/C | P |
| 100 KJ | 2d | 1d | S | C/S | C | P/C |
| 300 KJ | 3d | 1d+2 | S | C/S | C | P/C |
| 1 MJ | 4d | 2d | S | C/S | C | P/C |
| 3 MJ | 6d | 3d | S/L | S | C/S | C |
| 10 MJ | 8d | 4d | S/L | S | C/S | C |
| 30 MJ | 6d×2 | 6d | S/L | S | C/S | C |
| 100 MJ | 4d×5 | 2d×5 | L | S/L | S | C/S |
| 300 MJ | 3d×10 | 3d×5 | L | S/L | S | C/S |
| 1 GJ | 4d×10 | 4d×5 | L | S/L | S | C/S |
| 3 GJ | 6d×10 | 3d×10 | L/X | L | S/L | S |
| 10 GJ | 8d×10 | 4d×10 | L/X | L | S/L | S |
| 30 GJ | 6d×20 | 6d×10 | L/X | L | S/L | S |
| 100 GJ | 2d×100 | 2d×50 | X | L/X | L | S/L |
| 300 GJ | 3d×100 | 3d×50 | X | L/X | L | S/L |
| 1 TJ | 4d×100 | 2d×100 | X | L/X | L | S/L |
| 3 TJ | 6d×100 | 3d×100 | X | X | L/X | L |
| 10 TJ | 8d×100 | 4d×100 | X | X | L/X | L |
| 30 TJ | 6d×200 | 6d×100 | X | X | L/X | L |
| 100 TJ | 2d×1,000 | 2d×500 | X | X | X | L/X |
| 300 TJ | 3d×1,000 | 3d×500 | X | X | X | L/X |
| 1 PJ | 4d×1,000 | 2d×1,000 | X | X | X | L/X |
| 3 PJ | 6d×1,000 | 3d×1,000 | X | X | X | X |

*d-Dam:* The table shows decade-scale damage inflicted based on beam output. Use the D-dam2 column for antiparticle and plasma beams. Use the d-Dam1 for other beams, but treat graviton beams as 1/10 output for damage, i.e., a 10 MJ graviton beam is treated as 1 MJ for damage. Tractor beams do no damage; see *Tractor Beams in Combat* (p. 66).

*Range:* The table shows the range of beam weapons in the range bands used in the space combat system (P is point-blank, C is close, S is short, L is long, X is extreme). Use the appropriate range column shown on the beam weapon table, i.e., R1 means use the Range 1 column.

### Beam Weapon Table

| TL | Weapon | Damage | sAcc | Range | Rcl |
|---|---|---|---|---|---|
| 7^ | Heat ray | burn | 0 | R2 | 1 |
| 9 | Laser | burn(2) | 0 | R2 | 1 |
| 10 | Particle | burn rad sur (5) | -3 | R1 | 1 |
| 10^ | Plasma | burn exp (2) | -6 | R0 | 2 |
| 10 | UV Laser | burn(2) | 0 | R3 | 1 |
| 11 | Antiparticle | cr exp sur rad (3) | -3 | R1 | 1 |
| 11^ | Ghost Particle | cr exp (infinite) | -3 | R1 | 1 |
| 11^ | Graviton | cr (infinite) | 0 | R1 | 1 |
| 11^ | Tractor | special | 0 | R1 | 1 |
| 11 | X-ray Laser | burn* sur (5) | 0 | R3 | 1 |
| 12^ | Conversion | cor (10) | 0 | R2 | 1 |
| – | *followup* | burn exp rad sur | | | |
| 12^ | Disintegrator | cor (infinite) | 0 | R2 | 1 |
| 12 | Graser | burn sur (10) | 0 | R3 | 1 |

*Damage:* The table specifies the damage type inflicted, either tight-beam burning (burn), corrosion (cor), or crushing (cr). This is followed by any damage modifiers (sur is surge, exp is explosion, rad is radiation) and armor divisor. Weapons with an infinite armor divisor ignore armor – see below for special exceptions. Conversion beams that succeed in penetrating their target's DR convert some of it to energy, inflicting the same number of dice of followup damage that ignores all DR.

*sAcc:* The weapon's Space Accuracy. (To find normal Acc, subtract 18.)

*Range:* The range column used (R1 means use the Range 1 column, etc.)

*Rcl:* Recoil is shown the table.

#### Infinite Armor Divisors

Disintegrators, graviton beams, and ghost particle beams have an infinite armor divisor. DR is normally ignored, even if hardened. However, certain special defenses can protect against them, as follows:

*Disintegrator:* Force screens protect with 1/10 dDR; stasis webs block them.

*Graviton:* Force screens protect get 1/100 dDR; stasis webs block them.

*Ghost Particle:* Detonates inside the target. Only reality-stabilized force screens protect, at 1/5 dDR. Any damage that gets past screen DR is tripled due to the internal explosion.

# Guns and Launchers Tables

The table below indicates the sAcc, Range, and Recoil of guns and missile launchers.

*sAcc:* The Space Accuracy. A missile's sAcc depends on TL, e.g., a TL12 missile has sAcc +5.

*Range:* The maximum range. Raise range from C to S, from S to L, or from L to X if firing on a target whose last maneuver was Controlled Drift or Uncontrolled Drift.

*Rcl:* Recoil.

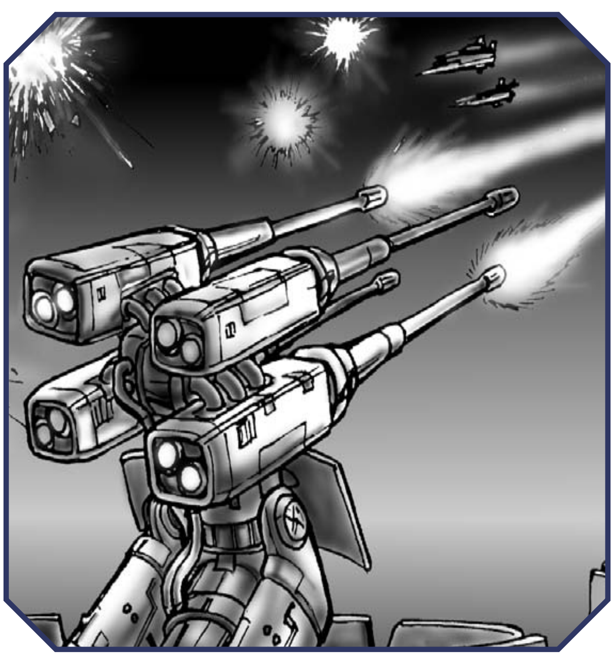
RoF and Shots depends on the battery system.

## Guns and Launchers Table

| TL | Weapon | sAcc | Range | Rcl |
|---|---|---|---|---|
| 7 | Conventional Gun, 2-6cm | -10 | C | 3 |
| 7 | Conventional Gun, 7-14cm | -9 | C | 4 |
| 7 | Conventional Gun, 16cm+ | -8 | C | 5 |
| 7 | Electromagnetic Gun, 2-6cm | -8 | S | 2 |
| 7 | Electromagnetic Gun, 7-14cm | -7 | S | 3 |
| 7 | Electromagnetic Gun, 16cm+ | -6 | S | 4 |
| 11 | Grav Gun | -5 | S | 2 |
| 7 | Missile Launcher, 20-28cm | (TL-8) | L | 1 |
| 7 | Missile Launcher, 32cm+ | (TL-7) | X | 1 |
| ^ | Warp Missile Launcher, 20-28cm | +17 | X | 1 |
| ^ | Warp Missile Launcher, 32cm | +18 | X | 1 |

Add +3 to Acc for cosmic-powered electromagnetic guns, warp missile launchers, grav guns, or for missile launchers firing super missiles (see Chapter 3).

Damage depends on the warhead used – conventional, nuclear, or antimatter.



## Conventional Warhead Damage Table

| Caliber | dDamage |
|---|---|
| 2cm | 6d×5 |
| 2.5cm | 6d×6 |
| 3cm | 6d×7 |
| 3.5cm | 6d×8 |
| 4cm | 6d×10 |
| 5cm | 6d×12 |
| 6cm | 6d×15 |
| 7cm | 6d×18 |
| 8cm | 6d×20 |
| 10cm | 6d×25 |
| 12cm | 6d×30 |
| 14cm | 6d×35 |
| 16cm | 6d×40 |
| 20cm | 6d×50 |
| 24cm | 6d×60 |
| 28cm | 6d×70 |
| 32cm | 6d×80 |
| 40cm | 6d×100 |
| 48cm | 6d×120 |
| 56cm | 6d×140 |
| 64cm | 6d×160 |
| 80cm | 6d×200 |
| 96cm | 6d×240 |
| 112cm | 6d×280 |

*Caliber* is missile launcher or gun diameter.

*dDamage* is the basic dice of damage. It is multiplied by velocity. For example, a 10 mps attack by a 56cm missile does 6d × 140 × 10 = 6d × 1,400 damage. A warhead set for proximity detonation has no armor divisor. Otherwise it has a (2) armor divisor.

### Nuclear and Antimatter Warhead Damage

The table below shows the direct-hit damage from a nuclear or antimatter warhead. Divide damage by 100 for a proximity detonation, e.g., 2.5 megaton does 8d×50 burn.

## Nuclear and Antimatter Warhead Damage Table

| Warhead Yield | d-Damage |
|---|---|
| 25 kiloton | 4d×1,000 burn ex rad sur 20cm+ |
| *linked* | 3d×1,000 cr ex |
| 100 kiloton | 8d×1,000 burn ex rad sur |
| *linked* | 6d×2,000 cr ex |
| 2.5 megaton | 8d×5,000 burn ex rad sur |
| *linked* | 6d×5,000 cr ex |
| 10 megaton | 8d×10,000 burn ex rad sur |
| *linked* | 6d×20,000 cr ex |

In space, nuclear and antimatter weapons inflict only burning damage with the explosive, radiation, and surge damage modifiers. If using nuclear weapons to attack targets on a world with an atmosphere, there is also a blast wave: add the linked crushing explosive damage (multiply this by air pressure in atmospheres).

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