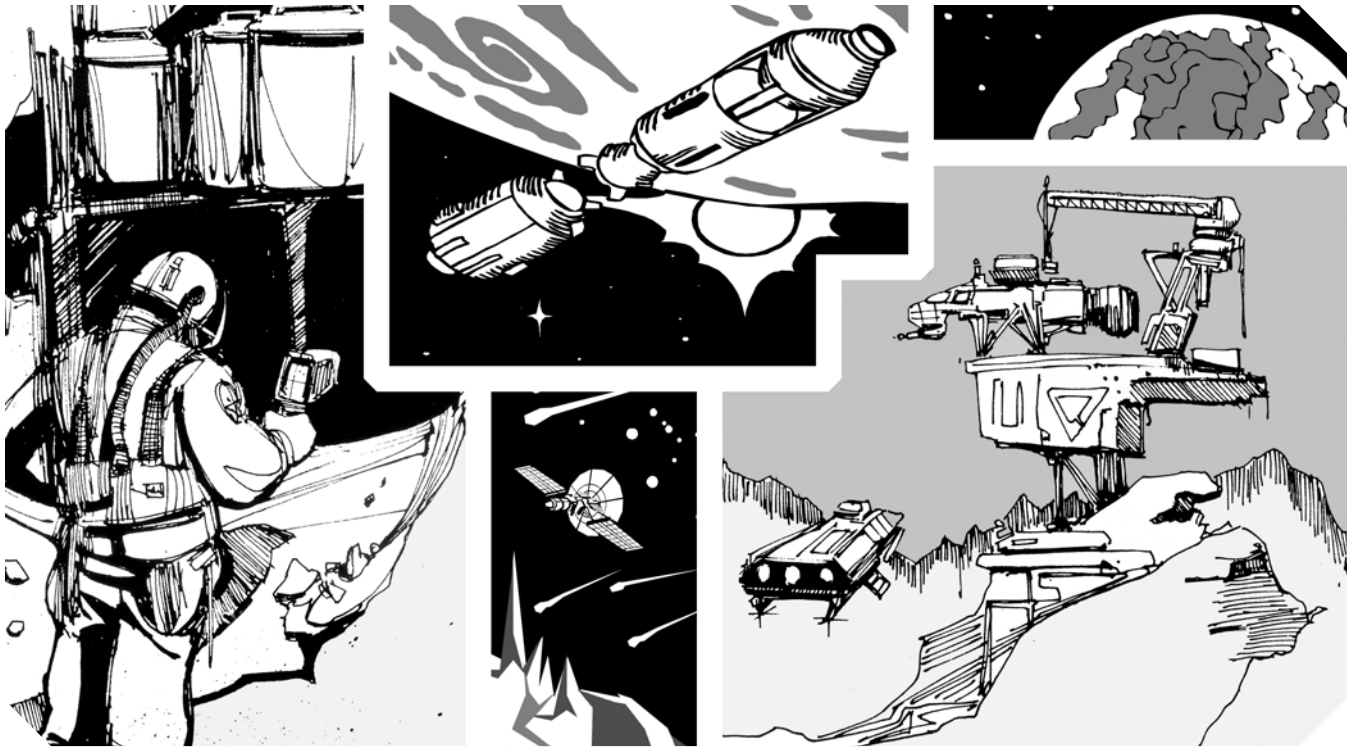
GURPS® Fourth Edition

SPACESHIPS 6

MINING AND INDUSTRIAL SPACECRAFT™



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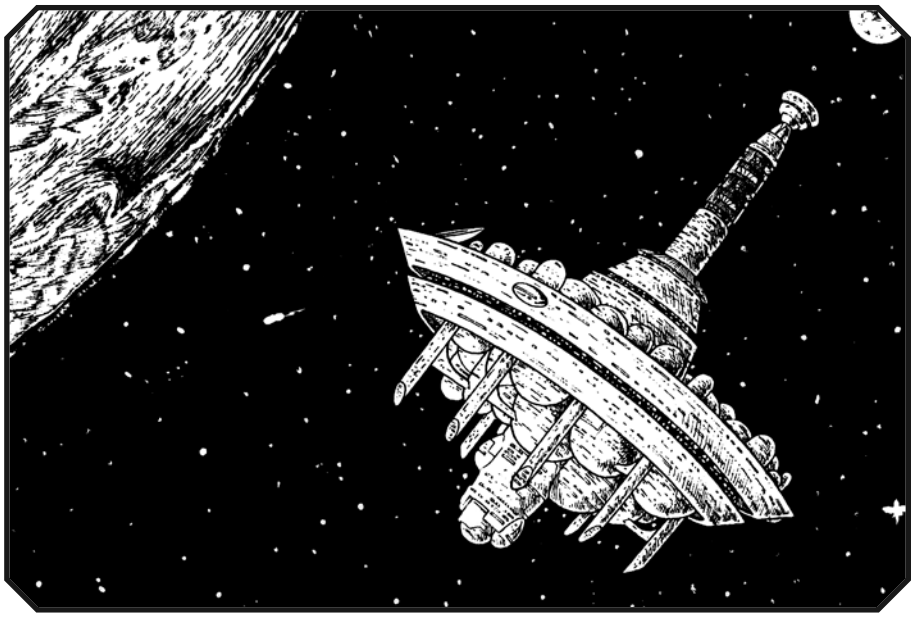
*An e23 Sourcebook for **GURPS**®*

STEVE JACKSON GAMES

Stock #37-0125

Version 1.0 – November 2009

Contents



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Extra-special thanks to Kenneth Peters for playtest contributions above and beyond the call of duty.

Introduction

This book covers asteroid miners, salvage ships, tankers, tugs, and similar rugged vessels that engage in resource extraction and industrial operations. It also covers orbital space yards, service stations, power satellites, and similar facilities.

These hardworking craft build and maintain the exploration ships, star liners, and warships that ply the space lanes. Although they don't seek out adventure, they'll sometimes encounter it: pirates attacking tankers carrying valuable fuel, murder mysteries at isolated mining stations, sabotage at vital orbital shipyards, conflicts between asteroid miners and claim jumpers, or violent labor disputes that sparks a revolution.

About the Series

GURPS Spaceships 6: Mining and Industrial Spacecraft is one of several books in the ***GURPS Spaceships*** series. This series supports ***GURPS Space*** campaigns by providing ready-to-use spacecraft descriptions and rules for space travel, combat, and operations. GMs will need the core book, ***GURPS Spaceships***, to use this book.

Publication History

Rules for space debris removal are derived from Phil Master's *Vacuum Cleaners* chapter in ***Transhuman Space: High Frontier.*** Some details of helium-3 and asteroid-mining operations are derived from ***Transhuman Space: Deep Beyond*** by David Pulver.

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 Fourth Edition*** and author of ***Transhuman Space, GURPS Spaceships, GURPS Ultra-Tech, GURPS Mass Combat, GURPS Banestorm: Abydos,*** and numerous other RPGs and supplements.

About *GURPS*

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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 resources that interest you! Go to each book's web page and look for the "Bibliography" link.

Errata. Everyone makes mistakes, including us – but we do our best to fix our errors. Up-to-date errata pages for all ***GURPS*** releases, including this book, are available on our website – see above.

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.

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Chapter One
Space Industry and Construction

War was coming to the outer system . . . all the projections agreed on it. The energy-starved Egg of Oort wanted to seize Neptune's helium-3 stations to fuel its expansionist agenda. The Commonwealth of Triton was determined to resist, but their national fleet consisted of civilian tankers, ice miners, and a few old patrol ships.

They planned to order the new ***Tsunami****-class strike cruisers from Consolidated Fusion on Rhea, but the progressive faction in the Solar Union had suddenly passed a law banning member states from selling warships to potential combatants.*

So they cheated.

Operation Fragarach was a desperate gamble, but it paid off. Tritonian agents stole the blueprints for the Solar Union's state-of-the-art "Clarent" X-ray laser battery system. Triton's small but sophisticated spaceyards could tool up to build reverse-engineered copies, and retrofit them into its fleet of ice miners. Replacing conventional lasers, the long-ranged beams would give the Oort Fleet a warmer welcome than they expected.

If *the job could be finished in time!*

Space Construction

Spacecraft are normally built at shipyards in Class III to Class V spaceports, examples of which are on pp. 9-10. Construction time depends on the size of the ship built and the port facilities.

GURPS Spaceships lists production times for factory systems. These times are for relatively small items, such as spare parts, personal equipment, etc. For equipment of significant size (SM +2 or more) the time is measured in days, not hours.

Spacecraft can be completely manufactured on a production line inside a station's factory system. The largest size vessel it can build is the system's SM - 6. For example, a factory system scaled to SM +11 could create an SM +5 spacecraft. (Three or more factory systems installed in the same hull section add +1 to the SM limit.) Any production, of course, requires the necessary parts or raw materials be available in cargo storage (equal in mass to the finished ship). Thus, sustaining a high rate of production requires constant deliveries of materials.

Example: A Class V spaceport (an SM +15 station) has an SM +15 fabricator factory with a capacity of $150 million per hour. For larger systems, like entire spaceships, this is changed to $150 million per day. It turns parts or raw materials into ships, provided they are no larger than (SM +15) - 6 = SM +9. For example, since *Klondike*-class mining ships (pp. 18-19) are SM +8 and $69.7M each, it could build two of these ships every day on its production line.

If a vessel is too large to fit the production line but still fits inside a hangar on the manufacturing spaceyard, it can be assembled more slowly. First, the factory time is increased: Treat the project as if it were 10 times as expensive. Then add "assembly time" equal to eight man-hours times hull tonnage. The maximum number of man-hours worth of workers a spaceyard can assign to a single hangar bay assembly effort (humans or human-sized robots) is equal to the workspace crew of that hangar bay (or combination of bays, if several are combined together to make a single larger bay).

Example: Let's say the same spaceport is constructing a 30,000-ton (SM +11) *Jupiter*-class tanker (p. 23) that costs $596.6M. This cost is multiplied by 10 to $5,966M as it's not built on a production line. It takes 5,996/150M = 40 days to build the (oversized) components the ship uses. It then takes another eight hours times 30,000 tons = 240,000 man-hours to assemble. However, an SM +15 spaceyard's hangar bay has 300 crew, so if all 300 work on the ship the time required is 240,000/300 = 800 hours, or 33 days.

If a vessel is even larger and can't fit in a hangar bay, it can be assembled outside the station. The factory time is unchanged; the time required to assemble it is tripled (24 man-hours times hull tonnage). If a spaceyard lacks on-site capability to manufacture parts, individual pieces are built elsewhere, shipped in, stored in cargo or hangar bays, and then assembled using the specified times.

Production times can be sped up: Building a ship in two-thirds the listed time doubles the cost; doing it in half the time triples it.

Port Size and Ship Construction

Class V – Full Facilities: These ports build or refit vessels of any size. The average time required is a number of days equal to twice the project's hull dHP if it is 100,000 tons (SM +12) or larger. For smaller spacecraft, it takes half that.

Class IV – Standard Facilities: These ports build or refit vessels up to 100,000 tons (SM +12) at the same speed as a Class V port. Larger vessels take three times as long.

Class III – Local Facilities: These ports build or refit vessels up to 10,000 tons (SM +10) at the same speed as a Class V port. They build ships up to 100,000 tons (SM +12) but take twice as long. Even larger vessels take three times as long.

Spacecraft are built outside of ports (if the necessary personnel, factories, parts, etc. are available in-system) but the time required is quadrupled.

It's possible to build a spaceship more quickly by paying extra for overtime and other expenses. Tripling the price reduces the time to two-thirds. Quadrupling the price cuts the time in half. Accelerating the time may also require successful negotiations with spaceport or company officials, trade unions, etc**.**

Blueprints and New Spacecraft

Spacecraft are normally built to order from existing hull plans. The GM decides whether standard plans exist for a given type of vessel. The more common space travel is in the universe, the greater the variety of plans available. If spacecraft are common and the requirements are neither outlandish nor locally illegal, a customer can find plans for an appropriate ship.

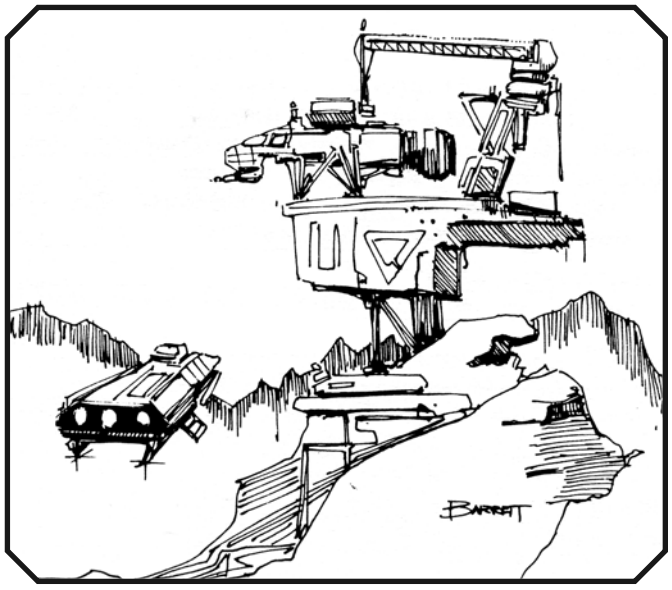
Creating plans and prototypes uses the New Inventions rules on p. B473. It takes years to get a ship design fully operational! These rules assume it is assembled from existing systems that have been built for that size of spacecraft before. If not, these subsystems also have to be invented! That is, if a fusion torch drive has never been built, or no one has ever built that *size* of engine before (e.g., an SM +10 spacecraft's fusion torch), it would be a separate new invention. In the real world, most design delays and cost overruns on ships and aircraft occur when the project runs in tandem with efforts to develop new subsystems for it.

Required Skills: Engineer (Spacecraft) is the only skill needed to design the spaceship itself. See below for notes on inventing specific systems.

Complexity: The vessel's retail price determines Complexity (see p. B473). The spacecraft retails for the unmodified cost calculated on p. 34 of ***GURPS Spaceships.*** Most cost over $1 million and are Amazing.

Concept: The concept roll (p. B473) provides a +1 to +5 bonus for inventions that are variations of existing ones. To qualify as a variant, a ***GURPS Spaceships*** design must have the same hull size, TL, and degree of streamlining. If the only difference is a *single* system, design feature, or design switch, it receives a +5 bonus. For every changed system, and each addition or removal of a feature or design switch, reduce the bonus by 1 to a minimum of 0. Thus, a design with 6+ changes no longer qualifies as a variant.

After the concept is established, the normal rules for prototypes, testing, etc. apply.



Inventing New Sizes of Systems

Realistically, engineers have to organize new research and development projects for systems when they build spacecraft of different sizes. An SM +14 ship needs a different size and model of engine or weapon or sensors than an SM +13 vessel, for example, and this requires a whole new R&D program! This does not apply to armor, cargo holds, habitats, hangars, fuel tanks, open spaces, and passenger seating. The GM may also skip it in cinematic space opera, where scaling things up tends to be easy!

Example: The Federation Navy Yard on Mercury is building the largest fusion-drive warship ever made: the battleship *FNS Gomorrah*. It is SM +11. The yard uses hyperdrive and reactionless engine designs from the existing SM +11 *Jezebel*-class assault carrier, but in this universe, no Federation ship ever used an SM +11 X-ray laser spinal weapon. A new invention program is needed to build a laser cannon of this size.

Buying – or stealing – the plans of existing systems is obviously a more cost-effective method.

Refitting and Repairs

It's cheaper to refit an existing vessel (or second-hand design) than to buy it entirely new. A spacecraft that takes damage may also require repairs so extensive as to amount to a refit.

Cost of refitting is the cost of all new equipment added, plus 30%. Old equipment may have salvage value, especially if the PCs are good negotiators. The time for extensive refitting is generally one day per dHP the spacecraft has. Multiple systems are refitted simultaneously, so there is no extra time requirement. This is modified by extra payments as described under *Space Construction* (pp. 4-5).

For repairs, see ***GURPS Spaceships*** (p. 46): Cost is the price of all equipment destroyed, plus 10%. Multiple systems are repaired simultaneously. The GM can make parts for obsolete spacecraft harder to find, at least in up-to-date spaceyards. Costs are +20% instead of +10% if parts are special-ordered or are custom-fabricated without much difficulty. Alternatively, the GM can rule characters must go to considerable lengths to find parts (or the blueprints used to design them), which entail adventures that take them to out-of-the-way places like shipbreaker yards (below) in the hope of finding vital components.

Modular Systems and Other Upgrades

Any non-core spacecraft system can be *modular:* It can be removed and replaced by other modular systems. Modular Cargo Hold systems cost $1K per ton of the system's cargo capacity (e.g., an SM +8 Cargo Hold is $50K). Other modular systems double their usual cost.

It takes man-hours equal to 2% of the spacecraft's loaded mass (e.g., two man-hours for a 100-ton SM +6 vessel) to swap out a modular system (minimum 1/2 hour). Most spaceyards charge a fee of $1K per man-hour to do this. Crews may do so themselves without the heavy equipment found in spaceyards, but it takes 10 times as long and they must succeed with a roll vs. the Repair skill of each system. Failure just wastes the time; critical failure disables the system (or destroys it if already disabled).

If a party of techs are involved, the team leader makes the skill rolls against the lower of his skill (usually the required Repair skill) or the average skill of the team. (To calculate the team's average skill, use the better of each member's Spacer-2 or Repair skill.)

> *Calamities are of two kinds: misfortune to ourselves, and good fortune to others.*
>
> *– Ambrose Bierce*

Habitat and Weapon Upgrades

The facilities or weapons located in habitats and batteries can be upgraded even if the habitat or battery is not itself modular.

Remodeling Habitats: The facilities in a habitat can be swapped out. Cost for the necessary parts is $10K per cabin-equivalent (plus any lab, teleport projector, minifac, or automed costs). Time required is one man-hour per ton of facility swapped out; labor cost is $1K per ton; skill rolls are as detailed above.

Weapon Batteries: The individual fixed or turret weapons in batteries can be removed and inserted using the modular system times, skill rolls, and labor costs. Roll once for all work on a given system. A weapon in a spinal battery requires triple the man-hours.

Shipbreaker Yards

Obsolete spacecraft sell for scrap at 10% of their value. An elderly ship's last voyage is often to a shipbreaker yard where it is cut up and any useful components are removed.

Characters may be hired to crew a vessel on this trip. This is not without risk. A ship on its last legs develops numerous problems to fix as its limps its way to its final resting place. Spacecraft may become involved in many intrigues, especially if they're ex-military. Warships are stripped of their weapons and any sensitive technology (state-of-the-art software controlling defensive ECM, for example) . . . unless some bureaucratic error or bribe leaves some of it intact. Even an obsolete ultra-tech warship devoid of its primary armament is a useful weapon in the hands of a poorer nation, pirates, or terrorists. If such a faction can't openly *buy* an obsolete ship (e.g., due to embargoes), they may hijack it on the way to demolition.

The shipbreaker yards are located on barren moons, asteroids, or space stations unless reactionless drives, contragravity, or other technologies make it easy to land a ship on a habitable terrestrial planet. An entire world could be nothing more than a graveyard of old ships with the inhabitants living inside their partially gutted hulks.

Shipbreaker yards are not always the most environmentally friendly industries since old spacecraft are irradiated, polluted by toxic chemicals, etc. They are found on poorer industrialized worlds one TL below the norm so the labor is cheaper (human or robot). Moreover, such worlds find uses for the obsolete technology in outdated vessels, which may be modern by their standards. If an entire moon or planet is devoted to the shipbreaking industry, such a place would contain many used spacecraft lots and be a useful source of spare parts for elderly vehicles.

Chapter Two
Spacecraft

This chapter describes several representative mining and industrial spacecraft built using the ***GURPS Spaceships*** rules. Since ***GURPS*** has no default interstellar background setting, only a few of the many possible combinations of spaceship systems, drive types, and degrees of superscience are covered. These represent a mix of hard science and superscience vessels. The basic system in ***GURPS Spaceships*** is highly modular, so the GM can swap out components and adjust details to fit campaign assumptions.

Note on Computers: The abbreviation "C" is used for Complexity when referring to control station computers, e.g., a "C8 computer" is one with Complexity 8.

Orbital Shipyards and Factory Stations

Orbital shipyards are space facilities for constructing, servicing, maintaining, and repairing spacecraft and satellites. Since many ships cannot take off from a planet, the stations are vital for deep-space commerce, especially in settings where there are no superscience space drives. At low TLs, deep-space vessels are expensively assembled in orbit by boosting prefabricated components on successive flights and gradually assembling them. At higher TLs, it's better to place the shipyard there as well and build the entire craft in orbit. Similar facilities are needed for building constructs such as space colonies, space elevators, Dyson spheres, and other megastructures (see ***GURPS Ultra-Tech,*** p. 79 and p. 224, and ***GURPS Space,*** pp. 132-133).

The space environment lends itself to specialized projects where near-perfect vacuum and microgravity conditions are important for industrial processes. In addition to shipbuilding, factories may manufacture exotic alloys, microbot components, perfectly spherical ball bearings, specialized nanomachines, and high-purity protein crystals for drugs. Space industry benefits from the ready availability of abundant resources from asteroid mines and plentiful solar power. Energy from the sun itself is a valuable commodity, beamed down from orbital satellites to planetary customers.

Work Shack (TL8)

Small space-habitat facilities and supply depots are built to provide a temporary but livable environment for workers as they construct larger stations. A work shack is an unstreamlined cylinder 50' long (SM +6, 100 tons) with attached solar panels, often made of a discarded chemical rocket booster's upper stage. It has a bunkroom, a small factory area, several storerooms for tools and spare parts, and a small hangar bay/airlock holding thruster packs and vacc suits. The shack may be dismantled after the project is completed, or towed off to support another endeavor.

> *Wretched mining companies.*
> *No sense of aesthetics.*
> *– Jenna Stannis,* ***Blake's 7*** *#2.10*

Front Hull	***System***
[1]	Light Alloy Armor (dDR 3).
[2-6]	Cargo Holds (five tons each).
[core!]	Fabricator ($5k/hour production capacity).
Central Hull	***System***
[1]	Light Alloy Armor (dDR 3).
[2]	Hangar Bay (three tons capacity).
[3]	Engine Room (one workspace).
[4]	Solar Panel Array (one Power Point).
[5]	Habitat (minifac fabricator).
[6]	Habitat (briefing room).
[core]	Habitat (one bunkroom).
Rear Hull	***System***
[1]	Light Alloy Armor (dDR 3).
[2-6]	Cargo Holds (five tons each).

The facility requires two technicians to run. Additional crewmen are present for zero-G construction work and cargo handling outside the work shack.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
8	Work Shack	30	–	14	–	100	53.4	+6	4ASV	3	0	$6.49M

Space Industrial Park (TL8)

This is a cheap, non-rotating microgravity space station. Privately owned, they serve as the headquarters of companies performing maintenance, towing, and orbit correction; they house a variety of factory and research enterprises. Although too small to build spaceships, it may be the headquarters of companies specializing in repair and refit of spacecraft, space-debris removal and salvage operations, or retrofitting of obsolete satellites with upgraded components. Ugly but functional, this 1,000 ton (SM +8) unstreamlined facility is composed of a cross-shaped structure (150 feet long) festooned with attached modules and solar panels. It has a long robot arm for unloading cargo and a large hangar bay.

Front Hull	*System*
[1]	Steel Armor (dDR 5).
[2]	Robot Arm (ST 700).
[3-4]	Hangar Bays (30 tons capacity each).
[5]	Fuel Tank (50 tons of reaction mass, for refueling other spacecraft).
Front Hull	*System*
[6]	Solar Panel Array (one Power Point).
[core]	Control Room (C4 computer, comm/sensor 5, and four control stations).
Central Hull	*System*
[1]	Steel Armor (dDR 5).
[2!]	Fabricator ($50K/hour production capacity).
[3]	Cargo Hold (50 tons).
[4!]	Fabricator ($50K/hour production capacity).
[5-6]	Cargo Holds (50 tons each).
[core]	Habitat (three bunkrooms, gym, one cabin).
Rear Hull	*System*
[1]	Steel Armor (dDR 5).
[2]	Habitat (two labs, one-bed sickbay, office).
[3]	Engine Room (one workspace).
[4-5]	Cargo Holds (50 tons each).
[6]	Solar Panel Array (one Power Point).

Personnel includes a station manager, chief engineer, a communications operator, four scientists, a robot arm operator, and five factory workers and technicians.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
8	Space Industrial Park	70	–	14	–	1,000	311.4	+8	14ASV	5	0	$127.4M

I rushed us out of space dock, because I had something to prove. And I risked the lives of 81 humans, a Vulcan and a Denobulan to do it.

– Capt. Jonathan Archer, ***Enterprise*** *#1.12*

Solar Power Satellite (SPS) (TL9)

With no atmosphere to get in the way, solar panels in space are more efficient than those on a planetary surface. Energy is vital to any industrialized civilization, and solar energy from the sun is an economical way to power a spacefaring population. Built using a 1,000 ton (SM +8) unstreamlined hull, this space station uses a large array of solar panels to track and collect photons. It is in geosynchronous orbit (22,300 miles up for Earth) where it bathes in sunlight nearly all the time. Solar panels power emitters which beam microwaves to ground-based multi-acre rectifying antenna. The "rectenna farms" convert this energy into electricity. The SPS's spinal battery and major batteries represent the microwave beam transmitterss, but the energy is not tightly focused enough to be useful as a weapon. The cargo capacity aboard the satellite may be used by its owners for orbital warehousing, or represent open space.

Front Hull	*System*
[1]	Light Alloy Armor (dDR 7).
[2-3]	Solar Panel Array (one Power Point each).
Front Hull	*System*
[4!]	Spinal Battery (1 GJ power beam).
[5!]	Major Battery (300 MJ power beam).
[6]	Hangar Bay (30 tons capacity).
[core]	Control Room (C6 computer, comm/sensor 6, and only two control stations).
Central Hull	*System*
[1]	Light Alloy Armor (dDR 7).
[2-3]	Solar Panel Array (one Power Point each).
[4]	Engine Room.
[5]	Cargo Hold (50 tons).
[6!]	Major Battery (300 MJ power beam).
[core!]	Spinal Battery (central system).
Rear Hull	*System*
[1]	Light Alloy Armor (dDR 7).
[2-3]	Solar Panel Array (one Power Point each).
[4!]	Spinal Battery (rear system).
[5!]	Major Battery (300 MJ power beam).
[6]	Cargo Hold (50 tons).

It has total automation. It functions with no crew but has provisions for two onboard operators for manual override and maintenance.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
9	SPS	70	–	12	–	1,000	130.2	+8	2SV	7	0	$71.8M

Space Factory (TL9)

A wheel-shaped station massing 10,000 tons (SM +10), this facility is a small manufacturing complex or corporate R&D facility. It includes engineering labs for projects too dangerous for an inhabited world, or ones in which microgravity and/or hard vacuum are useful.

The station spins to simulate gravity, but one fabricator complex is in the non-spinning central spoke to take advantage of zero-G for those processes that benefit from it. Above the installation are large solar panels providign power for its factories. It's a fairly austere environment with little in the way of luxuries. Employees are usually rotated out every four to six months. Higher-TL versions may replace the fabricators with robofacs or nanofacs.

Front Hull	*System*
[1]	Steel Armor (dDR 10).
[2-5]	Solar Panel Array (total four Power Points).
[6]	Hangar Bay (300 tons capacity).*
[core]	Control Room (C7 computer, comm/sensor 8, and only four control stations).*
Central Hull	*System*
[1]	Steel Armor (dDR 10).
[2-3!]	Fabricators ($500K/hour production capacity each).*
[4-5]	Cargo Holds (500 tons each).
[6]	Fuel Tank (500 tons of reaction mass, for refueling other spacecraft).
[core]	Habitat (14 cabins and one luxury cabin with total life support, two establishments, large lab, and four-bed sickbay).*
Rear Hull	*System*
[1]	Steel Armor (dDR 10).
[2!]	Fabricator ($500K/hour production capacity).*
[3-5]	Cargo Holds (500 tons each).
[6!]	Fabricator ($500K/hour production capacity).*

* One workspace per system.

It has spin gravity (0.2G). Each shift is manned by a stationmaster, deputy, sensor and communications operators, medic, engineering officer, seven technicians, and 10 researchers.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
9	Space Factory	150	–	14	–	10,000	2,803	+10	30ASV	10	0	$2.2507B

Class III Orbital Spaceport (TL8)

This is a typical Class III orbital spaceport and attached spaceyard, providing shipbuilding, repair, and cargo facilities. It services and repairs ships up to 10,000 tons (SM +10) internally; the few external clamps are reserved for occasional larger vessels that might dock with it. Enhanced scientific sensors are installed due to the undeveloped nature of the systems a Class III spaceport serves. In civilized systems, they represent an astronomical observatory attached to the station.

Front Hull	*System*
[1]	Stone Armor (dDR 10).
[2]	External Clamp.
[3]	Cargo Hold (15,000 tons).
[4-6]	Hangar Bays (10,000 tons capacity each).*
Central Hull	*System*
[1]	Stone Armor (dDR 10).
[2]	Science Array (comm/sensor 12).*
[3]	Habitat (1,000 cabins, 500 luxury cabins).*
[4]	Habitat (1,000 cabins, 100 establishments, 200 offices, 100-bed hospital sickbay, and 2,500 tons cargo).*
[5]	Solar Panel Array (one Power Point).
[6]	Open Space (2.5 acres of farms).*
[core]	Control Room (C6 computer, comm/sensor 10, and 30 control stations).*
Rear Hull	*System*
[1]	Stone Armor (dDR 10).
[2]	External Clamp.
[3]	Cargo Hold (15,000 tons).
[4-6]	Hangar Bays (10,000 tons capacity each).*
[core!]	Fabricator ($15M/hour production capacity).*

* 30 workspaces per system.

It has spin gravity (0.7G).Crew consists of 30 control room staff (some of whom operate a system-wide or planetary traffic-control network), 360 technicians, and 60 passenger attendants.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
9	Class III Spaceport	500	–	14	–	300,000	93,000	+13	5,000ASV	10	0	$20.975B

Class IV Orbital Spaceport (TL9)

This spaceport and attached spaceyard can service, repair, and construct ships up to 30,000 tons (SM +11) internally; as with its larger cousin, other ships – and anything too big to fit inside – dock outside using the external clamps. Any planet with a station of this class has smaller spaceports as well. It is a donut-shaped station that rotates to provide artificial gravity, with a large solar-panel array to provide power. Ship construction at a Class IV spaceport tends to focus on smaller jobs: Most projects that can afford to occupy a Class IV's capacity can afford to find a Class V to do it more efficiently.

Front Hull	*System*
[1]	Stone Armor (dDR 15).
[2]	External Clamp.
[3]	Cargo Hold (50,000 tons).
[4-6]	Hangar Bays (30,000 tons capacity each).*
Central Hull	***System***
[1]	Stone Armor (dDR 15).
[2]	Habitat (6,000 cabins).*
[3]	Habitat (3,000 luxury cabins).*
[4]	Habitat (1,500 establishments, 1,500 offices, 500-bed hospital sickbay, and 5,000 tons cargo).*
[5]	Open Space (five acres of farms).*
[6]	Solar Panel Array (provides one Power Point).
[core]	Control Room (C9 computer, comm/sensor 12, and 40 control stations).*
Rear Hull	***System***
[1]	Stone Armor (dDR 15).
[2]	External Clamp.
[3-6]	Hangar Bays (30,000 tons capacity each).*
[core!]	Fabricator ($50M/hour production capacity).*

* 100 workspaces per system.

It has spin gravity (1G). Crew consists of 1,300 technicians, 40 control room crew, and about 270 passenger attendants.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
9	Class IV Spaceport	700	–	14	–	1,000,000	266,800	+14	18,000ASV	15	0	$61.01B

Class V Orbital Spaceport (TL10)

A Class V orbital spaceport, this has berths for hundreds of spaceships, multiple landing and launch facilities, surface-to-orbit shuttles, and every amenity imaginable from crew union halls to high-tech training facilities. It can service, repair, and construct ships up to 100,000 tons (SM +12) internally; anything bigger than 100,000 tons docks outside using the external clamps.

This station consists of an 800-yard long spire with a habitat ring around its middle. This spins to provide gravity while the spire remains stationary to allow ships to dock at its front and rear; a rotating transit system provides access between the two. Farms in the partial-G upper decks of the habitat ring make the spaceport self-sufficient, while the 1G region is reconfigured as people and projects come and go.

The factory's pace assumes all required parts are available and its output is devoted entirely to a single job. This is rarely the case as much of the time and expense constructing a spaceship comes from acquiring and delivering the parts for assembly. Even then, a Class V spaceport has several jobs at once. Smaller construction tasks are outsourced to Class IV spaceports if practical, reserving the station's capacity for jobs that need it.

Front Hull	*System*
[1]	Stone Armor (dDR 20).
[2-3]	External Clamps.
[4-6]	Hangar Bays (100,000 tons capacity each).*
[core]	Control Room (C11 computer, comm/sensor 14, and 60 control stations).*
Central Hull	***System***
[1]	Stone Armor (dDR 20).
[2]	Solar Panel Array (one Power Point).
[3]	Habitat (5,500 luxury cabins, 3,000 establishments, 2,000 offices, and 1,000-bed hospital sickbay).*
[4]	Open Space (10 acres of farms).*
[5]	Habitat (10,000 luxury cabins).*
[6]	Cargo Hold (150,000 tons).
Rear Hull	***System***
[1]	Stone Armor (dDR 20).
[2-3]	External Clamps.
[4-6]	Hangar Bays (100,000 tons capacity each).*
[core!]	Fabricator ($150M/hour production capacity).*

* 300 workspaces per system.

It has spin gravity (maximum 1.5G). It is operated by 3,300 technicians (who double as cargo handlers and factory workers when needed), 60 control room crew (mostly traffic control), and 900 passenger attendants.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
10	Class V Spaceport	1,000	–	14	–	3,000,000	753,100	+15	31,000ASV	20	0	$180.32B

Manchester-Class Industrial Star City (TL10^)

This is an itinerant city-ship traveling the universe seeking work. Built with a 3,000,000 ton (SM +15) unstreamlined hull, this immense vessel is 1,500 feet across. The star city has the resources to perform a wide variety of tasks, including major mining, industrial, and scientific projects. Although it has only 0.1G thrust, its powerful contragravity lifters land or take off from high-G worlds, or even hover inside the atmosphere of a gas giant to perform helium-3 gas-mining operations (p. 21).

Front Hull	*System*
[1]	Steel Armor (dDR 70).
[2]	Habitat (10,000 luxury cabins).*
[3-4!]	Fabricators ($150M/hour production capacity each).*

Front Hull	*System*
[5]	Habitat (300 mixed establishments, 1,500 offices, 15 major labs, 300 school rooms, 300-bed hospital sickbay, 83,500 tons cargo).*
[6]	Open Space (10 acres of farms).*
[core]	Control Room (C11 computer, comm/sensor 14, and only 40 control stations).*
Central Hull	*System*
[1]	Steel Armor (dDR 70).
[2]	Solar Panel Array (one Power Point).
[3]	Fusion Reactor (two Power Points).*
[4!]	Stardrive Engine (FTL-1).*
[5!]	Tertiary Battery (30 turrets with 3 GJ rapid fire UV lasers).*
[6!]	Contragravity Lifter.*
Central Hull	*System*
[core!]	Rotary Reactionless Engine (0.1G acceleration).*
Rear Hull	*System*
[1]	Steel Armor (dDR 70).
[2]	Hangar Bay (100,000 tons capacity).*
[3]	Cargo Hold (150,000 tons).
[4!]	Mining (15,000 tons/hour).*
[5!]	Chemical Refinery (50,000 tons/hour).*
[6]	Fuel Tank (150,000 tons capacity, for refined volatiles).

* 300 workspaces per system.

It has artificial gravity. Crew consists of 40 control, 1,500 administrators, 30 medics, 3,000 scientists, and 4,200 technicians.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL10 (HIGH-PERFORMANCE SPACECRAFT)												
10^	*Manchester*-class	1,000	-4/5	14	0.1G/c	3,000,000	335,500	+15	20,000ASV	70	1×	$445.769B

Leviathan-Class Super Constructor Ship (TL12^)

This huge starship is intended to assist in megascale space-engineering projects such as building giant stargates or Dyson spheres. Its powerful spinal mount conversion beam, though effective as a weapon, is a cutting tool to carve up asteroids, planets, etc. into building materials. Its many tractor beams manipulate large objects while its cavernous hangar bays house a swarm of smaller work craft and support vessels. Although not a dedicated warship, behemoths like the *Leviathan* bulldoze away any lower-TL civilization that gets in the way of progress!

Front Hull	*System*
[1]	Advanced Metallic Laminate Armor (dDR 200).
[2-3]	Hangar Bays (100,000 tons capacity each).*
[4]	Cargo Hold (150,000 tons).
[5!]	Spinal Battery (3 TJ conversion beam).*
[6!]	Light Force Screen (dDR 1,500).*
[core]	Control Room (C13 computer, comm/sensor 16, and 60 control stations).*
Central Hull	*System*
[1]	Advanced Metallic Laminate Armor (dDR 200).
[2!]	Mining (15,000 tons/hour).*
[3!]	Nanofactory ($3B/hour production capacity).*
[4]	Habitat (150 luxury cabins and 9,000 cabins with full life support, 100-bed automed hospital sickbay, five major labs, 50 establishments, large ops center, and 100 teleport projectors).*
[5-6!]	Secondary Batteries (each: 10 turrets with 100 GJ tractor beams).*
[core!]	Spinal Battery (central system).*
Rear Hull	*System*
[1]	Advanced Metallic Laminate Armor (dDR 200).
[2]	Fuel Tank (150,000 tons hydrogen with 10,000 mps delta-V).
[3!]	Stardrive Engine (FTL-1).*
[4]	Super Conversion Torch Drive (50G acceleration).*
[5]	Total Conversion Reactor (five Power Points).*
[6!]	Spinal Battery (rear system).

* 300 workspaces per system.

It has artificial gravity and gravitic compensators. Crew consists of 60 control, 100 administrators, 20 medics, 1,000 scientists, and 4,500 technicians.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL12 (HIGH-PERFORMANCE SPACECRAFT)												
12^	*Leviathan*-class	1,000	-2/5	14	50G/10,000 mps	3,000,000	351,830	+15	18,300ASV	200*	1×	$1,150.11B

* Add dDR 1,500 if force screen is powered up.

Top air speed is 1,800 mph.

Service and Salvage

The orbital space around Earth or other high-tech civilized planets may be crowded with satellites and stations. The first space industrial craft may be designed to service (repair and refuel) satellites and, perhaps just as important, take care of the waste they produce.

Most civilizations produce garbage, and spacefarers are no exception. Space junk can include dead satellites and abandoned stations whose orbits have not yet decayed; fragments from destroyed vehicles (especially those that blew up); objects accidentally let go of by people working in space; and whole upper stages of old booster rockets. Space may be infinite, but the volume defined as "planetary orbit" fills up with enough debris to make major collisions with valuable satellites, ships, or stations inevitable (*especially* in the aftermath of a battle or major accident). Since objects in low or medium orbits circle the planet at thousands of miles per hour, impacts can be catastrophic! The situation worsens through a "cascade effect" in which those collisions produce even more debris.

A functioning spacefaring civilization needs both to reduce the space-junk problem by regularly servicing and replacing satellites in orbit before they break down, and to mitigate it by cleaning up whatever debris is produced. Such operations are crucial when huge, populated facilities like giant manned space stations or space elevators (see ***GURPS Ultra-Tech***, p. 224) are in use. Under these conditions, space salvage and debris removal is a lucrative business venture, paid for by governments or corporations who own the assets at risk. The most reliable source of income is recovering defunct or malfunctioning satellites at the request of their owners: for repair or refueling, or to avoid liability for the debris. Smaller operators engage in contracted operations including removing specific catalogued debris, and freelance salvage – hunting for large objects of uncertain origin, picking them up, and determining whether they have scrap value or can be sold to collectors or historical researchers.

GMs may consult ***Transhuman Space: High Frontier*** for adventure ideas and extra rules for space-salvage operators (dubbed "vacuum cleaners" in that setting).

Dealing with Space Junk

There are several techniques for cleaning up space junk.

Capture involves spacecraft with clamps or robot arms or, for small bits of debris, crewmen operating in vacc suits. The object is taken into a hangar or attached in an external clamp and towed away. In game terms, use Electronics Operation (Sensors) skill for the initial assessment, Piloting and a DX roll or two for use of robot arms, and Vacc Suit and Free Fall for hand-recovery work. Failure knocks the object into another orbit, breaks it up, etc.

Destruction of dangerous debris requires vaporizing, and as such is mostly limited to small objects.

De-orbiting techniques deal with relatively large objects of low value. The principle is to change their orbit so they encounter significant upper-atmosphere air resistance, which slows them and lowers their orbit yet more, until they fall into the atmosphere and burn up (or crash in an uninhabited area). The simplest method is to target it with a laser from a particular direction, causing parts of the surface to vaporize. This produces an action and reaction, and hence effectively thrust. Alternatively, a rocket motor attached to an object slows it down. The most efficient version of this involves flying a manned or unmanned ship to clamp onto the object, setting it for re-entry, then detaching and boosting away. Plotting a de-orbiting operation requires effort in itself; in game terms, Navigation skill is required. Gunner (Beams) is appropriate if using a laser, while Piloting controls a rocket in person or remotely.

Kobold Work Bug (TL9)

Using a 30-ton (SM +5) unstreamlined hull, this rugged and versatile single-seat machine resembles the upper half of a giant robot. A sort of space pickup truck, it is intended for local-space construction, salvage, and debris removal jobs in and around space stations. With its rocket propulsion system, laser drill, and a pair of robotic arms, it performs many maintenance tasks. A vessel this size is carried as an auxiliary craft by an asteroid-mining or large salvage ship.

Front Hull	*System*
[1-2]	Light Alloy Armor (total dDR 4).
[3-4]	Robot Arms (ST 200 each).
[5!]	Major Battery (turret with 1 MJ rapid fire laser).
[6]	Cargo Hold (1.5 tons).
Front Hull	***System***
[core]	Control Room (C4 computer, comm/sensor 3, and one control station).
Central Hull	***System***
[1]	Light Alloy Armor (dDR 2).
[2]	Passenger Seats (two seats).
[3-4]	Cargo Holds (1.5 tons each).
[5-6]	Fuel Tanks (1.5 tons water with 0.15 mps delta-V each).
Rear Hull	***System***
[1-2]	Light Alloy Armor (total dDR 4).
[3]	Nuclear Thermal Rocket (with water, 1.5G acceleration).
[4-6]	Fuel Tanks (1.5 tons water with 0.15 mps delta-V each).
[core]	MHD Turbine (two Power Points).

It is operated by a single pilot.

TL	Spacecraft	dST/HP	Hnd/SR	HT	Move	LWt.	Load	SM	Occ	dDR	Range	Cost
PILOTING/TL9 (HIGH-PERFORMANCE SPACECRAFT)												
9	*Kobold*	20	0/4	12	1.5G/0.75 mps	30	4.8	+5	1+2SV	4/2/4	–	$1.095M

Planetoid-Class Orbital Salvage Ship (TL9)

This locates, tracks, and salvages space junk. It is lightly armored to withstand accidental impacts and operate in debris-infested areas, and its powerful nuclear rocket engines provide decent acceleration and plenty of towing capacity. It's equipped with a pair of robot arms for salvage and a laser for destroying or deflecting debris, plus a hangar bay for storage of captured objects. The *Planetoid* is built with a 300-ton (SM +7) unstreamlined hull 100 feet long.

Front Hull	System
[1-2]	Light Alloy Armor (total dDR 10).
[3-4]	Robot Arms (ST 500 each).
[5-6]	Hangar Bays (10 tons capacity each).
[core]	Control Room (C5 computer, comm/sensor 5, and three control stations).
Central Hull	**System**
[1]	Light Alloy Armor (dDR 5).
[2!]	Medium Battery (turret with 30 MJ laser and 10 tons cargo).
[3-5]	Fuel Tanks (15 tons hydrogen with 0.45 mps delta-V each).
[6]	Engine Room (one workspace).
[core]	Habitat (bunkroom, one-bed automed sickbay).
Rear Hull	**System**
[1]	Light Alloy Armor (dDR 5).
[2]	Fuel Cell (one Power Point).
[3-4]	Fuel Tanks (15 tons hydrogen with 0.45 mps delta-V each).
[5-6]	Nuclear Thermal Rockets (0.5G acceleration each).

Crew consists of a captain/pilot, sensor/comm operator, gunner, and engineering officer/technician. All are trained for salvage operations.

TL	Spacecraft	dST/HP	Hnd/SR	HT	Move	LWt.	Load	SM	Occ	dDR	Range	Cost
PILOTING/TL9 (HIGH-PERFORMANCE SPACECRAFT)												
9	*Planetoid*-class	50	-1/5	13	1G/2.25 mps	300	30.4	+7	4ASV	10/5/5	–	$11.91M

Samaritan-Class Rescue-and-Salvage Ship (TL11^)

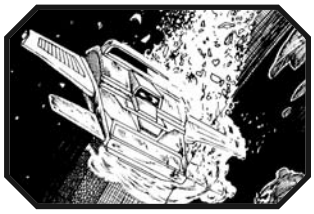
The *Samaritan* travels from system to system performing high-priority salvage, junk clean-up, and emergency rescue missions, especially in regions too small for their own dedicated teams. It has a 3,000-ton (SM +9) unstreamlined hull 200 feet long. Tractor beams safely grab wreckage, making robot arms unnecessary, although it has an external clamp for towing. The oversized sickbay and extra bunk space (in excess of crew requirements) and hibernation capsules are for rescue operations. Its enhanced sensors rapidly locate, track, and classify debris and/or lost vessels.

To get profit without risk, experience without danger, and reward without work is as impossible as it is to live without being born.

– A.P. Gouthey

Front Hull	System
[1]	Advanced Metallic Laminate Armor (dDR 20).
[2-5]	Hangar Bays (100 tons capacity each).
[6!]	Major Battery (turret with 1 GJ tractor beam).
[core]	Control Room (C9 computer, comm/sensor 9, and six control stations).
Central Hull	**System**
[1]	Advanced Metallic Laminate Armor (dDR 20).
[2!]	Medium Battery (two turrets with 300 MJ tractor beams, one turret with 30 MJ rapid fire improved ultraviolet laser).
[3]	Enhanced Array (comm/sensor 11).
[4!]	Light Force Screen (dDR 100).
[5]	External Clamp.
[6]	Cargo Hold (150 tons).
[core]	Habitat (five cabins, three bunkrooms, nine-bed sickbay, minifac robofac, and eight hibernation chambers).

Rear Hull	*System*
[1]	Advanced Metallic Laminate Armor (dDR 20).
[2-3!]	Super Reactionless Engines (50G acceleration each).
[4!]	Stardrive Engine (FTL-1).
[5]	Engine Room (two workspaces).
[6]	Super Fusion Reactor (four Power Points).



It has artificial gravity and grav compensators. Crew consists of a captain/pilot, a sensor/comm operator, an engineering officer, four gunners, two medics, two technicians, and two salvage specialists.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL11 (HIGH-PERFORMANCE SPACECRAFT)												
11^	*Samaritan*-class	100	+1/5	13	100G/*c*	3,000	553	+9	22ASV†	20*	1×	$292.5M

* Add dDR 100 if force screen is powered up.
† Plus eight in suspended animation.

Top air speed is 2,500 mph.

Space Tugs

These vessels are the backbone of space industry: rugged, hard-working craft equipped with external clamps, robot arms, or tractor beams. Tugs move objects that don't have space drives such as satellites, space stations, wrecks, asteroids, cargo canisters, or chunks of ore. They may provide an initial boost to spacecraft with low acceleration drives (e.g., 0.001G) such as ships using ion engines, magnetic sails, or solar sails for propulsion, or whose drive radiation is considered too dangerous for crowded orbital space. They assist such vessels in quickly docking with space stations and maneuvering through crowded space lanes.

Tugs come in various sizes ranging from small, local-space vessels that reposition satellites or push ion-drive craft in or out of parking orbit, to heavy-duty deep-space craft intended for long-duration missions like moving a planetoid from the Asteroid Belt to Earth orbit. Since tugs operate in a zero-G environment, even a small one with a low-powered engine can (slowly) accelerate a massive object, but the more powerful the tug the faster it can do the work. Although called "tugs" out of tradition, vessels clamp onto or push their payloads rather than pulling them (though some maneuvers involve tethered cables). See the External Clamp description (***GURPS Spaceships,*** p. 15) to calculate the performance of a tug when it is pushing or otherwise attached to another vessel.

Panama-Class Orbital Transport Vehicle (TL8)

This small manned space truck is designed to push satellites and small stations (such as the work shack on p. 7) into different orbits. It has a 100-ton (SM +6) unstreamlined hull, and uses a simple low-tech chemical rocket engine for propulsion. It transports a half-dozen passengers and several tons of cargo, and is a general utility vehicle and intra-orbital taxi.

Front Hull	*System*
[1]	Steel Armor (dDR 2).
[2]	External Clamp.
[3]	Cargo Hold (five tons).
[4]	Passenger Seats (six passengers).
[5-6]	Fuel Tanks (five tons rocket fuel with 0.21 mps delta-V each).
[core]	Control Room (C3 computer, comm/sensor 3, and two control stations).
Central Hull	***System***
[1]	Steel Armor (dDR 2).
[2-6]	Fuel Tanks (five tons rocket fuel with 0.21 mps delta-V each).
[core]	Engine Room (one workspace).
Rear Hull	***System***
[1]	Steel Armor (dDR 2).
[2-5]	Fuel Tanks (five tons rocket fuel with 0.21 mps delta-V each).
[6]	Chemical Rocket Engine (3G acceleration).

Crew consists of a pilot and navigator.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL8 (HIGH-PERFORMANCE SPACECRAFT)												
8	*Panama*-class	30	-1/3	13	3G/2.31 mps	100	5.8	+6	2+6SV	2	–	$860K

Quarterhorse-Class Deep Space Tug (TL9)

This workhorse fusion drive spaceship uses a 3,000-ton (SM +9) unstreamlined hull and moves large objects such as small asteroids or chunks of ore. It was given a relatively high thrust for a fusion rocket-propelled craft to maintain a reasonable acceleration while hauling objects more massive than itself.

Front Hull	*System*
[1]	Steel Armor (dDR 7).
[2]	Hangar Bay (100 tons capacity).
[3-6]	Cargo Hold (150 tons each).
[core]	Control Room (C6 computer, comm/sensor 7, and only four control stations).
Central Hull	***System***
[1]	Steel Armor (dDR 7).
[2]	External Clamp.
[3-5]	Fuel Tanks (150 tons hydrogen with 6 mps delta-V each).
[6]	Engine Room (two workspaces).
[core]	Habitat (10 cabins, two-bed sickbay, 12 hibernation chambers, and 25 tons cargo).
Rear Hull	***System***
[1]	Steel Armor (dDR 7).
[2-3]	Fuel Tanks (150 tons hydrogen with 6 mps delta-V each).
[4-6]	High Thrust Fusion Rockets (0.01G acceleration each).

It has spin gravity (0.15G). Crew consists of four control (one of whom is also a small-craft pilot), and six technicians.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL9 (LOW-PERFORMANCE SPACECRAFT)												
9	*Quarterhorse*-class	100	-3/5	13	0.03G/30 mps	3,000	728.2	+9	20ASV*	7	–	$107.6M

* Plus 12 in suspended animation.

That's the answer! A space tug hauling a tow to the Platform!

– Joe Kenmore, ***Space Tug***

Kinshasa-Class Heavy Interstellar Towing Vehicle (TL10^)

This tug is a limited superscience design using a 100,000-ton (SM +12) unstreamlined hull. It's designed to carry massive loads in its magnetic clamps including entire asteroids and large spacecraft, and if possible to move them over interstellar distances. Despite its size, it operates with a small crew. It has a large internal cargo hold as well.

Front Hull	*System*
[1]	Steel Armor (dDR 20).
[2]	Hangar Bay (3,000 tons capacity).*
[3]	Habitat (20 cabins with total life support, four-bed automed sickbay, minifac fabricator, 20 hibernation chambers, and 2,750 tons cargo).*
[4-6]	Cargo Holds (5,000 tons each).
Central Hull	***System***
[1]	Steel Armor (dDR 20).
[2]	External Clamp.
[3-6]	Fuel Tanks (5,000 tons hydrogen with 15 mps delta-V each).
[core]	Control Room (C10 computer network, comm/sensor 11, and only five control stations).*
Rear Hull	***System***
[1]	Steel Armor (dDR 20).
[2]	External Clamp.
[3-4!]	Stardrive Engines (FTL-1 each).*
[5-6]	Fusion Torch (0.5G acceleration each).*
[core]	Fusion Reactor (two Power Points).*

* One workspace per system.

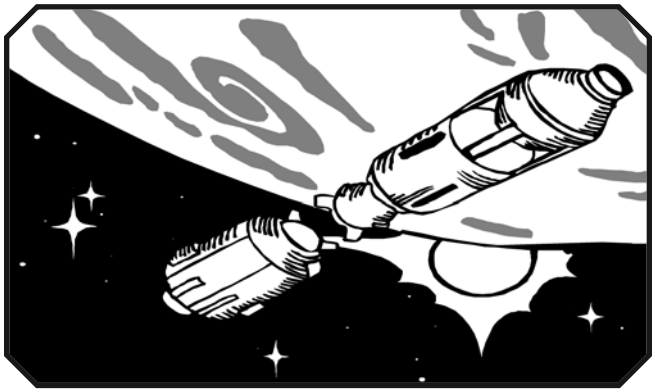
It is highly automated and has spin gravity (0.5G). Crew consists of a captain, pilot, sensor/comm operator, engineering officer, and eight technicians.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL10 (HIGH-PERFORMANCE SPACECRAFT)												
10^	*Kinshasa*-class	300	-2/5	13	1G/60 mps	100,000	20,756	+12	40ASV*	20	2×	$7.60015B

* Plus 20 in suspended animation.

Termagant-Class Advanced Orbital Tug (TL10^)

This small but agile short-range tug relies on its standard reactionless engines for normal thrust while towing. However, its two reactionless auxiliary rotary engines can generate 0.2G thrust in *any* direction, and these are used to maneuver in tight confines. It does not use both systems at once.



Front Hull	***System***
[1-2]	Steel Armor (total dDR 4).
[3]	Control Room (C7 computer, comm/sensor 5, and two control stations).
[4]	External Clamp.
[5-6]	Cargo Hold (five tons each).
Central Hull	***System***
[1-2]	Steel Armor (total dDR 4).
[3-4!]	Rotary Reactionless Engines (0.1G acceleration each).
[5]	Robot Arm (ST 300).
[6]	Fuel Cell (one Power Point).
[core]	Fuel Tank (five tons rocket fuel; powers fuel cell for 96 extra hours).
Rear Hull	***System***
[1-2]	Steel Armor (total dDR 4).
[3-4!]	Standard Reactionless Engines (0.5G acceleration each).
[5]	Hangar Bay (three tons capacity).
[6]	Fuel Cell (one Power Point).
[core]	Fuel Tank (five tons rocket fuel; powers fuel cell for 96 extra hours).

It is operated by a single pilot.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL10 (HIGH-PERFORMANCE SPACECRAFT)												
10^	*Termagant*-class	30	0/4*	12	1G/*c**	100	13.2	+6	2SV	4	–	$1.8M

* When using rotary reactionless engines, Hnd/SR is -1/4 and Move is 0.2G/*c*.

Asteroid Mining

Asteroids and comets are the rocky or frozen debris left over after a solar system forms. There are millions of them, ranging in size from small boulders to huge islands. In our solar system most rocky and metallic asteroids are found orbiting in the Asteroid Belt between the orbits of Mars and Jupiter, but a significant minority stray closer or farther from the sun. For example, the so-called near-Earth asteroids are several thousand bodies that cross our orbit, making them both a hazard and an easier-to-reach supply of resources. In the outer system, beyond Neptune's orbit, are populations of icy planetoids in the Kuiper Belt and the comets of the Oort Cloud, both offering additional resources.

In general, the asteroids contain vast amounts of excellent ore, including iron, nickel, platinum, and other metals. The icy bodies found in the colder outer reaches of a solar system lack metals, but are rich in carbon and frozen gasses ("volatiles") such as water. These are refined for reaction mass, life support, and chemical industries, or to enable terraforming for Mars and other planets. As all of these planetoids have minimal escape velocities, removing resources is far easier than lifting them from the gravity of a planet or moon. Asteroid or comet mining provides the raw materials that support space and off-world planetary colonies, major orbiting spaceyards, and space stations and colonies.

The location, types, and resources found in these bodies are detailed in ***GURPS Space*** (pp. 130-132). GMs seeking additional material on mining and settlement in Earth's solar system can consult ***Transhuman Space: Deep Beyond***.

Nomad-Class Catapult Ship (TL9)

The sturdy *Nomad*-class is a 10,000 ton (SM +10) unstreamlined spacecraft for prospecting and mining missions to asteroids in the inner system. Its solar-powered mass driver engine lets it "live off the land" by utilizing asteroid rock as reaction mass, reducing operating costs. A *Nomad*-class ship would depart from Earth orbit to rendezvous with a small near-Earth asteroid. Human crewmen follow on a faster nuclear or chemical rocket to minimize exposure to solar and cosmic radiation. Arriving at the destination, they establish a base camp using the asteroid's material to build cosmic-ray shielding and begin mining operations. *Nomad*-class vessels perform on-site mining or clamp themselves onto an asteroid and slowly accelerate it back to a factory station in high orbit. Workers from an orbital manufacturing station then dismantle it. The entire process can take a few years.

Front Hull	*System*
[1]	Steel Armor (dDR 10).
[2-3]	Solar Panel Arrays (one Power Point each).
[4]	Habitat (10 cabins, two-bed sickbay, gym, lab, minifac fabricator, and 215 tons cargo).*
[5-6]	Fuel Tanks (500 tons rock dust with 0.42 mps delta-V each).
[core]	Control Room (C7 computer, comm/sensor 8, and only four control stations).*
Central Hull	***System***
[1]	Steel Armor (dDR 10).
[2]	External Clamp.
[3!]	Mining (50 tons/hour).*
Central Hull	***System***
[4-6, core]	Fuel Tanks (500 tons rock dust with 0.42 mps delta-V each).
Rear Hull	***System***
[1]	Steel Armor (dDR 10).
[2-4]	Fuel Tanks (500 tons rock dust with 0.42 mps delta-V each).
[5-6!]	Mass Driver Engines (0.01G acceleration each).*

* One workspace per system.

It has spin gravity (0.2G). Crew consists of a captain, pilot, engineering officer, sensor/communications officer, scientific specialist, and five technicians.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL9 (LOW-PERFORMANCE SPACECRAFT)												
9	*Nomad*-class	150	-4/5	13	0.02G/3.78 mps	10,000	217	+10	20ASV	10	–	$236.2M

Mosquito-Class Volatile Miner (TL9)

Space stations find it cheaper to extract volatiles from asteroids rather than a planet's gravity field. The *Mosquito* is a late-TL9 design for just that. It uses a 3,000-ton (SM +9) hull 150 feet long, propelled by a fusion rocket engine. The engine uses water for propulsion, so it easily refuels itself.

Front Hull	*System*
[1]	Steel Armor (dDR 7).
[2]	Habitat (12 cabins, minifac fabricator, and 35 tons cargo).
[3!]	Mining (15 tons/hour).
[4!]	Chemical Refinery (50 tons/hour).
[5-6]	Fuel Tanks (150 tons water with 2.8 mps delta-V each).
[core]	Control Room (C6 computer, comm/sensor 7, and six control stations).
Central Hull	***System***
[1]	Steel Armor (dDR 7).
[2-6]	Fuel Tanks (150 tons water with 2.8 mps delta-V each).
[core]	Engine Room (two workspaces).
Rear Hull	***System***
[1]	Steel Armor (dDR 7).
[2-4]	Fuel Tanks (150 tons water with 2.8 mps delta-V each).
[5]	Fusion Reactor (two Power Points).
[6]	High Thrust Fusion Rocket Engine (with water, 0.03G acceleration).

One doesn't discover new lands without consenting to lose sight of the shore for a very long time.

– André Gide

The spacecraft has spin gravity (0.15G) and exposed radiators. Crew consists of six control (captain, pilot, sensor operator, engineer, mining systems operator, and refinery operator) and two technicians.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL9 (LOW-PERFORMANCE SPACECRAFT)												
9	*Mosquito*-class	100	-3/5	13	0.03G/28mps	3,000	37.4	+9	24ASV	7	–	$88.6M

Vredefort-Class Asteroid Mine Station (TL9)

This 100,000-ton (SM +12, unstreamlined hull) station is an example of a facility assembled on a medium-sized asteroid for a major mining operation. Composed of a series of solar power, mining, habitat, and storage modules and an attached electromagnetic mass driver track, it is tethered to a small asteroid and covered by waste rock or slag for radiation shielding. A retractable landing pad leads into a spacious hangar bay that houses mining machines and visiting transport vessels.

The particular mix of refinery and mining modules in this station suggests it's used on a carbonaceous asteroid, producing both precious metals and volatiles. These are stored in bins or large tanks, with excess production kept outside the station proper in nets or external tank farms. Its output is picked up by cargo ships.

Alternatively, its mass driver system is an electromagnetic catapult that accelerates packages of ore or containers of volatiles back home (e.g., to Earth orbit), where they are intercepted by tugs and unloaded at an industrial space station.

Front Hull	*System*
[1-2]	Stone Armor (total dDR 14).
[3!]	Mining (500 tons/hour).*
[4-5]	Cargo Holds (5,000 tons each).
[6]	External Clamp.
[core]	Control Room. (C8 computer, comm/sensor 10, only eight control stations).
Central Hull	***System***
[1-2]	Stone Armor (total dDR 14).
[3!]	Chemical Refinery (1,500 tons/hour).*
[4-5]	Fuel Tanks (5,000 tons reaction mass each).
[6]	Hangar Bay (3,000 tons capacity).*
[core]	Habitat (30 luxury cabins with full life support, one briefing room, three establishments, two labs, four minifac fabricators, three offices, seven-bed automed sickbay, and 2,275 tons cargo).*
Rear Hull	***System***
[1]	Stone Armor (dDR 7).
[2-3]	Solar Panel Arrays (one Power Point each).
[4-5]	Fuel Tanks (5,000 tons reaction mass each).
[6!]	Mass Driver (0.01G acceleration).*

* 10 workspaces per system.

The facility has spin gravity (0.5G). Crew consists of a station master, chief engineer, communicators and sensor operators, three administrators, six scientists, two mining and refinery supervisors, and 50 technicians.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL9 (LOW-PERFORMANCE SPACECRAFT)												
9	*Vredefort*-class	300	-4/5*	13	0.01G/1.2 mps*	100,000	15,281	+12	60ASV	14/14/7	–	$1.9541B

* Fuel tanks can be used to store mined volatiles, in which case the asteroid has no Handling or Move.

Wildcat-Class Asteroid Prospector (TL10)

This is for solo prospectors performing mining surveys of the outer system. The *Wildcat*'s fusion engine is optimized for continuous acceleration for a lengthy period, allowing fairly fast prospecting voyages to the Main Asteroid Belt, Trojan asteroids, or Kuiper Belt. Built on a tiny 100-ton (SM +6) unstreamlined hull, a cramped vessel like this is ideal for a small commercial science team or the stereotypical rock-rat who loves the splendid isolation of deep space. It has no onboard mining capability: It's strictly a prospecting ship, although its cargo hold is filled with portable geological survey tools, mining robots, and similar gear.

Front Hull	*System*
[1]	Light Alloy Armor (dDR 3).
[2]	Science Array (comm/sensor 7).
[3]	Robot Arm (ST 300).
[4-6]	Cargo Holds (five tons each).
[core]	Control Room (C7 computer, comm/sensor 5, and two control stations).
Central Hull	***System***
[1]	Light Alloy Armor (dDR 3).
[2]	Habitat (one-bed automed sickbay).
[3]	Habitat (with robofac minifac).
[4-5]	Fuel Tank (5 tons hydrogen with 60 mps delta-V each).
[6]	Engine room (one workspace).
[core]	Habitat (one cabin).
Rear Hull	***System***
[1]	Light Alloy Armor (dDR 3).
[2-4]	Fuel Tank (5 tons hydrogen with 60 mps delta-V each).
[5-6]	Fusion Rocket (0.005G acceleration each).

Crew consists of one or two prospectors who perform all onboard tasks.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL10 (LOW-PERFORMANCE SPACECRAFT)												
10	*Wildcat*-class	30	-2/4	13	0.01G/300 mps	100	15	+6	2ASV	3	–	$5.93M

Klondike-Class Mining Starship (TL10^)

This 1,000 ton (SM +8) unstreamlined starship goes on long-range interstellar asteroid prospecting missions in uninhabited frontier systems. It carries a small crew in austere conditions, but has plenty of onboard equipment to look after itself when away from home. Its hangar bay carries a shuttle or small work pods like the *Kobold* (pp. 12-13).

Front Hull	*System*
[1]	Light Alloy Armor (dDR 7).
[2]	Habitat (one cabin, bunkroom, one-bed automed sickbay, lab, minifac fabricator).
[3]	Hangar Bay (30 tons capacity).

Front Hull	*System*
[4]	Science Array (comm/sensor 9).
[5!]	Chemical Refinery (15 tons/hour).
[6!]	Mining (five tons/hour).
[core]	Control Room (C8 computer, comm/sensor 7, and four control stations).
Central Hull	***System***
[1]	Light Alloy Armor (dDR 7).
[2-3]	Fuel Tank (50 tons hydrogen with 15 mps delta-V each).
[4]	External Clamp.
[5]	Hangar Bay (30 tons capacity).
[6]	Cargo Hold (50 tons).

Rear Hull	*System*
[1]	Light Alloy (dDR 7).
[2]	Engine room (one workspace).
[3]	Fuel Tank (50 tons hydrogen with 15 mps delta-V).
[4-5!]	Stardrive Engines (FTL-1 each).
[6]	Fusion Torch (0.5G acceleration).
[core]	Fusion Reactor (two Power Points).

It has spin gravity (0.1G). Crew consists of a captain-pilot, engineering officer, navigator, mining engineer, refinery engineer, and technician.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL10^ (HIGH-PERFORMANCE SPACECRAFT)												
10^	*Klondike*-class	70	-2/5	13	0.5G/45 mps	1,000	110.6	+8	6ASV	7	2×	$69.7M

Pluto-Class Ice Ship (TL10)

The outer solar system contains countless icy planetoids in the Kuiper Belt and Oort Cloud. These are a source of water for terraforming and colonization.

The ice ship consists of a 2.7 million ton icy asteroid or comet core with an attached fusion engine and control system (so about three million tons in all, SM +15). A fraction of the asteroid is converted to water-reaction mass to fuel the fusion engine; the remaining 2.5 million tons is delivered to the customer.

A ship of this sort takes 10 years from the Kuiper Belt (some 31 AU out from the sun) to rendezvous with a destination in need of volatiles. Engineering vessels then dismantle the expensive fusion rocket and control systems while a swarm of mining craft take apart the asteroid. Alternatively, the vessel could be directed on a collision course with a planet in need of volatiles for terraforming (e.g., Mars).

Front Hull	*System*
[1-6]	Ice Armor (total dDR 90).
[core]	Control Room (C11 computer, comm/sensor 14, and no control stations).
Central Hull	***System***
[1-6]	Ice Armor (total dDR 90).
[core]	Fuel Tank (150,000 tons water with 20 mps delta-V).
Rear Hull	***System***
[1-5]	Ice Armor (total dDR 75).
[6]	Fusion Rocket Engine (with water, 0.015G acceleration).

It has total automation.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL10 (LOW-PERFORMANCE SPACECRAFT)												
10	*Pluto*-class	1,000	-5/5	13	0.015G/20 mps	3,000,000	0	+15	0	90/90/75	–	$39.997B

Rock Snake Mobile Industrial Colony (TL10)

This huge mining vessel hunts asteroids: to mine them for minerals valuable back on Earth (primarily metals like platinum), and to support the development of space infrastructure. It uses a mix of fusion and solar power; if it operates far from the sun it has to husband its energy to run everything at once. There is twice as much farm capacity as needed to feed everyone on board, both as a backup and to run agricultural experiments or grow luxury goods for domestic use or resale.

Front Hull	*System*
[1]	Stone Armor (dDR 15).
[2-3]	Habitats (each has 1,000 bunkrooms, 2,500 cabins, 500 luxury cabins, 100 bed hospital sickbay, three major labs, large ops center, 100 establishments, and 2,500 tons cargo).*
[4]	Cargo Hold (50,000 tons).
[5]	Hangar Bay (30,000 tons capacity).*
[6!]	Mining (5,000 tons/hour).*

Central Hull	*System*
[1]	Stone Armor (dDR 15).
[2]	Science Array (comm/sensor 15).*
[3]	Solar Panel Array (one Power Point).
[4]	Control Room (C11 computer, comm/sensor 13, 40 control stations).*
[5-6]	Open Spaces (5 acres of farms each).*
[core!]	Fabricator ($50M/hour production capacity).*

Rear Hull	*System*
[1]	Stone Armor (dDR 15).
[2]	Cargo Hold (50,000 tons).
[3!]	Chemical Refinery (15,000 tons/hour).*
[4-5]	Fuel Tanks (50,000 tons hydrogen with 60 mps delta-V each).
[6]	Fusion Rocket (0.005G acceleration).*
[core]	Fusion Reactor (two Power Points).*

* 100 workspaces per system.

It has spin gravity (1G). While all of a *Rock Snake*'s inhabitants are technically crew, the primary space crew consists of 40 control-room personnel, 100 administrators, 1,200 technicians, 800 medics, and 200 attendants (security, teachers, chefs, and other service occupations).

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL10 (LOW-PERFORMANCE SPACECRAFT)												
10	*Rock Snake*	700	-6/5	14	0.005G/120 mps	1,000,000	137,000	+14	20,000ASV	15	–	$94.42B

Look at this fat, juicy magnetic profile. And it's mine, mine, mine.
– Russ Jorden, ***Aliens***

Nugget-Class Interstellar Prospector (TL11^)

A converted scout or star tug, this is a compact, 300-ton (SM +7), unstreamlined starship for a small crew or solo prospector. It scours frontier systems, using its science array to search for rich sources of valuable ore. Its tractor beam snags ore samples or tows meteoroids too large to fit into the cargo bay. A force screen protects it when working in dangerous areas (such as cinematically dense asteroid belts). It has a small laser for cutting rock samples, which is also useful for self-defense against debris impacts and claim jumpers. The *Nugget* has some mining equipment, but if it makes a big find the crew sells the claim to a larger corporation rather than exploiting it themselves.

Front Hull	*System*
[1]	Metallic Laminate Armor (dDR 7).
[2]	Habitat (two cabins).
[3]	Habitat (one-bed automed sickbay, minifac fabricator).
[4]	Science Array (comm/sensor 9).
[5!]	Secondary Battery (one turret with 10 MJ tractor beam, one turret with 10 MJ improved laser, and 12 tons cargo).
[6!]	Mining (1.5 tons/hour).
[core]	Control Room (C8 computer, comm/sensor 7, and three control stations).

Central Hull	*System*
[1]	Metallic Laminate Armor (dDR 7).
[2]	External Clamp.
[3!]	Light Force Screen (dDR 50).
[4-6]	Cargo Holds (15 tons each).

Rear Hull	*System*
[1]	Metallic Laminate Armor (dDR 7).
[2-3]	Cargo Holds (15 tons each).
[4]	Engine room (one workspace).
[5!]	Stardrive Engine (FTL-1).
[6!]	Super Reactionless Engine (50G acceleration).
[core]	Fusion Reactor (two Power Points).

It has artificial gravity and gravitic compensators.

Crew consists of a captain, pilot, engineering officer, sensor/communications officer, scientific specialist, and five technicians.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL11 (HIGH-PERFORMANCE SPACECRAFT)												
11^	*Nugget*-class	50	0/5	13	50G/*c*	300	87.4	+7	4ASV	7*	–	$20.03M

* Add dDR 50 if force screen is powered up.

Top air speed is 1,800 mph.

Gas Giant Mining

One of the most important power sources for an ultra-tech society is nuclear fusion. Advanced fusion reactors are designed to use a variety of fuel cycles, but one of the most efficient is the combination of deuterium and helium-3.

Deuterium is easily refined from seawater, but helium-3 is relatively rare on Earth and other terrestrial planets. It is refined from the soil of worlds that, due to lack of atmosphere and magnetic fields, are directly exposed to the solar wind, such as the moon. However, this process requires mining and refining about 100 million tons of soil for every ton of helium-3. Although its estimated value is $7 million per pound, such operations struggle to turn a profit.

Fortunately, there's one other source for helium-3: It exists in vast quantities in the atmospheres of gas giants like Jupiter and Saturn. In a mid-size body like Saturn, for example, only about 130,000 tons of atmosphere need be scooped out and refined to produce a ton of helium-3.

There are some obstacles to gas-giant mining. First, at least in our solar system, they're located in the outer region well beyond the Asteroid Belt, which increases transportation times. Second, gas giants have a high escape velocity, so a reaction-drive spacecraft needs a lot of delta-V to lift its payload out of the atmosphere. Although Jupiter is our nearest gas giant, it's also the largest in our solar system and has the highest escape velocity. Operations are impractical without superscience technology, restricting mining activities to Saturn and other, smaller gas giants in the outer system. Third, conditions around them are hazardous, with belts of intense radiation and powerful storms in the atmosphere. A refinery operating inside the atmosphere is protected from radiation, but needs to be mobile or rugged enough to withstand turbulent weather conditions. Unless superscience technology is used, these requirements are too much for any single vessel. Instead, a family of craft is needed, such as the *Tempest* and *Storm Bird* designs.

Tempest-Class Gas-Mining Cruiser (TL9)

This streamlined 300-ton (SM +7) vessel is actually an aircraft rather than a spacecraft. Transported by cargo ship to a Saturn-type gas giant, it is released into the atmosphere to function as a mobile gas-mining system.

The aircraft is propelled by nuclear thermal engines operating in ramjet mode, which use the atmosphere as reaction mass. It remains aloft for years at a time. The cruiser has provisions for the crew that performs onboard maintenance, usually working in nine-month shifts, but some operations use robots.

Mining operations take place just below the lower cloud layer where the pressure is about 10 atmospheres. The refinery's reactor-powered pumps suck in atmospheric gas, which is cooled and liquefied by refrigeration units. The hydrogen is then separated from the helium and used as part of the cooling mechanism, after which it is dumped. Next, the rare helium-3 is separated from the more abundant and heavier helium-4, a process possible because the lighter isotope behaves differently at cryogenic temperatures. The helium-3 is stored for retrieval and the helium-4 dumped overboard. About 130,000 tons of raw atmosphere yields one ton of helium-3. As the *Tempest*'s refineries process 20 tons an hour, this takes about 270 days. The *Storm Bird*-class shuttle (p. 22) rendezvouses with the cruiser every nine months to retrieve the helium-3, but it can store up to 11 years' worth (15 tons) of helium-3.

Front Hull	***System***
[1]	Metallic Laminate Armor (dDR 5).
[2-3]	Fuel Tank (15 tons each; used for raw atmosphere).
[4-6, core!]	Chemical Refineries (five tons/hour each).
Central Hull	***System***
[1]	Metallic Laminate Armor (dDR 5).
[2]	Habitat (one cabin and one bunkroom).
[3]	Engine Room (one workspace).
[4]	Habitat (one-bed automed sickbay and five tons cargo).
[5]	Control Room (C5 computer, comm/sensor 5, and three control stations).
[6]	Fuel Tank (15 tons; used for processed helium-3).
Rear Hull	***System***
[1]	Metallic Laminate Armor (dDR 5).
[2-3]	Nuclear Thermal Rockets (ram-rockets; 0.5G acceleration each).
[4-6, core]	Fission Reactors (one Power Point each).

It is winged. Crew consists of a pilot, an engineering officer, and four refinery technicians.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL9 (HIGH-PERFORMANCE SPACECRAFT)												
9	*Tempest*-class	50	-1/5*	13	1G/0 mps*	300	5.6†	+7	6ASV	5	–	$24.3M

* In atmosphere, top air speed is 2,500 mph, and it has Hnd/SR +3/6.

† Plus 15 tons capacity in the central helium-3 tank.

Storm Bird-Class Helium-3 Shuttle (TL9)

This 100-ton (SM +6) winged and streamlined vessel is designed to lift helium-3 out of the steep gravity well of a Saturn-sized gas giant. It connects with an aerial helium-3 refinery craft such as the *Tempest*-class.

The *Storm Bird's* nuclear thermal rocket ram rocket engines and fuel tanks provide about 12 mps of delta-V. Normally this isn't enough to lift away from Saturn, which has an escape velocity of 22 mps and requires 17.6 mps to reach orbit (***GURPS Spaceships,*** p. 37). To achieve the necessary performance, the *Storm Bird* relies on another characteristic of large gas giants: their rapid rotation. Saturn rotates at an equatorial velocity of about 6.1 miles per second. By taking off along the equator in the direction of the planet's rotation (using its engines in ramjet mode), this shaves 6.1 mps off the necessary delta-V, requiring only 11.5 mps to reach low orbit. It uses its remaining reserve of delta-V to rendezvous with a station or tanker in orbit.

Front Hull	*System*
[1]	Metallic Laminate Armor (dDR 3).
[2-6]	Fuel Tanks (five tons hydrogen with 0.81 mps delta-V each).
[core]	Control Room (C5 computers, comm/sensor 4, and two control stations).
Central Hull	***System***
[1-6]	Fuel Tanks (five tons hydrogen with 0.81 mps delta-V each).
[core]	Fuel Tank (five tons; for helium-3).
Rear Hull	***System***
[1-4]	Fuel Tanks (five tons hydrogen with 0.81 mps delta-V each).
[5-6]	Nuclear Thermal Rocket (ram-rockets; 0.5G acceleration each).

It is winged.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL9 (HIGH-PERFORMANCE SPACECRAFT)												
9	*Storm Bird*-class	30	0/4*	12	1G/12.15 mps*	100	0.2*	+6	2SV	3/0/0	–	$6.28M

* In atmosphere, top air speed is 2,500 mph, and it has Hnd/SR 4/5. It can cruise indefinitely in atmosphere using ramjet mode.
† In addition, there are five tons of capacity in the central helium-3 tank.

Titanic-Class Gas-Mining Platform (TL10^)

A massive production complex for helium-3 mining operations, this 300,000 ton (SM +13) streamlined craft functions much like the TL9 cruiser but on a greater scale. Taking advantage of superscience technology, it uses contragravity generators to operate in any size gas giant. Its fusion-powered refineries process 30,000 tons of atmosphere per hour, producing 5.5 tons of refined helium-3 per day. When a production cycle is complete, the mining platform uses its contragravity generators and reactionless drive to lift into orbit; otherwise tanker vessels dive down to rendezvous directly with the station.

A large number of technicians are required to keep the mining platform running smoothly for years at a time in an environment even more hostile than deep space. Working for months at a time underneath a gas giant's atmosphere is stressful, so crew quarters are designed for comfort, with plenty of amenities.

Front Hull	*System*
[1]	Metallic Laminate Armor (dDR 50).
[2-3]	Fuel Tank (15,000 tons each; used for raw atmosphere).
[4-6!]	Chemical Refineries (5,000 tons/hour each).*
Central Hull	***System***
[1]	Metallic Laminate Armor (dDR 50).
[2-4!]	Chemical Refineries (5,000 tons/hour each).*
[5]	Habitat (450 luxury cabins with total life support, ops center, 20-bed automed clinic sickbay, 10 minifac robofacs, five establishments, and 750 tons cargo).*
[6]	Fuel Tank (5,000 tons; used for processed helium-3).
[core]	Control Room (C10 computers, comm/sensor 12, only 11 control stations).*
Rear Hull	***System***
[1]	Metallic Laminate Armor (dDR 50).
[2!]	Standard Reactionless Engine (0.5G acceleration).*
[3-6]	Fusion Reactors (two Power Points each).*
[core!]	Contragravity Lifter.*

* 30 workspaces per system.

It has artificial gravity. Crew consists of 11 control room personnel (captain, communications officer, executive officer, sensor officer, chief engineer, and six refinery supervisors), 10 administrators, and 420 technicians.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL10 (HIGH-PERFORMANCE SPACECRAFT)												
10^	*Titanic*-class	500	-4/5	13	0.5G/*c*	300,000	840	+13	900ASV	50	–	$19.51105B

In atmosphere, top air speed is 1,800 mph, with Hnd/SR -2/5.

Tanker Spacecraft

Volatiles such as water, hydrogen, nitrogen, or the fusion fuel helium-3 are vital for civilization's fuel, reaction mass, life support, modern industry and agriculture, but they aren't found on every world in useful quantities. Specialized heavy freighters carry them where they are needed, plying the routes between mines, refineries, and distribution centers. If reaction drives (or stardrives that require fuel) are common, meeting and refueling other vessels is a priority for tankers. Military and exploratory missions are often accompanied or supported by them.

Jupiter-Class Deep Space Tanker (TL10)

This is a reaction-drive tanker. Most of the *Jupiter*-class' carrying capacity is devoted to volatile tanks, but it has significant cargo capacity for standard loads and such vessels carry other supplies to the stations they serve. It uses a SM +11 unstreamlined hull that masses 30,000 tons and is 450 feet long.

Front Hull	*System*
[1]	Steel Armor (dDR 15).
[2-6]	Fuel Tanks (1,500 tons of volatiles each).
[core]	Control Room (C9 computers, comm/sensor 10, and only three control stations).
Central Hull	***System***
[1-6]	Fuel Tanks (1,500 tons of volatiles each).
[core]	Habitat (three luxury cabins, two-bed automed sickbay, gym, and 950 tons cargo).
Rear Hull	***System***
[1]	Steel Armor (dDR 15).
[2-3]	Fuel Tanks (1,500 tons hydrogen with 60 mps delta-V each).
[4-5]	Fuel Tanks (1,500 tons of volatiles each).
[6]	Fusion Rocket Engine (0.005G acceleration each).

It has total automation. Crew consists of three bridge crew: a pilot, a captain/navigator, and a chief engineer.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL10 (LOW-PERFORMANCE SPACECRAFT)												
10	*Jupiter*-class	200	-5/5	13	0.005G/120 mps	30,000	950.6*	+11	6ASV	15/0/15	–	$596.6M

* Plus 19,500 tons volatiles in fuel tanks.

Aquarius-Class Interstellar Supertanker (TL11^)

With advanced drives it is possible for enormous tankers to lift volatiles from a deep gravity well like Earth or even a gas giant. It massively simplifies processes needed for space colonization and terraforming – for example, ocean water is cheaply lifted into space and transported to a space habitat or desert world. The *Aquarius*-class is one such supertanker: a massive vessel with an SM +13 streamlined hull massing 300,000 tons, 450 feet in diameter.

Front Hull	*System*
[1]	Steel Armor (dDR 20).
[2-6]	Fuel Tanks (15,000 tons of volatiles each).
Central Hull	***System***
[1]	Steel Armor (dDR 20).
[2-5]	Fuel Tanks (15,000 tons of volatiles each).
Central Hull	***System***
[6]	Control Room (C11 computers, comm/sensor 13, and only four control stations).*
[core]	Habitat (seven cabins with total life support, two-bed automed sickbay, 9,920 tons cargo).*
Rear Hull	***System***
[1]	Steel Armor (dDR 20).
[2-3]	Fuel Tanks (15,000 tons of volatiles each).
[4!]	Stardrive Engine (FTL-1).*
[5-6!]	Hot Reactionless Engines (2G acceleration each).*
[core]	Fusion Reactor (two Power Points).*

* Three workspaces per system.

The tanker has high automation. Crew consists of three bridge crew (a pilot, a captain/navigator, and a chief engineer), three control techs, three habitat technicians, three stardrive mechanics, six maneuver drive mechanics, and three power mechanics.

TL	*Spacecraft*	*dST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ*	*dDR*	*Range*	*Cost*
PILOTING/TL11 (HIGH-PERFORMANCE SPACECRAFT)												
11^	*Aquarius*-class	500	-3/5	13	4G/*c*	300,000	9,921.4*	+13	14ASV	20	1×	$10.3589B

* Plus 165,000 tons of volatiles.

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