GURPS® Fourth Edition

SPACESHIPS 6

MINING AND INDUSTRIAL SPACECRAFT™

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*An e23 Sourcebook for **GURPS**®*

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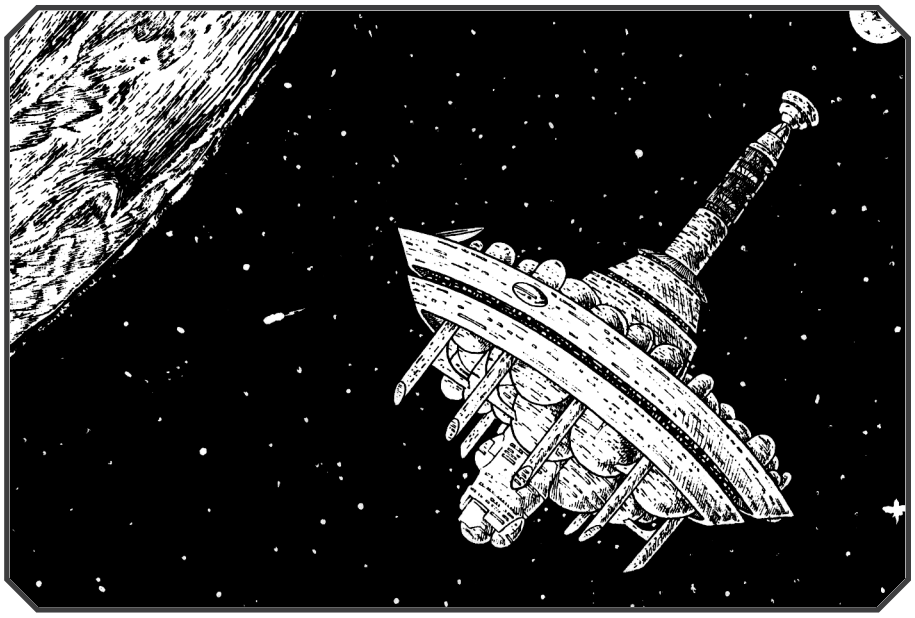

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Extra-special thanks to Kenneth Peters for playtest contributions above and beyond the call of duty.

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 the *Vacuum Cleaners* chapter by Phil Masters 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*

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 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.

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.

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.

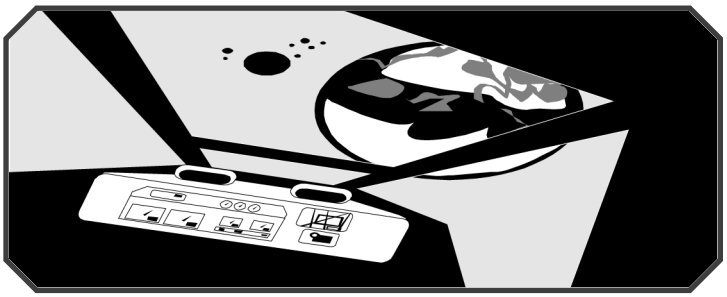
There are some obstacles to gas-giant mining. First, at least in our solar system, they're located in the outer region well beyond the Asteroid Belt, which increases transportation times. Second, gas giants have a high escape velocity, so a reaction-drive spacecraft needs a lot of delta-V to lift its 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.

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