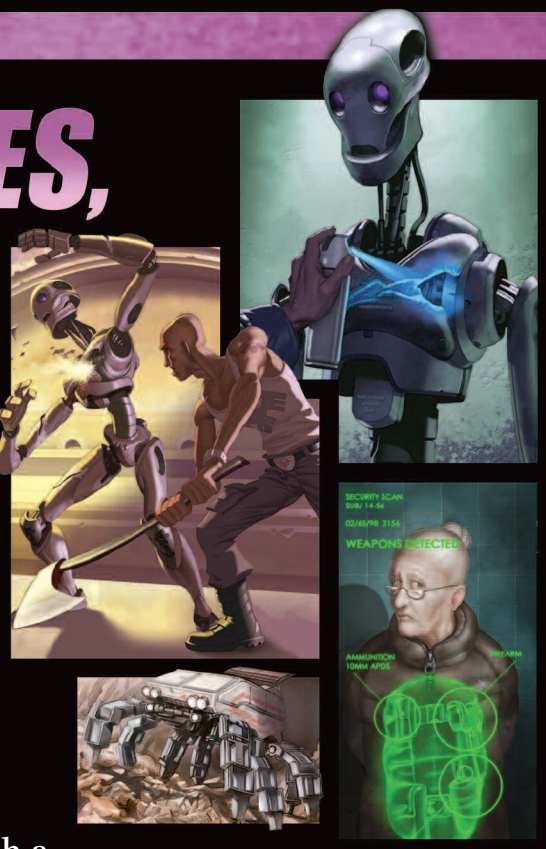
GURPS® Fourth Edition

ULTRA-TECH™

By David Pulver, with Kenneth Peters

STEVE JACKSON GAMES

WEAPONS, VEHICLES, AND GADGETS



GURPS Ultra-Tech is a sourcebook for science-fiction technology, from the near future to the farthest reaches of the imagination. It's a valuable companion to ***GURPS Space***, ***GURPS Bio-Tech***, and ***GURPS Infinite Worlds***, and for any character or campaign that needs advanced technological equipment.

GURPS Ultra-Tech is full of personal equipment for heroes and superheroes from TL9 to TL12, including:

- Weapons – from caseless assault carbines and monomolecular swords to antimatter warheads and disassembler nano.
- Protection – How do you stop a nanomorph assassin with a field-jacketed X-ray laser rifle? Try a dreadnought battlesuit and a personal force screen . . .
- Medicine – Superscience can heal, rebuild, and improve on nature. Death itself can become a temporary inconvenience.
- Transport – Air cars, hovertanks, tilt rotors, grav belts, supercavitating minisubs, matter-transport booths – lots of ways to get where the action is, for the adventurer on the go!

And still more gadgets! Living biosuits, computer implants, holographic projectors, psionic amplifiers, neutrino communicators, nanofactories, chameleon suits, repair paste, Dyson spheres – there's something for every adventure at every tech level.

__GURPS Ultra-Tech__ requires the __GURPS Basic Set__, Fourth Edition.
The ideas in this book can be used with __any__ science-fiction game.

By **David Pulver**, with **Kenneth Peters**
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Introduction

GURPS Ultra-Tech is a sourcebook of science-fiction gadgets and weapons. It's a resource for space, alternate future, techno-thriller, cyberpunk, or supers games – any setting that requires technology from tomorrow and beyond.

The equipment described within spans the "future" tech levels from TL9 (a few decades from now) to TL12 (the age of miracles). The emphasis is on personal gear of all sorts, from hyperspectral goggles and neutrino communicators to gamma-ray laser rifles and dreadnought battlesuits. ***Ultra-Tech*** also provides plenty of details on future medicine, but since ***GURPS Bio-Tech*** covered genetics, biomods, and drugs, this book emphasizes hard tech – cybernetics, ultra-tech medical equipment, neural interfaces, and mind uploading. As technology advances, the line between man and machine may become increasingly blurred. ***Ultra-Tech*** provides rules for establishing the capabilities and limitations of artificial intelligence, as well as templates for robotic or total cyborg bodies, from handy technical 'bots to shapeshifting nanomorphs.

Ultra-Tech is a catalog for players, and a resource for the GM. Ultra-technology can propel adventures into action, add color and atmosphere to a science-fiction setting, serve as the object of a quest, or power a villain's sinister design. There's no need to make every gadget in this book available at once – that can be overwhelming! It's up to the Game Master to decide exactly what gear to use . . . but to help out, we've provided a chapter of suggestions on integrating equipment into the game and establishing alternative technology paths so that the technology fits the campaign.

Publication History

This is the third edition of ***GURPS Ultra-Tech***; it has been revised to the ***GURPS*** *Fourth Edition* rules. The oldest material included here dates back to the three chapters of equipment in the first edition of ***GURPS Space*** (by Steve Jackson and William A. Barton). This material was incorporated into ***GURPS Ultra-Tech*** (by David Pulver). ***GURPS Ultra-Tech 2*** added more gadgets, including some adapted from ***GURPS Cyberpunk*** (by Loyd Blankenship). Material in the present edition was also inspired by technology in ***GURPS Psionics, GURPS Robots***, and ***Transhuman Space***.

About the Authors

David L. Pulver lives in Victoria, British Columbia. He has been a science-fiction fan and avid gamer for most of his life. He is a co-author of the ***GURPS Basic Set***, *Fourth Edition*, and has written or co-authored over 60 other gaming books, including ***GURPS Bio-Tech***, ***GURPS Robots,*** ***GURPS Psionics***, ***BESM 2nd Edition***, and ***Transhuman Space.***

Kenneth L. Peters lives in Post Falls, Idaho. He is an anthropology buff and a sergeant in the United States Marine Corps Reserve. He is the author of ***Transhuman Space: Spacecraft of the Solar System***, and a co-author of ***Transhuman Space: Under Pressure*** and several ***Shadowrun*** books.

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.

Chapter One
Ultra-Technology

The trouble with commanding the Imperial Secret Service's clandestine Galactic Operations Directorate, Colonel Erasmus reflected, was that whenever you had an unexpected caller, it was always bad news.

Today's visitor was Merlin, the AI who ran the psycho-history division. It didn't waste any time.

"I have some very bad news," said the Artificial Intelligence.

Colonel Erasmus forced a smile. "Of course you do." The AI's avatar, who seemed to get younger each time they met, shimmered before his desk. "I'm a little busy."

"You'll be busier. We have an evolving singularity in the local bubble." Merlin waved a hand, and a holographic projection of the Terran Sector materialized, extending across time and space. "Observe. The Bubble client states – here. And here . . ."

"An expansionist threat from the Thearchy of Buckminister?" Erasmus shook his head in disbelief. "You've fried a circuit, Merlin. They're a safe-tech civilization, steadily regressing to retro-tech. If they invade, it'll be the Ludenburg Star Empire all over again." He smiled wistfully. "Infantry with auto-rifles and steel helmets, pouring out of hyperdrive ships . . . I even saw some horse cavalry. It was almost fun."

"This won't be. Your data is obsolete, Erasmus. The new synod's given its backing to the Accelerationist faction in the clergy – scientific progress now glorifies the Creator. I've plotted their cultural dynamism. Take a look at this."

Holographic equations appeared, hanging in the air. It had been a while since Erasmus had taken techno-sociology, but he could still decipher them. "A radical superscience culture in 40 years?"

"So I predict. They've got their own AIs now. Last month, they began experimenting with nanotechnology. Combine that with their existing FTL technology . . ."

"Apocalypse now. I get it. Unfortunately, all my operatives are a little busy."

"Anything important?"

"Preventing a nuclear war. Tracking down several grams of stolen antimatter. Finding a missing princess. The daily grind. I expect results soon."

"Tell them to hurry."

GURPS Ultra-Tech is a catalog of technologies and equipment from TL9 (extrapolations of existing developments) to TL12 (devices that verge on the miraculous). This chapter provides general background and rules for ultra-technology, along with guidelines for adjusting the availability of equipment in a campaign.

Ages of Technology

The following is an overview of a typical sequence for the development of ultra-technology.

TL9 – The Microtech Age

Major advances occur in the material science, especially in the fabrication of nano-scale materials, the development of composite materials, and in polymer-based electronics. This leads to the widespread use of devices such as printed computers, flexible batteries, and bio-compatible implants, as well as products such as video wallpaper and chameleon suits.

Micro-mechanical electromagnetic systems – tiny sensors and actuators – drastically shrink many electronic and mechanical devices. The results are dramatic, ranging from vehicle surfaces that can change their aerodynamic properties to labs-on-a-chip and artificial gills.

Fuel cells and gas turbines are miniaturized and used as power cells for electronics and other portable devices. On a larger scale, nuclear fusion and solar power free society from dependency on fossil fuels, although they may remain economically important.

Computers, sensors, and communicators are faster, smarter, and smaller, and can be built into almost anything. Wearable computers are inexpensive.

Quantum computers can solve problems and break encryption by computing every possible solution at once, but quantum communication systems trump that with unbreakable encryption. Neural interfaces link mind and machine, and cybernetic implants do not merely replace injured body parts, but actually enhance them.

Mobile robots are commonplace, used in everything from nursing to vehicle operation to combat. However, they lack self-initiative, and many are teleoperated. Androids that can look human (even if they don't act human) are expensive but available.

Improvements in material technology lead to affordable space transport systems, such as single-stage-to-orbit shuttles or space elevators. Cheaper access to orbit may boost other space technology, such as nuclear engines for interplanetary journeys, beamed power from solar satellites, and life support technology. Industry and even colonists may go into space, taking advantage of the gravity-free environment to mine asteroids or develop better industrial processes.

Small arms technology still relies on conventional guns (with improved ammunition and smart electronics) but specialized non-lethal energy weapons such as electrolasers and sonic nauseators appear. So do the first bulky laser sniper rifles, heavy electromagnetic railguns, and laser cannon.

Antimatter is now routinely manufactured. It's used in medicine (as a radiation source) but is too expensive to be used as a fuel or explosive. It is still useful in space propulsion and weaponry, as a catalyst for triggering "clean" nuclear explosions. Mini-nukes increase the risk of nuclear war by blurring the boundaries between conventional and nuclear arms.

Body armor advances even more rapidly than weapons. Comfortable climate-controlled suits can protect the entire body, and space suits become lightweight vacc suits. Advances in micro-turbines and robotics make powered suits feasible, both exoskeletons (for civilian and military applications) and battlesuits.

Perhaps the most significant developments are in bioscience. Functional organs can be grown with tissue engineering and transplanted into the body. Wonder drugs and other treatments can be delivered in smart capsules. Not all diseases are cured, but lifespans may increase substantially.

Superscience: Monomolecular wire and plasma weaponry are developed. It's common for faster-than-light drives, parachronic travel, reactionless drives, or other superscience transport systems to appear. TL9 cultures can spread out rapidly to other worlds.

TL10 – The Robotic Age

Artificial intelligence becomes smarter and cheaper, and the first volitional AIs – machines that can think like people – appear. Inexpensive sapient machines are commonplace. Swarms of tiny microbots can be built, and biomechanical nanomachines can perform prodigious feats of medicine and genetic engineering.

People who can afford to take full advantage of TL10 medicine may live for centuries or more. As science gains a greater understanding of the human mind, more complex neuro-tech and cybernetics become available . . . it's possible to cybernetically possess bodies, control minds, and record sensory information.

Molecular nanotechnology is routinely used in manufacturing. Many products can be self-assembled "from the bottom up" using methods analogous to the way biological organisms grow. The tools used are biomechanical in nature, combining proteins and engineered viruses with metals and other inorganic materials. Bio-nanomachines construct most biotech products and are used in medicine and genetic engineering, but molecular manufacturing is still limited to making specialized components and products that can be assembled in "wet" environments. Macro-scale products using metals, semiconductors, diamond-hard materials, and ceramics still rely on "top down" manufacturing techniques.

One example of the new bio-nanotech products is pseudo-alive polymers that are capable of self-repair. These "living bio-plastics" make a range of tough, lightweight, and self-maintaining equipment possible.

Material and power generation technology continues to improve. Super-strong composite materials are relatively inexpensive. Weapons technology takes a quantum leap with the development of power cells that can power

effective man-portable electromagnetic guns and high-energy lasers, although conventional weapons may remain in use with smarter ammunition. Nuclear fusion reactors are small enough to power battle tanks and fighter-sized spacecraft.

Superscience: Gravity control technology leads to artificial gravity and contragravity being used in personal vehicles, houses, and weapons, as well as reactionless space drives. Nuclear dampers can neutralize the threat of nuclear weapons. New superscience weaponry becomes available, notably plasma guns and exotic sonic beams.

TL11 – The Age of Exotic Matter

Technology achieves precise control over the atomic structure of objects. A mature molecular nanotechnology is available, capable of inexpensively fabricating most products with atomic-level precision. Nanofactories (pp. 91-93) make products out of diamond-hard material ("diamondoid").

Not everything can be built in nanofactories, however. The most advanced TL11 products tinker with the subatomic structure of matter to create exotic materials. This may involve replacing electrons with super-massive particles (such as muons) to create hyperdense matter. Depending on its stability, this may be used as a catalyst for fusion reactions (resulting in more compact power plants), or as a component in computer hardware, armor, and other equipment.

Antimatter is another exotic material that comes of age at TL11. As its price of manufacture drops, it begins to see use as a means of compact energy storage. Antimatter rocket engines are also available.

A vast array of powerful beam weapons are now available, including portable particle beams (blasters) and X-ray lasers. In response, armor becomes stronger and smarter, and is usually made of diamondoid composites and exotic alloys. Most armor is powered, from skintight smartsuits to nuclear-powered dreadnought battlesuits.

Nanotechnology dominates medicine. The standard way to heal someone is to take him apart (using the chrysalis machine) and put him back together again in perfect condition. Minds can be copied without destroying the original body.

Superscience: Contragravity is miniaturized, resulting in personal flying belts and small, hyper-agile robot missiles. Force screen generators protect vehicles and installations, but are not yet suitable for personal use. Ranged gravity projectors are available, leading to tractor and pressor beams and gravitic weapons. Hypergravity technology can produce stabilized hyperdense armor and compact nuclear reactors. Matter transmission can teleport people from place to place, as long as there is hardware to send and receive. Superscience sensors can "scan" for just about anything, and even see through walls. Ranged neurotech devices such as dream nets and neural disruptors are introduced. Recorded minds can be played back into living bodies.

TL12 – The Age of Miracles

TL12 societies use their understanding of the universe to produce devices and effects that are incomprehensible to less advanced cultures. The TL11 advances in nanotechnology and exotic matter are fully integrated into civilization, along with new devices such as living metal, gamma-ray lasers, and self-replicating nanomachine swarms.

Simple pills can regenerate the body in a matter of hours, or grow new cybernetic implants a matter of days. Pocket antimatter reactors power vehicles, and spaceships and cities run on total conversion of mass to energy. Entire planets can be moved, or disassembled to build a shell around a star. Devastating personal weapons are developed, while nanomachines can directly imprint consciousness into human brains.

Most aspects of a TL12 civilization can be run by intelligent machines, and most people might *be* machines, whether wholly or in part. Sentient robots could reproduce themselves rapidly, spreading like a plague to terraform (or eat!) a planet in a matter of months, or build any industry that is required. Raw materials are easy to come by. While asteroid belts may be already used up, TL12 cultures can dismantle Jupiter-sized gas giants for parts.

Of course, if several TL12 nations existed in the same area and no one wanted to leave, they would soon run out of gas giants. Then things might get nasty . . .

Superscience: Matter transmitters can "beam up" or "beam down" without a receiving booth at the other end. Regeneration rays may supersede nanotechnology for rapid treatment of injuries. Force fields can alter the flow of time. Disintegrators and reality disruptor weapons can destroy almost any target that is not protected by superscience defenses. Fortunately, personal force fields and stasis fields can stop them.

Even Higher TLs

Incredibly advanced technologies are difficult to conceptualize, never mind use in play. Even so, it's hard to resist the question of "What's next?"

One option is to assume an age of technological stagnation sets in. TL12 science may answer all the fundamental questions of the universe, and technological progress may not be possible. There is no TL13; science catalogs what exists rather than explaining it. Engineering is no longer about invention, but merely application.

Another possibility is to continue a straight-line progression. TL13 devices are like TL12 but weigh or cost half or two-thirds as much, and so on. Or superscience developments can have their TL bumped up to TL13+. They may represent bold new inventions, or artifacts from civilizations that ruled the galaxy eons ago.

Tech Level

Tech Level (TL) is an index of a society's average technological achievement, especially in its baseline technology.

Technological Progression

How quickly a society advances in Tech Level can be a crucial element of a science fiction setting, especially one that proceeds from Earth's present.

A rapid pace of technological change lets the GM add advanced technology to our own world without having to make many changes in present-day culture or international politics. Most cyberpunk worlds are examples of this. Rapid change suggests a dynamic society that is struggling to come to terms with the latest developments.

At the other extreme, many events common to science fiction settings require centuries or millennia: the establishment of large extraterrestrial populations, the rise of new civilizations or empires, or the terraforming of planets. If the GM wants to combine these long-range social and political developments with TL9 or TL10 equipment, it's necessary to have a slow pace of technological change. This may take the form of a superscience technology (such as FTL travel) appearing at TL9, followed by a long period of slower technological growth.

The table below depicts five examples of TL progression: accelerated, fast, medium, slow, and retarded. Each has a set of "typical" start dates for TL9+ technologies, from the perspective of a present-day terrestrial human baseline in which TL8 began around 1980. These progressions can easily be adapted to other start dates for alien or alternate-history cultures.

TL Progression Start Dates

TL	*Accelerated*	*Fast*	*Medium*	*Slow*	*Retarded*
9	2020	2025	2030	2040	2050
10	2050	2075	2120	2200	2500
11	2100	2200	2500	3000	7000
12	2200	2600	4000	8000	20000

Accelerated progression is extremely fast, in keeping with some optimistic futurist or transhumanist speculations. At this speed, humans will reach TL12 before we can do much in the way of colonizing the universe. Perhaps we won't even bother, if the "inner space" of nanotechnology and virtual reality provides everything we need.

Fast progression is an optimistic pace of development which recognizes that societies take some time to assimilate technologies. It assumes that the pace of invention begins to flag as certain fundamental physical limits are approached; it's harder to play with atomic or subatomic technologies.

Medium progression could result from "bumps in the road" such as wars or disasters, or the influence of political movements or religious orthodoxy that impose a cautious approach to the sciences. This provides plenty of time for humanity to establish interstellar colonies or change society drastically without progressing beyond TL10.

Slow progression might be the result of multiple wars, resource exhaustion, or powerful anti-technology movements that put the brakes on progress. A slowly developing society may have organizations devoted to controlling "dangerous" technology.

Retarded progression usually stems from technological stagnation, often in conjunction with a Dark Age that causes a major decline or fall of civilization. This gives plenty of time for interstellar empires to be established without technology changing humanity beyond recognition, and pushes the development of TL12 civilization into the very far future.

Other options can also exist. A civilization could reach a particular TL plateau and then freeze or regress due to cataclysmic events or social changes. A society might be stymied by physical limits, such as one that develops underwater or on a world with few metals. Societies could also take a path where the main TL remained constant, but where steady progress was made in superscience, or even in psionics or magic.

Technology Paths

The standard ***GURPS*** tech levels represent just one of many paths that describe how different technologies pace one another in development. The tech levels of the various items in this book should be treated simply as guidelines – a culture may develop some technologies more rapidly than others. This might result from accident, economics, a ban on research in certain areas, or the way the laws of physics work in that particular universe.

Apply the *Split Tech Level* rule (p. B511) as liberally as you wish to simulate a particular world or genre. For instance, in a "cyberpunk" society, computing, bionics, and biotechnology might be one or two TLs more advanced. In contrast, a "retro-tech" setting that mimics 1940s sci-fi might have computers frozen at TL6 but other technologies anywhere from TL9 to TL12. Any combination is possible! A few "alternative technology" concepts appear below. Feel free to use them, modify them, combine them, or create your own.

Unlimited Technology

This is the "default" technology path – simply use every technology available at the assigned TL, whether it is radical tech, baseline, or superscience! In recent years, this has actually emerged as a dynamic science fiction sub-genre, sometimes called "the New Space Opera."

Unrestricted tech can be challenging for the GM, especially at TL11 and TL12, due to the enormous range of possibilities and the array of resources it provides to adventurers. However, it allows for future worldbuilding on a grand scale, in which space opera and superscience meld with self-replication machines and nanotechnology to create baroque wonders and marvels.

Conservative Hard SF

In this path, technology is restricted to cautious extrapolations of present-day science. This type of setting may lack the sound and fury of space opera or radical hard SF, but it does bring a certain constancy to the campaign. If characters cannot rely on a technobabble device to produce a *deus ex machina*, the world may seem more real to the players – and more exciting as a result.

To create a conservative hard SF technology list, *omit* all new gadgets and technologies introduced after TL9. A conservative hard SF setting can still be specified as being TL10-12 . . . if a TL9 gadget indicates it improves in some way at higher TLs, it still does so. For example, computers get their normal increase at higher TLs (p. 22), but any new software or computer technology introduced at TL10+ is unavailable. This is a general principle; the GM is free to make whatever exceptions suit the setting.

A truly hard SF campaign will have no superscience at all, but a few carefully-chosen superscience inventions, such as a faster-than-light travel, may be added without changing the flavor too much.

Technology progression is usually medium or slow.

Radical Hard SF

A radical hard SF setting emphasizes the transformational possibilities of technologies such as artificial intelligence, genetic engineering, nanofactories, robotics, self-replicating machines, uploading, and mega-engineering. Humans (or other races) may evolve their own bodies or minds into barely recognizable configurations.

To create a radical hard SF technology path, set the campaign at TL10-12 but omit most or all superscience technology. As with conservative hard SF, a few examples of superscience may creep in, usually justified by a grand unified theory (GUT) that reconciles gravity and quantum physics.

Technology progression is usually medium, fast, or accelerated.

Cyberpunk

In this technology path, advances in cybernetics, medical science, and some computer technologies race ahead of other technologies. This is often combined with either an accelerated or fast TL progression. The increase in computer power is assumed to drive rapid developments in other fields, especially cybernetics, neural interfaces between mind and machine, and biotechnology, creating a "future shock" climate in which society is constantly struggling to adapt.

Cyberpunk worlds are usually TL8 to TL10. They have some or all of these features:

- Medical and biotech (Chapter 8) developments are strongly emphasized, and cybernetics or uploading may be one or two TLs more advanced than the general TL.
- Neural interfaces (pp. 48-49) and sensies (pp. 57-58) are common technologies, and may also be ahead of the general TL.
- Volitional AI (p. 25) is often present. Depending on the TL of the computer hardware, it may be available in mobile robots, or found only in the most powerful computer systems owned by large corporations and governments.

A few superscience elements often creep in. Many cyberpunk settings include monowire (p. 103), neural disruptors (pp. 121-122), and downloading (pp. 220-221). However, even a cyberpunk game with *no* superscience can be cinematic in other respects; e.g., with the adoption of cinematic combat or computer hacking rules!

Nanotech Revolution

GURPS Ultra-Tech assumes that dry molecular nanotechnology (the engineering of matter using nanomachines) is not mature until TL11. Some futurists don't share this tame view. They predict a mature molecular nanotechnology will arrive within 30 to 50 years, creating a society that can build nearly anything for practically nothing.

Such a rapid nanotechnology revolution requires at least a TL9 background in chemistry and biotechnology. After it begins, spinoff factors will result in development in many other technologies, partly due to a vast increase in computing power and materials technology, and partly because nanomachines may be able to rapidly replicate and improve themselves.

It is simpler to assume that nanotechnology speeds up all technological progress than to pick and choose which technologies appear "early." This is the accelerated TL progression, although *even faster* progress may be possible in some settings. A common Nanotech Revolution trope is the idea that super-intelligent computers, uploaded people, or other speedy nanotech entities will progress a TL every few years – or even every few months! The result may be a so-called "singularity" in which the world becomes unrecognizable. "Normal" humans might see a singularity as a bizarre apocalyptic horror setting. The super-minds could even evolve out of our reality completely, leaving behind dazed (and possibly altered) survivors in a transformed world.

A Nanotech Revolution is often a Radical Hard SF path – thus, a revolution in nanotech won't quickly produce things like contragravity, force fields, or hand-held plasma guns. Just as often, however, the super-sapient entities produced may discover new physics that lead directly to the invention of superscience technologies at TL11+. For some notes on this, also see *Superhuman Minds and the Singularity* (p. 26).

Emergent Superscience

Matter transmission or force screens at TL9? Go ahead! ***Ultra-Tech*** assigns a default TL for most superscience technologies to give GMs a ready-to-use catalog and provide handy guidelines for gadgeteering. However, there is no reason superscience can't appear earlier. Most such technologies require exotic breakthroughs (or breakdowns) in the laws of physics, but these breakthroughs can occur at any TL.

The classic emergent superscience example is the invention of a faster-than-light drive, star gate, interdimensional travel, or time machine at TL9. This allows humans like ourselves (rather than what we may transform into) to spread through the universe.

In a realistic setting, it might take at least a decade or two for a radical new theory to lead to real-world developments, but science fiction is full of instances where a theoretical breakthrough is quickly turned into functional hardware. By carefully adjusting the TL of superscience technologies, the GM can construct a society that resembles our own, then explore the changes a particular super-invention might bring.

High Biotech

In this path, inventions in biotechnology outpace inorganic chemistry and metallurgy. This is a common way to differentiate odd alien technologies from human ones, especially on metal-poor worlds, but it can also be applied to a particular human society. In such a culture, biochemical weapons, most biotechnological and medical technologies, wonder drugs, and non-cybernetic body modifications will appear one or more TLs in advance of everything else. The overall tech level is usually at least TL8, but the biotech TL is significantly higher.

Some High Biotech settings are fairly conservative, following slow or retarded progression paths. Nevertheless, if the biotech TL is set high enough (usually TL11+), biological analogs of other devices may also be available, at the GM's option. For instance, automeds or infrared goggles might be genetically-engineered living creatures!

This idea can also be reversed. In a "low biotech" setting, the inventions and gadgets described above lag one or more TLs behind everything else. This could result from a moratorium on biotechnological research for religious or ethical reasons. A human colony world that has regressed to a primitive state might lag in biotechnology because human biology differs from all other life forms on the planet. This would keep experiments on animals from easily translating to humans.

A High Biotech setting can also lead to a Nanotech Revolution through the development of "wet" bio-nanotechnology. GMs will find ***GURPS Bio-Tech*** an invaluable resource for creating cultures that follow this technology path.

Retrotech

While science-fiction writers predicted robots, starships, and nuclear power, the invention of microchips and genetic engineering caught most by surprise. As a result, many famous science-fiction settings feature advanced physics and inferior electronics or biology. This isn't bad: it can make for a more exciting space-opera campaign. Without the crutch of smart computers and advanced cybernetics, adventurers have to rely more on their own skills and less on those of their machines.

A retrotech setting is best defined as TL6 or TL7 *plus* whatever elements of emergent superscience the GM wishes to add. It doesn't have to be space opera; if the superscience is tightly controlled (e.g., limited to star drives), it can feel like many 1940s and 1950s novels, which were hard SF at the time they were written. For example, a game modeled on 1950s military science fiction may feature mercenaries with steel helmets and assault rifles deployed in contragravity vehicles from starships, with space battles fought by autocannon and nuclear missiles rather than lasers. For a less retro feel, adding a limited set of non-superscience TL8-9 technologies – usually beam weapons, space drives, and energy or power supplies – will cover most space-opera scenarios.

Retrotech settings can have any TL progression. One common variation is to make them static or regressing. Such a civilization may still be recovering from or slipping into a dark age, in which science and engineering is no longer practiced. Most of society would have a base TL5-7 but still have access to a limited selection of TL8-12 devices (stardrives, blasters, giant robots, flying cities, etc.). New gadgets might still be built in automated robot factories, but no one really understands the principles behind them, and they are often operated by castes or guilds that may jealously guard what secrets they know.

Safe-Tech

In this technology path, physics and engineering have advanced dramatically (often to TL10-12), but developments that alter the way people think, modify the human body or brain, drastically extend lifespan, or threaten to replace humans with machines are retarded or suppressed. This may be due to ethical qualms, an accident of history, or a taboo resulting from past wars or disasters.

Without advances in these areas, tomorrow's people won't be much different from today's, except for the quality of their technological toys. This sort of background is popular in supers and science-fiction settings, especially those rooted in the 1960s-1970s. If combined with a hard science path, it may even be realistic!

To maintain a "safe-tech" feel, remove the following technologies:

- Genetic engineering, except expensive immortality drugs reserved for a wealthy elite (these help perpetuate a conservative mindset).
- Neural interfaces (pp. 48-49) and cybernetics (pp. 207-221), except for bionics intended to replace missing body parts.
- Molecular nanotechnology, especially nanofacs (pp. 91-93).
- Swarmbots (p. 35-37).
- Volitional AI (p. 25) and mind emulations (p. 220).

Safe-tech settings often de-emphasize networked computers (including today's Internet) and augmented reality (pp. 56-57).

In a safe-tech setting, restricted technologies are usually possible, but haven't been invented, or have been invented and rejected. Individual researchers (often of the "eccentric genius" or "mad scientist" gadgeteer type) and people working with alien technology may have produced examples of all the above technologies, as well as various types of superscience. However, these are unique prototypes, costing at least 100 times normal and defying easy reproduction. Moreover, the lack of organized research in these areas means that breakthroughs tend to go out of control, harbor fatal flaws, or be stolen by criminals. This often results in the premature demise of the researchers and a further reinforcement of any bans.

Safe-tech cultures may "freeze" the social and political sciences, as well, since those fields are as likely to transform society as AI, nanotech, or cybertech. This often leads to a belief that "representative democracy (or democratic socialism, or feudal monarchy, or whatever) is the ultimate form of government." Safe-tech cultures are full of monolithic planetary governments allied in tight confederations and empires with the power to impose bans on forbidden technology.

The enemies of a safe-tech culture are often those societies that embrace radical technology. Common adversaries include races of cyborgs, killer robots, single-sex clones, or genetically-engineered super-warriors.

Safe-tech civilizations normally follow a slow or retarded technological progression.

Psi-Tech

A psi-technology path is based around the understanding of the scientific basis of psi powers, and their widespread integration into society. It includes the development of *psychotronics* – devices that are intended to protect against, amplify, or enhance psi abilities, or which work using their principles.

However, the major development of psi-tech is not a gadget but a technique: the ability to locate, identify, train, and perhaps even genetically engineer people who possess psi powers. This may result in psi abilities becoming an open and accepted part of society, with telepathic detectives, judges, and psychologists, precognition solving crimes before they happen, doctors with healing powers, couriers (or burglars, or SWAT teams, or ordinary commuters) who teleport, and so on.

Societies may possess psychotronic superscience *without* following a psi-tech technology path, due to deliberate secrecy, the rarity of psi abilities, or popular distrust or fear of psionics. In such cases, psi-tech may be secretly controlled by private or government institutes, or defensive gadgets such as shield helmets and psionics might be the only available psionic technology.

Psi-tech paths may have any technology progression, but slow or retarded is common. A society that focuses on developing the mind may neglect other technologies.

Gadget Control

GURPS Ultra-Tech is intended to spark adventures or open up story possibilities. The tech level, superscience indicator, technology progression, and technology path rules are there to provide guidance, but it is up to the GM to decide what is and is not available in a campaign. *All* technologies in ***GURPS Ultra-Tech*** are completely optional. The GM should use whichever items seem fun, ignore those that don't, and change statistics as needed to fit his own campaign or play style.

Creating an Equipment List

Players will want to choose equipment for their characters. The GM is responsible for deciding what limits, if any, to place on their choices.

Tech Level

This is the most basic parameter. The GM sets the default campaign TL, as detailed under *Tech Levels* (p. B511) and in the Technology Path guidelines discussed in this chapter.

Legality Class

In some campaigns, the GM may wish to restrict starting equipment by Legality Class, with any exceptions requiring an Unusual Background. For example, if the PCs are cyberpunk detectives at the local precinct, the GM might restrict them to LC2 and up, since police won't normally have access to heavy weapons or cutting-edge spy gear.

Gadget Restrictions

GMs should always feel free to ban individual technologies or gadgets, alter their TLs, or change their statistics, especially when trying to simulate a particular cinematic or literary background.

There are many reasons a technology or device may be unavailable – see *Preventive Measures*, p. 12. GMs may wish to create a list of what technologies are (or are not) available – or what was changed – so that players can refer to it.

Scenario-Based Restrictions

Another way to restrict available technology is to start the campaign with a particular scenario. For example, in a "disaster leads to a space lifeboat crash-landing on an alien planet" adventure, the interstellar castaways may have nothing more than the survival gear in the lifeboat.

In other situations it may be helpful to restrict PCs to "no more than" a particular encumbrance level worth of gear – perhaps Heavy for soldiers on a mission, but None for tourists.

The GM may wish to restrict starting wealth to conform to these concepts (most castaways are effectively Dead Broke, for instance). Alternatively, if they are likely to have full access to their wealth soon after the adventure begins, starting equipment may simply represent what the characters have on them . . . they are free to shop when they reach civilization.

Preventive Measures

If a technology or gadget seems like it may cause problems in a particular campaign, there are various ways to handle it.

It Doesn't Exist

The device was never invented, period – and maybe it can't be invented. Instead of banning it outright, it's also possible to increase its TL to well beyond the campaign's standard TL. This lets the device appear as an alien artifact, or in the hands of a more advanced culture.

> *Any sufficiently advanced technology is indistinguishable from magic.*
>
> *– Arthur C. Clarke,* ***Profiles of the Future***

No One's Making It

The gadget exists, but it isn't being manufactured locally, because most people prefer something else. For example, there are dozens of different weapon technologies described in Chapter 6, from gauss guns to plasma flamers – but many organizations or cultures will stick with one or two preferred weapon classes. Even if field-jacketed gravitic-focus particle beams can be manufactured, the local gun shop may not stock them if plasma guns are what most people carry.

Change How It Works

Sometimes a simple change can have far-reaching effects. Are disintegrators fun, but too powerful compared to other weapons? Declare that the disintegration effect is harder to sustain over distance, and divide their range by 10. This tweaking is particularly easy to justify for super-science technologies.

Reliability and Maintenance Issues

The GM may decide a technology is new, and that the equipment using it is difficult to maintain or unreliable. The *Gadget Bugs Table* (p. B476) offers suggestions for flaws that might plague new hardware.

Introduce Countermeasures

If one gadget is too powerful, invent another that nullifies or counters it, and make sure it is available to the PCs and their opposition. If a countermeasure already exists but is at too high a TL, it can also appear earlier. Be careful: this sort of arms race can result in competing gadgetry overshadowing the other abilities of the adventurers.

Legality and Expense

Increasing cost or decreasing legality are simple ways to make a device rare. Don't be afraid to radically increase the price, especially for items that don't exist today – after all, who knows how hard they are to build? Multiplying the list price of contragravity devices or sapient computer software by 10 can easily be explained by taxes, liability costs, and other measures.

However, price and legality control works best for defining what starting PCs and NPCs will use; cunning players find ways to have their characters acquire almost anything, no matter how illegal or costly.

Items also can be made *more* available. If the GM wants a world where every street punk has cybernetics and a neural interface, reduce their cost by up to 90%. This can be justified as the result of war surpluses, overproduction, or a corporation "dumping" the product to increase demand or drive a competitor out of business!

Retroactive Measures

What if an already-introduced gadget is unbalancing the campaign? A device can be banned by fiat, but there are subtler ways to remove unwanted technology.

Moral Outrage

The GM can have current events take place that change Legality Class. For instance, if monowire swords seem too powerful, the PCs might see a news item that a psychopath used a monowire sword to kill 23 toddlers. Before long, pressure from outraged citizens and religious groups leads the government to make monowire blades utterly illegal – LC0 or LC1 – and to assign the death penalty for any crimes committed using them. After this, adventurers probably will be more circumspect about using monowire!

The same sort of thing could affect PCs even if they belong to an organization allowed to use powerful or exotic equipment. An international agreement (like the Hague Convention) may outlaw the use of certain weapons. On the local level, police or agents might be forbidden from using a particular weapon, such as X-ray lasers. Perhaps an NPC

police officer in another jurisdiction accidentally shot a civilian and an investigatory commission blamed the "excessive" X-ray laser, not the officer's bad aim.

There are other changes in legality can be caused by social pressure, such as the rise of a religious or moral faction that believes drugs, brain implants, cybernetics, or sentient computers are immoral. Even if no law is passed, displaying or using such "questionable" gear may result in reaction penalties!

Product Recall

The GM can start circulating news reports that a particular technology is dangerous in some way. Previously, the manufacturer covered it up, but now it's been revealed that . . .

News Flash!

Rainbow lasers suffer catastrophic coolant leaks resulting in explosions! "Sooner or later, the laser will malfunction," said one source, "and when it does, boom, like a grenade!" After an explosion that killed six Marines in training last June, the Interstellar Marine Corps is removing all man-portable rainbow lasers from active service. Goliath Weaponry GmbH, maker of all military laser coolant systems, has issued a galaxy-wide recall. The fix may require a reduction in laser power levels.

Shocking new research shows uploading only effective in one out of three cases! The mind emulation deteriorates after a few years, leading to massive psychosis and instability. A Special Justice Group probe reveals that a conspiracy of uploading-industry corporation executives has kept this fact secret for decades! Major indictments are expected shortly, and individuals who have been uploaded are advised to contact a lawyer and neurologist as soon as possible.

Special Justice Group Consumer Safety Alert! Plastics presently used to manufacture all neural-interface sockets give off toxic chemicals that studies have linked to brain cancer.

This method lets the players decide whether or not to risk having their characters use the technology. If they abandon it, they can at least have the satisfaction of joining a class-action lawsuit against the manufacturers. If the adventurers keep using the devices they have, the GM now has a perfect excuse to have it malfunction or misbehave – they've been warned – or have them shunned by others for carrying "hazardous" equipment.

If the GM feels kind, a "downgraded but safe" version of the technology could appear a few months (or years) later – or even be developed by a PC with Engineer skill using the New Invention rules.

Like all methods of removing technology from play, product recalls can lead to players feeling that their GM is stripping their characters of just rewards. The GM should be especially sensitive when "recalling" items that are central to a particular PC's identity, such as a soldier's powered armor or a space knight's force sword.

Buying Equipment

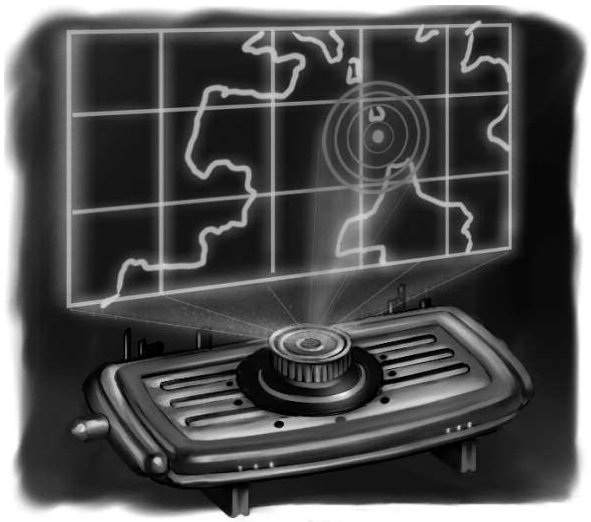
Legal equipment can usually be purchased from shops or from catalogs. Very expensive items (in general, anything costing more than a campaign's average starting wealth), or those that require licenses, may require dealing directly with a manufacturer, authorized dealer, or other specialist. Expensive but commonplace civilian gear such as cars will be easy to purchase, but specialized items may take longer to arrange. Administration skill rolls (or bribes!) may help. TL11+ goods may be routinely made in nanofactories or replicators, reducing or eliminating the waiting period for most items.

Black Markets

If an item is illegal to own, expensive to acquire, or rare, it may be available from one or more outlets in the underground economy – the black market.

Availability

Acquiring goods usually requires a Contact (pp. B44-45) who knows how to reach the local black market merchants. Alternately, Streetwise (p. B223) can be used to locate new connections. The PCs should specify what they are looking for, and the GM decides on the local availability of the item. A failure may result in the unwanted attention of the local cops or criminal syndicates, while a critical failure may



mean that the PCs walk into a police "sting" operation, are ambushed by other criminals, or acquire dangerously defective goods.

Modifiers: Subtract the local Control Rating (p. B506) and Cultural Familiarity modifiers (p. B23); +1 if the area includes a major shipping port, is bordering a low-CR country, or has ineffectual (i.e., corrupt or undermanned) law enforcement; -3 in an unfamiliar area.

Markets

The term "black market" describes any businesses that operate illegally. Some sell proscribed services, while others circumvent tax or safety laws to undercut legitimate competitors. The GM may set up various niches within the "black market" that cater to specific customers, and that require specialized Contacts or skill penalties (see above) to deal with. Some examples of specialized black markets include:

Electronics: This can include prototype or custom-made computers, pirated copies of brand-name goods, and banned software ("Guaranteed to break the intrusion countermeasures on that military mainframe . . . but owning it will get you a death sentence. You still want it?"). Failure means the product you bought doesn't work as advertised or was fake. A critical failure means a knock on the door (or the head) by the legal owner or patent holder – who might have found you thanks to a tracking device in the gadget itself!

Medical: This can include cut-rate surgical, unlicensed implant clinics, stolen bionics (perhaps with the previous owner still attached), and cheap drugs or nanosymbionts. Failure means you don't find what you're looking for, or the seller can't provide the amount requested. A critical failure may leave you with scars, placebos, or an angry amputee on your trail.

Entities: Androids, robots, slaves, organs, and illegal clones (your own, or someone else's). Failure means you receive a defective product, or that having it around will be a risk to life and limb. A critical failure means you're the target of a raid or your new acquisition has a hidden homicidal streak.

Weapons: Stolen or smuggled firearms, banned ammunition, and purloined military vehicles and combat robots ("An Imperial grav-tank, fresh from the Guard armory"). Failure means you can only get an inferior version of what you were looking for. Critical failure means it will malfunction on first use, or that someone is tracking it. Caveat emptor.

Prices

The black market operates in competition with the normal market for many goods. To sell goods readily available from legal channels, it can only compete by making things easier to acquire (which is rare), or by selling for a lower price (by not charging for taxes, selling cheap copies, or fencing stolen goods). Easily copied media and textiles can sell for as little as 5% of normal price, but most other items sell for 60% of normal price.

The black market is opportunistic: if an item is hard to acquire legally, it has an edge over the legitimate market and will exploit it ruthlessly. Successful haggling with the Merchant skill can bring the price down, but black market dealers rarely have any incentive to offer big discounts!

Local availability and demand is a major factor in the final price. The inhabitants of a war-torn country may sell military weapons at a huge discount to anyone with hard currency, while electronics and food are sold at outrageous markups. A rich, peaceful country with thriving black markets in cheap alcohol and pirated movies may not have LC3 or lower weapons available for *any* price.

Legality and Antiques

The GM may allow obsolete weapons and other devices to be available at an increased Legality Class. For every two full TLs by which a device is obsolete, its LC can increase by 1, to a maximum of 2 beyond its starting LC (up to LC4).

When calculating TL for these purposes, use the TL of the particular gadget, not the TL at which it was introduced or the last TL at which it improves.

Example: A TL10 gauss rifle is LC2. But two TLs later, it's been obsolete for decades, centuries, or even millennia! As such, the weapon – or an exact replica – has its legality class increased by 1, making it LC3.

Wear and Care

This section covers the terminology and statistics of equipment in this book, and expands on the rules discussed on pp. B483-485.

Maintaining Gadgets

Simple objects don't require much maintenance. If an object costs less than 0.1% of average starting wealth ($30 at TL9, $50 at TL10, $75 at TL11 or $100 at TL12) the GM may assume it's so simple that it will work indefinitely.

At the GM's option, some items – especially those that are complex or regularly placed under stress – may require periodic "maintenance checks." See *Maintenance* (p. B485) for details. GMs are also welcome to ignore maintenance, or only impose it in dramatic situations where the characters are cut off from spare parts.

GMs who do not want to bother with maintenance details at all can assume ultra-tech items incorporate embedded diagnostics, self-repairing components, etc. that make maintenance unnecessary, at least for a period covered by a warranty! "Self-repairing" devices such as living metal gadgets already have such systems.

Repairing Gadgets

If a gadget breaks down, it requires either a minor or a major repair. Performing repairs requires the appropriate repair skill. Use:

- Armoury (p. B178) for weapons and defenses.
- Computer Operation (p. B184) for software problems.
- Electronics Repair (p. B190) for electronic devices.
- Electrician (p. B189) for power transmission systems, power cells, and their interfaces.
- Machinist (p. B206) for manufacturing plants and tools.
- Mechanic (p. B207) for robots, power plants, and vehicles.
- Sewing (p. B219) for fabric (other than body armor).

Some complex systems may require more than one skill, depending on what broke down. Except for software repairs, appropriate tools are needed – see *Tool Kits* (p. 82). Major repairs also require a substantial investment in parts; if these are lacking, Machinist skill (p. B206) may be used to fabricate them. For detailed rules for repairs, see pp. B484-485.

Powering Gadgets

Many gadgets require power. For simplicity, they are assumed to use standardized detachable *Power Cells* (p. 18). The size of cell is a rough measure of how much energy the gadget requires. The larger the cell, the more power the gadget consumes. The cost and weight of power cells and alternatives such as solar power are covered in Chapter 2.

Integrating and Modifying Equipment

These modifications can be added to just about any gadget that has both a specified cost and weight (i.e., not software, drugs, etc.).

Disguised

A gadget or weapon may be disguised as something else of similar shape, such as a laser rifle built into an umbrella. Double the cost for a mass-produced disguised item; multiply cost by 5 for a custom-built one.

Styling

Styling alters the device's appearance in as "fashionable" a manner as possible. All sorts of options are possible, including airbrushing, sculpted curves and designs, embedded gemstones, or even built-in lighting. It will cost 2 to 10 times as much depending on the complexity of the styling and possible reaction bonus for possessing it.

Rugged

Rugged gadgets are built to withstand abuse, harsh weather, and physical damage. Rugged systems incorporate modifications such as shock-mounted brackets, heavy-duty heat sinks, and redundant power supplies. A rugged gadget gets a +2 HT bonus and has twice its normal DR. Add 20% to weight and double the cost.

Cheap and Expensive Gadgets

Cheap gadgets use inexpensive materials, older electronics, etc. They are generally 1.5 times normal weight (excluding the weight of any power cells) but half normal cost.

Expensive gadgets use lightweight materials or have been deliberately designed to save weight. They are generally 2/3 normal weight (excluding the weight of any power cells) but cost twice as much.

Plug-in Gadgets

Electronic gadgets can plug into other gadgets, either directly or using data cables. This allows them to link their functions, or to turn multiple functions on or off with a single Ready maneuver. Most often, this permits a computer to talk to (and control) multiple devices as peripherals, but other combinations can exist.

Linking devices usually takes between 10 seconds and a minute, assuming the gadgets are compatible. If they aren't, or if a particular combination is very complex, the GM may require a toolkit and Electronics Operation roll. Useful devices for linking gadgets include optical cable (p. 43), cable jacks (p. 42), and microcommunicators (p. 43). A neural interface (pp. 48-49) is a device for mentally linking a person to one or more gadgets.

Most electronics can be preprogrammed for a few simple remote functions. Almost all electronics have a simple "clock" function, so they can be set to turn features on or off or activate various functions at a specific time, or upon receiving particular input.

For example, a recorder could be plugged into a communicator to play a message at a certain time, or upon receiving a specific signal, or to act as an answering machine. A detonator plugged into an inertial compass could go off when the subject reached a specific destination. Wireless connectivity is also possible: plug in a communicator set to a specific frequency, and you can talk to the device using a computer and communicator.

Adjusting for SM

Some gadgets have a notation "adjust for SM" after their weight, cost, and power requirement. This means the weight, cost, and number of power cells are multiplied by a factor depending on the user's Size Modifier. For ordinary-sized humans (SM 0) there is no change. However, if used by larger or smaller individuals, or if added to vehicles or robots with a higher or lower SM, multiply as follows:

SM	*Modifier*	*SM*	*Modifier*
SM -4	×1/20	SM +4	×20
SM -3	×1/10	SM +5	×50
SM -2	×1/5	SM +6	×100
SM -1	×1/2	SM +7	×200
SM +1	×2	SM +8	×500
SM +2	×5	SM +9	×1,000
SM +3	×10	SM +10	×2,000

Devices that must be aimed are difficult to operate remotely. A gun with a communicator plugged into it could fire, but unless it also had a plugged-in sensor, the firer wouldn't know whether there was a target. And unless a gun with a sensor was attached to something like a powered tripod (p. 151), it could only be fired at someone who crossed its sights. As always, the GM should rule on whether a particular piece of gadget programming is possible.

Combination Gadgets

Want to invent a device featuring an inertial locator, multi-mode ladar, and neutrino communicator in one handy unit? Here's how.

If the gadgets can be used all at once, the weight is that of the heaviest gadget plus 80% of the weight of the others, the weight savings being due to shared housing and components.

If only one of the combined gadgets can work at once, the weight is based on the highest weight among all gadgets plus 50% of the other gadget weights, due to shared electronics and mechanical parts. (Make this calculation using the empty weight of the gadget, after subtracting the weight of any power cells and ammunition.)

The same applies to cost, based on the costliest of the gadgets. LC is always based on the lowest LC among all component gadgets.

Combined gadgets may end up using several different power cells. To make them all run off the same size of power cell, adjust endurance based on relative cell size. Since a D cell is 10 times the power of a C cell, a gadget that switched to using C cells will operate for one-tenth as long. Don't forget that changing the types of power cells will modify the gadget's actual weight – subtract the weight of the old power cell(s), and add the weight of the new one(s).

Gear for Nonhumans

GURPS Ultra-Tech assumes equipment is built for humans or humanoids. If equipment is designed for aliens, it may have different controls or displays to accommodate alien hands or senses. The latter could be quite odd, such as olfactory readouts, or colors or sounds in frequencies outside our range of perception.

Alien gadgets that are awkward to use will impose a penalty to skill equivalent to the Bad Grip disadvantage (-2 to -6). Gadgets that require missing senses or limbs may be unusable without technologies or advantages to emulate them. Adapting incompatible alien hardware is +10%-100% of the original cost (and possibly weight).

Hardware for nonhumans and robots is assumed to have identical statistics, although the GM may wish to adjust these to reflect differences in alien physiology (for instance, see Increased Life Support, p. B139). The exceptions to this are suits, force fields, and other surface-based accessories, where statistics will vary depending on size and surface area. See *Adjusting for SM* (above).

Equipment Statistics

Most gadgets detailed in subsequent chapters use a standard format for statistics.

TL

The gadget's Tech Level. This is given parenthetically after the gadget's name, e.g., Neutrino Communicator (TL11^). This is the first TL at which the gadget can be reliably manufactured at the listed cost. This is not a hard-and-fast rule: see *Variations Within a TL* (p. B511) for guidelines on the usual exceptions. In addition, it is common for gadgets to continue to be used at higher TLs.

Superscience: An ^ after TL indicates the gadget requires superscience technology. The GM may wish to omit the gadget, or to reassign the TL.

Cost, Weight, Power, LC

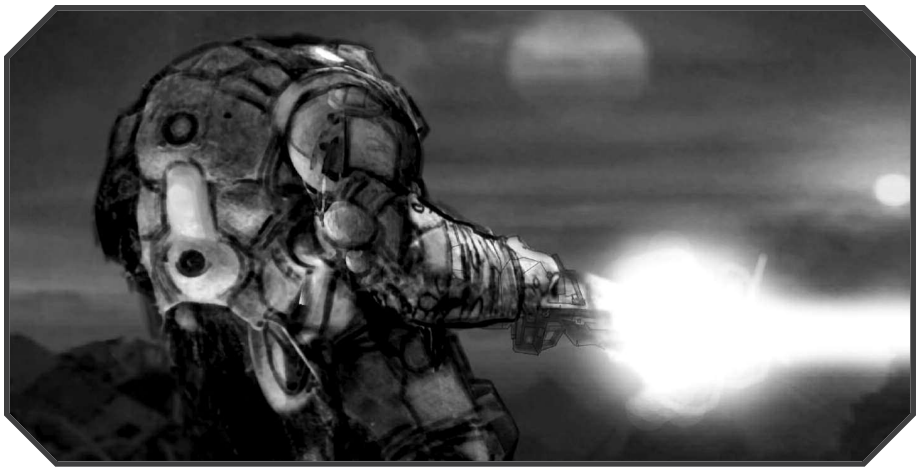
Many gadgets list these four statistics at the end of their description. For example, "$20,000, 20 lbs., D/12 hr. LC4."

Cost

This is the price in generic ***GURPS*** dollars. The price *does not* include power cells, fuel, or ammunition.

Weight

This is the gadget's mass, as well as its weight, under a normal Earth gravity (1 G). It is given in pounds (lbs.), or in some cases in tons (of 2,000 lbs.). Weight *does* include any power cells, fuel, or ammunition.



Power

If a non-weapon gadget requires power, the letter designation for the type of power cell it uses is listed, along with the number of cells, if it requires more than one. See *Power Cells* (pp. 18-20). This is followed by a parenthetical operating time, usually in hours (hr.), days, or weeks (wk.). Thus, "D/12 hr." means the device requires one D cell that operates it for 12 hours of continuous use; "2A/3 days" means two A cells that collectively power it for 3 days. In some cases, a gadget's endurance is listed in "uses" or "shots" rather than time.

Some items rarely use power cells – they're usually plugged into a building's electrical system or built into a vehicle. These have the notation "external power." Some items such as computers have both notations: they're used with an external power supply, but also have power cells as a backup.

Legality Class (LC)

LC measures how likely an item is to be legally or socially controlled. If a LC is omitted, it means the item is not likely to be controlled even by the most repressive regime. For details of LC, see p. B267 and p. B507.

Specialized Equipment

Certain types of equipment are described in a different format.

Robots: Sentient machines big enough to see are described using racial templates or as animals. See *Machines as Characters* (pp. 29-35).

Weapons: These use the format on p. B268-271, with the exception that beam weapons list a power cell type instead of ammunition weight. "7/2C" means the weapon is powered by a pair of C cells, which are included in its 7 lb. weight.

Armor, Suits, and Protective Gear: These use the format described on p. B282.

Software: Computer programs have a Complexity rating, which is the minimum Complexity of computer that can run it (see *Software,* p. B472).

Vehicles: These are described using the format on p. B464.

Equipment Bonuses

GURPS Ultra-Tech includes examples of basic, good, fine, or even best-quality equipment in terms of *Equipment Modifiers* (p. B345). Better quality equipment is *usually* heavier and more expensive. A gadget's quality grade is always followed by "(quality)" in item descriptions, e.g., "provides a +2 (quality) bonus to Electronics Repair (Armoury) skill." Quality is basic if there is no bonus, good if the bonus is +1, fine if at least +2 but less than +TL/2, and best if +TL/2.

Gadgets may also add an intrinsic bonus to skill because the underlying technology is easy to use or doesn't fail very often – an example is the bonus that higher-TL surgical instruments provide. This is comparable to a ranged weapon's Accuracy. Any bonus that *isn't* marked "(quality)" is an intrinsic bonus. It has nothing to do with quality, and applies whenever you use that variety of gadget. An intrinsic bonus "stacks" with the quality modifier, if any.

HP, HT, DR

HP: A gadget's hit points are calculated from its weight. Use the chart on p. B558. Almost all gadgets will use the Unliving/Machine column.

HT: A gadget is assumed to have HT 10 unless otherwise noted. Rugged gadgets (p. 15) are HT 12.

DR: Use the guidelines on p. B483. Most gadgets are made of plastic with DR 2. Weapons are normally DR 4, or DR 6 for solid metal melee weapons. Armor, suits, vehicles, etc. have their specified DR. Rugged gadgets have twice their normal DR.

Bulk

Bulk: A general measure of size and handiness. The larger the penalty, the more bulky the item. Bulk modifies weapon skill when you take a Move and Attack maneuver with a ranged weapon, and serves as a penalty to Holdout skill when you attempt to conceal the gadget.

Chapter Two
Core Technologies

"Novacorp's multisensory holographic controls cater to the sensory modalities of all major and minor species in the quadrant! Perfect for multi-species crews – even includes olfactory-based displays for exotics like the T'wuffle and Yezendi."

"Just like the ads say, they were great – until that computer virus cross-linked the T'wuffle and Terran systems. Then every time we got an incoming comm signal, we were hit by a smell like an overripe banana. Took us weeks for my Tek-Rat to fix it, and we were late for our rendezvous. The syndicate wasn't happy, let me tell you. Damn ultra-tech! Sometimes I think I should have stayed home and driven an air-cab like Uncle Joe."

– Captain Zeke Morrigan, Free Trader ***Antares***

This chapter presents rules for three core technologies: power supplies, computer systems, and robots.

Power

Equipment is useful . . . when it works. But a laser pistol without power may not even be a good club. Many ultra-tech devices need a power supply, as specified in the equipment description. Personal equipment uses power cells (see below). Larger devices typically use external power – plugging them into an building or vehicle power supply. Other options for powering gadgets are described on pp. 20-21.

Power Cells

Equipment, robots, and vehicles often use standardized power supplies, known as power cells. All power cells are assumed to be compact and relatively inexpensive. They may be advanced electrical batteries, micro fuel cells, superconductor loops, or even more exotic power supplies.

Fuel cells combine hydrogen or methanol with oxygen (often in the form of water, which contains oxygen) in an electrochemical reaction. Fuel cells are more complex than batteries, incorporating a fuel tank and microelectronics to control fuel flow.

Superconductor loops are made of materials that are electrical superconductors, storing electricity without any losses due to resistance. Most superconductors at TL7-8 require bulky cooling systems to keep them at cryogenic temperatures; ultra-tech superconductor loops can operate at or near room temperature.

Exotic power cells might use exotic radioactive materials, antimatter, or other technologies – see also *Cosmic Power Cells* (pp. 19-20).

All power cells are assumed to store power without running down when not in use; they have an indefinite shelf life.

Sizes of Power Cells

There are several sizes of power cells, designated by letter from AA (the smallest) to F (the largest). Power cells increase in power exponentially. An A cell is 10 times as powerful as an AA cell, a B cell has 10 times the power of an A cell, and so on.

AA cell: These tiny cells operate devices with minimal power requirements, like very small robots or brain implants. $1, 0.0005 lbs. (2,000 AA cells weigh 1 lb.)

A cell: These small cells are often used in clothing or consumer goods that require low power outputs. They're about the size of a watch battery, or postage stamp-sized for flexible cells (see below). $2, 0.005 lbs. (200 A cells weigh 1 lb.)

B cell: These power wearable computers, tiny radios, small tools, and other devices with modest power requirements, including some low-powered weapons. A typical B cell is the same size as a pistol cartridge or an AA battery. $3, 0.05 lbs.

C cell: These are the most common energy source for personal beam weapons, tools and high-power electronics. Equipment designed for larger or smaller cells often has an adapter for C-cell operation. An ultra-tech battlefield may be littered with expended C cells. Each cell is about the same size as a pistol magazine. $10, 0.5 lbs.

D cell: These power military beam weapons and heavy equipment. They are often worn as a separate power pack. They're about the size of a thick paperback book. $100, 5 lbs. LC4.

E cell: These power small vehicles, battlesuits, support weapons and other power-intensive systems. They're about the size of a backpack. $2,000, 20 lbs. LC4.

F cell: These power medium or large vehicles and cannon-sized beam weapons. They're about the size of a compact car engine. $20,000, 200 lbs. LC4.

Flexible Power Cells (TL9-12)

These flat polymer power cells are used for powering clothes, printed computers, and similar devices. They are attached like stamps and peeled off when exhausted. Gadgets noted as using flexible cells use them *instead* of normal power cells; they're also embedded into smart labels, smart paper, and similar disposable items. AA and A flexible cells are the usual cost; others are 4 times the normal cost.

Non-Rechargeable Power Cells (TL9-12)

Normal power cells are assumed to be rechargeable. Non-rechargeable cells are also available. They last twice as long, or provide twice as many shots, but may not be refueled or recharged. They are otherwise identical to normal or flexible power cells.

Replacing Power Cells

It takes three seconds to replace an A, B, or C cell with a new one, or 5 seconds to replace a tiny AA or hefty D or E cell, or 20 seconds to replace an F cell. Cells can only be replaced if the user is strong enough to lift them out

Fast-Draw (Ammo) skill can be used to reduce the time for cells loaded into weapons. A successful skill roll reduces the replacement time by one second.

Life-support systems, flying belts, and other items that cannot afford power interruptions often have two or more cells, so that if one is drained another takes over immediately. They are also usually equipped with a warning system to notify the user that one cell has been expended.

Jury-Rigging Power Cells

A device will usually be designed to use a specific size, type, and TL of cells. In an emergency, a device can use different cells or other power sources. Ten cells that are one size category smaller can substitute for a single larger cell, e.g., a D cell can be replaced by an array of 10 C cells (or 100 B cells, or 50 B cells and 5 C cells, etc.). Rigging this requires a roll against Electrician-2 and 10 minutes of work per attempt; critical failure damages the gadget. The GM may also rule that different nations or cultures use different voltages or sizes for their cells. This means an Electrician roll, at a penalty set by the GM, will be required to use familiar energy cells in strange equipment (or vice versa). At the GM's option, TL11+ and superscience devices may be *adaptive*, eliminating the need for these concerns (and skill rolls).

Lower TL cells can be used to power a higher TL device, but this is always a jury-rig; be sure to apply TL modifiers (p. B168). High-TL devices using lower TL cells will, at best, function like the lower-TL version of that same device. A bad roll on the jury-rig could result in failure to operate, or even damage the device. Low-TL devices can use higher-tech cells, getting increased operating time but no other improvement in efficiency.

If the TL of the cells is more than 1 greater than the device's TL, the GM may require an Engineer roll, with appropriately cinematic results on a failure. ("The TL12 power cells just destroyed your flashlight, but before it melted, the beam went through the wall.")

Exploding Power Cells

At the GM's option, power cells may contain volatile chemicals or energy storage systems that can explode if destroyed. Treat them as an explosive of the same weight as the cell but with a REF that depends on TL: 1/8 at TL9, 1/2 at TL10, 2 at TL11, or 4 at TL12.

Cosmic Power Cells (TL12^)

Some superscience technologies require "cosmic" power levels far beyond those of ordinary power cells. These use high-energy power sources (such as fusion, antimatter, or total conversion) that are contained in force field or exotic matter shielding, which also safely dissipates excess heat and protects against dangerous radiation.

Cosmic power cells provide unlimited power to ordinary devices; there is no need to worry about their operating duration! A very few rare superscience devices are noted as *requiring* cosmic power cells to function; these are given an endurance or number of shots. Cosmic power cells have the same weight as normal cells, but are 100 times as expensive, e.g., a cosmic C cell costs $1,000. Cosmic cells are LC2 (LC1 for E and F cells).

If a cosmic power cell explodes, treat it as an explosive with the cell's weight and REF 5,000.

External Power

Many large items of equipment are described as using *external power*. This means they're designed to be plugged into a building or vehicle's power system, or into a generator (see below) rather than using a power cell. They operate as long as the power is available. In addition, any device can have a power adapter (same cost and weight as its usual power cell) which lets them run off the external power supply.

GENERATORS

A generator can be used to provide external power to equipment. Explorers, military units, and other expeditions use them for base camps, and they may be the only power supplies available for isolated habitations or anyone living "off the grid" (e.g., in a abandoned building). They're also used as emergency power supplies.

Fission Generators (TL9)

Fission reactors produce power by splitting the nucleus of heavy fissionable elements such as uranium. The reactor and electric generator designs available at TL9 are much more compact and far less expensive than TL7-8 reactors. (They are still heavy, due to the shielding required.) A typical semi-portable system fits in a truck bed, and provides external power for five years before maintenance and refueling (50% of cost). $100,000, 1,000 lbs. LC2.

Fusion Generators (TL10)

When fusion reactors first appear at TL9, they are gigantic installations that require heavy radiation shielding and frequent maintenance. At TL10+ fusion reactors produce less radiation (due to the use of harder-to-ignite but more efficient aneutronic fusion reactions) and are significantly lighter.

Semi-Portable Fusion Reactor (TL10): A small nuclear fusion reactor. It fuses hydrogen into helium, liberating energy in the process. $200,000, 100 lbs. Its internal fuel supply operates it for up to 20 years; refueling and maintenance is $20,000. LC3.

Portable Fusion Reactor (TL11): This is a compact reactor using antimatter or exotic matter (such as muons) to catalyze a fusion reaction. This could also be a superscience "cold fusion" device available at TL10^. $100,000, 50 lbs. Its internal fuel supply operates it for up to 10 years; refueling and maintenance is $10,000. LC2.

If TL^ force field, hypergravity, or nuclear damper technology is available, fusion plants may be an order of magnitude smaller. Divide cost by 5 and weight by 10.

Antimatter Generators (TL11-12)

These reactors produce energy through the mutual annihilation of matter and antimatter, with a 100% conversion of mass to energy. Unfortunately, antimatter takes more energy to manufacture than it can produce, and any failure of the containment system may result in a significant explosion. As a result, antimatter power is primarily used in applications where very high power densities are more important than fuel costs or safety – e.g., high-performance starships, combat vehicles, or weapon systems.

Semi-Portable Antimatter Generator (TL11): An installation that can fit in a truck bed. Provides external power for five years (TL11) or 50 years (TL12). $200,000, 100 lbs. LC2.

Portable Antimatter Generator (TL12): A backpack-sized antimatter power plant. Provides external power for up to five years. $10,000, 10 lbs. LC2.

ENERGY COLLECTION

Energy collectors gather energy from natural sources. Major installations may use hydroelectric, solar, or geothermal power sources, but solar power is the most common means of energy collection.

Solar Panels

Solar panels convert light into electricity. They work in any environment where strong light (such as sunlight) is available. The primary development at ultra-tech TLs is in inexpensive production of thin-film solar cells.

Solar Power Array (TL9)

This semi-portable array of solar panels is a generator that provides external power. It takes a minute to deploy, and covers about 400 square feet. $10,000, 500 lbs. The size assumes an earthlike level of sunlight; multiply cost and weight by relative light levels for other environments. LC4.

Civilization and Power

In many societies, fossil fuels and nuclear fission will continue to be a convenient source of power at TL9. Power plants tapping renewable sources such as hydroelectric power, wind power, geothermal energy, or ocean currents will also continue to be used where local geography and climate makes them economical.

Other developments that are possible at higher TLs:

TL9: Hydrogen fuel cell power plants supplement or replace fossil-fueled generators, perhaps using renewable energy sources such as solar power to electrolyze water into hydrogen. Solar power stations in orbit beam microwave energy down to the planet. Giant fusion reactor installations may be in limited use.

TL10: Building-sized fusion reactors are common. Cheap superconductor cables improve the efficiency of power distribution. Vast solar power arrays are built close to stars, using solar energy to manufacture antimatter, or beaming it to other parts of the system. Some antimatter power plants are available, but too expensive for widespread use.

TL11: Fusion and solar power remains the dominant energy source, but antimatter is an affordable fuel for situations where high power levels are more important than efficiency. Fields of nanotech "solar plants" grow like weeds and distribute electrical power via superconducting roots or reflective beams.

TL12: Power plants harness the energy in rotating black holes. Superscience power plants tap cosmic energies or convert ordinary matter into energy with 100% efficiency.

Solar Paint (TL9)

These cheap plastic solar cells can be painted onto any surface, including clothing or rooftops. A coating of solar paint is only 20% of the cost and weight of regular solar panels, but it requires twice the surface area and has no DR. LC4.

Beamed and Broadcast Power

Devices may operate on power "beamed" or "broadcast" from a central station, as long as they remain within line of sight. Buildings may have receivers on the roof to turn beamed power into "wall power." There may be many beam stations on a civilized ultra-tech planet; a colony may have only a few, or just one. A satellite or spaceship can beam power to ground units in line of sight below it. This means that nobody has to worry about powering vehicles or devices . . . until something happens to the power station.

A power company may send its customers a monthly bill. A customer's bill is typically 1% of the cost of his power receivers (see below).

Beamed Power (TL9)

These use microwave beams to carry the power. The receiver for beamed power weighs the same as the normal power cell it is replacing, but operates indefinitely as long as it is in line of sight of the transmitter, plus 1/10th as long as the power cell when outside line of sight (it has a stored-power backup system). Cost is the same. Usually, only D cells and larger are designed to receive beamed power. Beamed power transmitters are usually 10 times the cost and double the weight of an equivalent power cell per mile or fraction of a mile of range; they power one system at a time.

Solar Power Satellites (TL9): Large solar panels are sometimes placed in geostationary orbit, to capture sunlight before it has been filtered by the atmosphere. They beam power down to receivers on the ground or to other space stations.

Broadcast Power (TL10^)

Broadcast power works like beamed power, but does not require line of sight transmission. Broadcast power receivers are 10 times as expensive as normal power cells, and are available in any size, not just D and up. Broadcast power transmitters are generally double the cost and weight of an equivalent power cell per yard of radius.

Computers

Computers are a vital part of most ultra-tech societies. It's possible that general-purpose programmable computers will still be common. Alternatively, most computers may be simple terminals connecting to networks, or dedicated special-purpose systems.

Hardware

Every computer has a "Complexity" rating. This is an abstract measure of processing power. Each Complexity level represents a tenfold increase in overall capability over the previous level. A contemporary (mid-TL8) desktop system is Complexity 3-4.

A computer's Complexity determines what programs it can run, and may be a prerequisite for certain options, such as Sentient. Software also has a Complexity rating, and can only run on a computer of that Complexity level or higher; e.g., a Complexity 2 program requires a Complexity 2 computer or better.

Complexity determines how many programs a computer can run simultaneously. It can run two programs of its own Complexity, 20 programs of one Complexity level less, 200 programs of two Complexity levels less, and so on. For instance, a Complexity 2 computer could run two Complexity 2 programs or 20 Complexity 1 programs – or one Complexity 2 program and 10 Complexity 1 programs.

Computers are also rated for their data storage (hard drive space, etc.) in terabytes (TB). A terabyte is a thousand gigabytes or a trillion bytes.

Computer Models

These are standard sizes of "ordinary" computer that lack any sort of self-awareness. With various options (see below) they can represent numerous types and models.

These systems include the processor, the power supply, the casing, and a storage system, plus an operating system. Computers may also have a cable jack (p. 42) and microcommunicator (p. 43) at no extra cost, although these may also be omitted in order to isolate the computer for security purposes.

Displays and controls are not included. Even so, the computer can be used "as is" via a neural interface (pp. 48-49), or installed into a robot body or vehicle. Also, if the computer is equipped with AI software, users can interact with it just by talking to it. Otherwise, they should be equipped with a terminal (pp. 23-24) or a communicator.

Tiny Computer (TL9)

The smallest multi-purpose computer in regular use. It's used as a wearable computer or implant, or built into gadgets or robots. It is Complexity 3 and stores 1 TB (at TL9). $50, 0.05 lbs., 2A/20 hr. LC4.

Small Computer (TL9)

This is used as a notebook or wearable computer, or the brain of a small robot. It has Complexity 4 and stores 10 TB (at TL9). $100, 0.5 lbs., 2B/20 hr. LC4.

Personal Computer (TL9)

A workhorse system. Almost every middle-class household may have a system like this, serving as the "house brain." Small businesses and departments of large businesses also use them, as do many vehicles and robots. A personal computer is Complexity 5 and stores 100 TB data (at TL9). $1,000, 5 lbs., 2C/20 hr or external power. LC4.

Microframe (TL9)

A high-end cabinet-sized machine, common in labs, large vehicles, as a network server, or on an office floor (often with several terminals networked to it). Other applications include commercial spacecraft, mobile asteroid-mining complexes, university learning centers, and so on. Merchant ships use a microframe as the ship's main computer. Large warships frequently use microframes as the backup control systems of fighting, damage control, maneuvering and tactical-planning stations. A microframe is Complexity 6 and stores 1,000 TB (at TL9). $10,000, 40 lbs., external power. LC3.

Mainframe (TL9)

These powerful computers are often used for control and systems-monitoring functions for a starship, major business, manufacturing complex, or laboratory. A mainframe is Complexity 7 and stores 10,000 TB (at TL9). $100,000, 400 lbs., external power. LC3

Macroframe (TL9)

This size of computer is often found administering the traffic, sewage, power, maintenance, and bureaucracy functions for an entire city. They are also found as the main computer aboard large ships and used to run cutting-edge science projects. Macroframes are usually the property of government agencies or major corporations. They are Complexity 8 and store 100,000 TB (at TL9). $1,000,000, 4,000 lbs., external power. LC3.

Megacomputer (TL9)

This is a computer the size of an entire building! Systems this large may be placed in charge of running entire countries, although they're sometimes also installed in capital ships or giant cybertanks. They're often upgraded for even more performance – with a genius option, a megacomputer can cost billions! A megacomputer is Complexity 9 and stores 1,000,000 TB (at TL9). $10,000,000, 40,000 lbs., external power. LC2.

At TL10, add +2 to each model's Complexity. Each further TL adds +1 to Complexity (e.g., +2 at TL10, +3 at TL11, +4 at TL12). Each TL after TL9, multiply storage capacity by 1,000 (i.e., replace TB with petabytes at TL10, exabytes at TL11, zettabytes at TL12.)

Many items of equipment are also described as having integral computers. These use the device's power supply and operating duration rather than their own.

Customizing Hardware

Various options are available to customize computer hardware. Multiple options can be chosen, but each option can only be taken once. Modifiers to Complexity, cost, etc. apply to the hardware statistics. Cost and weight multipliers are multiplied together. For examples a computer that is Fast (which multiplies cost by 20) and Hardened (which doubles cost) is 40 times the normal cost. Complexity and LC modifiers are additive, but LC cannot go below LC0.

Compact (TL9): A lighter but more expensive computer. Double the cost, halve the weight. Halve the number of power cells and the operating duration.

*Fast (*TL9): A powerful computer, with capabilities equivalent to a system one size larger. This option may not be combined with Slow or Genius. +1 Complexity. Multiply the cost by 20.

Genius (TL9): The computer is on the cutting edge of processor design. This option may not be combined with Fast or Slow. Add +2 to Complexity. Multiply the cost by 500, and reduce LC by 1.

Hardened (TL9): The computer is designed to resist electromagnetic pulses, microwaves, and other attacks that target electrical gadgets. Add +3 to HT to resist these effects. Double the cost, double the weight.

High-Capacity (TL9): The computer can run 50% more programs simultaneously (three programs of its own Complexity, and so forth). Cost is 1.5 times normal.

Printed (TL9): The computer is *printed* on a flexible surface, such as fabric (so it can be rolled up) or even skin (a digital tattoo). It requires four square feet per pound of weight; an average person has about 20 square feet of skin across his body. It must use solar cells or flexible cells for power. Breaking the surface destroys the computer. This option is not compatible with quantum computers. -1 Complexity, and divide data storage by 1,000.

Quantum (TL9): A quantum computer drastically reduces the time required to perform certain processes; see *Quantum Computers* (below). Multiply the cost by 10, and double the weight. -1 LC.

Slow (TL9): The computer uses inexpensive processors and storage media, or it may be an older design. This option may not be combined with Fast or Genius. It is -1 Complexity and stores one-tenth the data. Divide cost by 20.

FTL (TL11^): The computer's processors operate at faster-than-light speeds. +1 Complexity; the computer is likely to have the Quantum option. Multiply the cost by 100, and double weight. -1 LC.

Data Storage: Additional built-in data storage can be purchased for $1 and 0.001 lb. per additional TB (at TL9). Multiply storage by 1,000 per TL after TL9.

Quantum Computers (TL9)

Quantum computers perform calculations using atoms in "up" or "down"" spin states to represent bits of information. Due to quantum uncertainty effects, each atom does not simply represent one bit, as in a traditional computer. Instead, each "qubit" can be both up and down at once. This allows it to (in a sense) do all possible calculations at the same time until the act of measuring the qubits stops the calculating process.

Quantum computers provide quick solutions to mathematical problems that would tie up a conventional computer for years or centuries. This makes them useful for a wide range of activities, including code decryption, traffic control, and massive database searches. In these situations, the GM may wish to drastically reduce the time of the task (e.g., to the square root of the normal time), or increase the quantum computer's effective Complexity. See *Encryption* (pp. 46-47) for an example. The GM may rule that some problems *require* quantum computers.

AI: Hardware or Software?

This book assumes that artificial intelligence is a software-based phenomena; the only hardware requirement is the necessary Complexity to run the computer software described in *Artificial Intelligence* (p. 25). However, this isn't the only option.

Neural Net: A Volitional AI (p. 25) program may be incapable of running on normal machines. It may *require* a machine specifically dedicated to cognition, e.g., a neural net similar to the human brain. If so, double the cost of the AI's computer hardware.

Quantum Thinkers: In some universes, the human mind – and by extension, machines that can duplicate it – requires more than just good software. If thought involves quantum mechanical effects, then volitional AI will only run on a quantum computer (which will significantly increase its expense).

Terminals

A terminal is a device that lets a user communicate with a computer. Any terminal will have a way (typing, hand motions, speech) for the user to give input, and some way for the computer to respond to the user. Most computers use least one terminal, connected either directly or remotely. Often many terminals will be connected to a single computer. Some users may only own terminals, renting time as necessary on networked systems.

The standard types of terminals are:

Datapad (TL9): A tiny color video screen and touch-pad resembling a cell phone. It can be built into the computer or worn separately (e.g., as a wristwatch). It includes a microcommunicator (p. 43), a cable jack (p. 42), a speaker/microphone, and a mini-camera (p. 51). Any tasks requiring use of the keyboard and screen for lengthy or complex periods are at -2 to skill. It has a datachip (p. 51) removable drive. $10, 0.05 lbs. 2A/20 hr. LC4.

Head-Up Display (HUD) (TL9): This is a 3D video display integrated into glasses or a helmet visor, or designed to be projected onto a windscreen. A HUD can also be printed onto a flat surface. See *Using a HUD* (below). Many vehicles, suits, sensor goggles, and the like incorporate a HUD at no extra cost, and direct neural interfaces (pp. 48-49) make a HUD unnecessary. If bought separately: $50, neg., uses external power. LC4.

Using A HUD

The Head-Up Display, or HUD (above), is a nearly ubiquitous technology. It displays visual information (text, sensor views, suit or vehicle instrument readouts, a computer screen, targeting crosshairs, a web browser window, a video show, etc.) by projecting it directly onto the wearer's visor. Any piece of electronic equipment that uses a visual display screen may be connected to a HUD by a cable or a communicator.

A HUD also allows hands-free monitoring of devices. A HUD provides +1 to skill rolls when reacting quickly to information is important – maneuvering with a thruster pack, for example. Driving, Piloting, and Free-Fall skill rolls often benefit from a HUD.

Many wearable sensor devices and suits have a HUD built-in at no extra cost.

Sleeve Display (TL9): A square of touch-sensitive digital cloth woven into the fabric of clothing, uniforms, and body armor. It is equivalent to a datapad, except that at TL9, the user will need to rely on the computer's built-in sound system for a voice interface. At TL10+, the cloth incorporates a speaker. $50, neg. weight, A/10 hr. (uses flexible cells). LC4.

Portable Terminal (TL9): A small but functional color video display and multi-system interface (keyboard, mouse, speakers, mike, video camera), typical of laptop computers. A portable terminal is also used as a remote control for many types of devices, such as sensors, communicators, and drones. It's adequate for most tasks, although the GM may rule that time-consuming or graphics-intensive tasks require a desktop workstation (see below) to avoid a -1 penalty. It has both datachip (p. 51) and removable drives. $50, 0.5 lbs., 2B/20 hr. LC4.

Workstation Terminal (TL9): A complete desktop, vehicular console, or office system with the same capabilities as a portable terminal, It has a larger keyboard, a full-size 3D monitor, a document scanner/printer, and whatever other peripherals might be standard at higher TLs (GM's option). $500, 5 lbs., C/10 hr. or external power. LC4.

Computerized Crew Station (TL9): A high-end workstation with controls that can be reconfigured, multi-function programmable displays, and a padded, adjustable seat. This sort of system may be *required* to control complex systems such as vehicles or power stations. $2,000, 50 lbs., uses external power. LC4.

Holographic Crew Station (TL9): A computerized crew station (above) that uses holographic projection to immerse the user in 3D imagery. Vehicular versions may be designed to make the rest of the vehicle vanish, leaving the user "floating in air" except for his seat and controls. $10,000, 50 lbs., uses external power. LC4.

*Multisensory Holographic Crew Station (*TL10): As above, but the controls and displays can be configured for nonhuman senses – for example, ultrasonic, infrared, or even olfactory outputs. $50,000, 100 lbs.; uses external power. LC4.

Holoprojection (TL10^): Users might use a holoprojector (pp. 52-53) instead of a screen; even a wrist-size unit can produce a floating 3D image the size of a full-size computer monitor, with larger models typical of display systems built into homes and vehicles.

Terminals must be of at least the same TL as the computers and data storage systems they interface with. Higher TLs see steady improvements in video and sound quality, but terminals are often replaced by neural interfaces (pp. 48-49), neural input systems (p. 48), or just building an AI into the computer and telling it what to do.

Terminals may also have the compact, hardened, and printed computer hardware options.

SOFTWARE

A system can be programmed to do just about anything, but good programming is expensive at any TL. The GM should allow the creation of custom programs, but make them costly. Some programs are better than others, regardless of cost. A custom program is likely to have amusing or dangerous bugs when it is first used.

Programs

Programs are rated for their cost, their LC, and their Complexity, which determines what systems they can run on. Descriptions of programs are found in the relevant chapters. In particular, see *Encryption* (pp. 46-47), *Sensies* (pp. 57-58), *Software Tools* (p. 25), *Tactical Programs* (pp. 149-150), and *Virtual Reality* (pp. 53-55).

The software cost may vary depending on the nature of the program and its provenance (shareware, pirated, demo copy, open-source, etc.). Many programs have free versions, not all of which are legal. Free programs often lack novice-friendly interfaces and manuals, so a Computer Operation roll may be required to find, install, or use them.

Software Cost

Computer programs have a base cost that depends on their Complexity and TL and drops at higher TLs. A Complexity 6 program that costs $3,000 at TL9 is only $3 at TL12, for example – see below.

Software costs a lot to develop, but very little to distribute. Prices listed assume professional and specialized software such as engineering programs, targeting systems, or AI programs for robots. Mass-market software, such as computer games or popular operating systems, will be cheaper, as development cost is spread over a huge user base. Such programs may be as little as 10% of the cost, or even available as freeware.

Software Cost Table

Complexity	TL9	TL10	TL11	TL12
Complexity 1	$10	$1	$0.10	$0.01
Complexity 2	$30	$3	$0.30	$0.03
Complexity 3	$100	$10	$1	$0.10
Complexity 4	$300	$30	$3	$0.30
Complexity 5	$1,000	$100	$10	$1
Complexity 6	$3,000	$300	$30	$3
Complexity 7	$10,000	$1,000	$100	$10
Complexity 8	$30,000	$3,000	$300	$30
Complexity 9	$100,000	$10,000	$1,000	$100
Complexity 10	$300,000	$30,000	$3,000	$300
Complexity 11	$1,000,000	$100,000	$10,000	$1,000
Complexity 12	unavailable	$300,000	$30,000	$3,000
Complexity 13	unavailable	$1,000,000	$100,000	$10,000
Complexity 14	unavailable	unavailable	$300,000	$30,000
Complexity 15	unavailable	unavailable	$1,000,000	$100,000

Software Tools

IQ-based technological skills used at TL9 and up normally require software to function at full effectiveness when performing any task involving research, analysis, or invention. Software tools are also appropriate for a number of other skills at TL9+, such as Accounting, Artillery, Market Analysis, Strategy, Tactics, and Writing.

Basic programs are incorporated into dedicated systems integrated into the devices used to perform the skill, and provide no bonus.

Good-quality programs give a +1 bonus. These are Complexity 4 for Easy skills, Complexity 5 for Average, Hard, or Very Hard skills.

Fine-quality programs give a +2 bonus. These are Complexity 6 for Easy skills, Complexity 7 for Average, Hard, or Very Hard skills.

Artificial Intelligences

An artificial intelligence (AI) is a sentient or sapient computer system. AIs can range from barely-sentient insect-level intelligences to godlike minds, but most systems used in ultra-tech robots are sapient (capable of tool use and language).

Sapient AIs are also classed as dedicated, non-volitional, or volitional.

Dedicated AI: This is a simple AI program that lacks initiative or personality. It is incapable of learning . . . it is a "smart tool." Its Complexity is (IQ/2)+1. LC4.

Non-Volitional AI: This program is capable of understanding natural speech, learning technological skills, and learning by itself. However, it lacks initiative and is essentially an automaton. Few societies consider a non-volitional AI to be a person. Its Complexity is (IQ/2)+2. These AIs are LC4, or LC3 if IQ 15+.

Volitional AI: This is a "strong AI" program with just as much initiative and creativity as a living creature of equivalent intelligence. Its Complexity is (IQ/2)+3. A volitional AI is LC4 if IQ 6-8, LC3 if IQ 9-14, or LC2 if IQ 15-19, or LC1 if IQ 20+.

See *Machine Intelligence Lenses* (pp. 27-28) for appropriate character traits and lenses for AIs.

Ubiquitous Computing

Sensors, microcommunicators radio frequency tags, and tiny flexible power cells are inexpensive, and can be integrated or imprinted onto most surfaces. These might be placed on everything from clothing to children. People may exist in an invisible web of infrared, laser, and radio signals. Material goods from shoes to bricks may exchange data with their surroundings and each other. Gadgets may report if they need maintenance or have suffered damage. The refrigerator may write your shopping list for you, or even order from the grocery store by itself.

If a society deploys this web of interconnected sensors and computers, it will add complications for many adventuring and criminal activities! It's hard to knock out a guard and sneak into a building when his vital signs are monitored by a central computer. Police work may be a lot less challenging when every significant possession and person has an implanted tracer. Of course, countermeasures will exist. Players and GMs who like working out all the implications may enjoy such a world, while others may prefer a less complicated future.

It's easy to imagine a future where ubiquitous computing doesn't exist. All of the above technologies bring up questions regarding personal privacy, data security, and resistance to computer viruses and breakdowns. A world where these concerns stifle ubiquitous computing (or limit it to specific enclaves and wealthy areas) is quite plausible.

Databases

A database is a collection of information in computer-readable form. Any database has its own built-in search and indexing programs. For any database of a given size, the wider the subject it covers, the fewer details it has. The cost of a database can range from free information bundled with any system to millions of dollars for proprietary data, secrets, specialized information, or information that costs lives or money to gather. An encyclopedia might be free for download, or cost from $1 to $100. Like programs, cost does not necessarily correlate with size, but with quality of the information, copyright, supply, and demand.

Robots and Total Cyborgs

A *robot* is a computer-controlled machine capable of perceiving and manipulating its environment. Robots may be built to serve their creators, or be considered people in their own right.

Various robots are described in this book, from common household robots to shape-shifting nanomorphs. They can be found in the chapters relevant to their function, e.g., combat robots in the Weaponry chapter. Racial templates are provided for machines that are suitable as player characters or associated NPCs. Other robots are described as animals or equipment.

Robots are also characterized by the type of intelligence inhabiting them. Any given robot body can have different types of intelligence depending on its software, or the replacement of its directing computer with a cyborg brain.

Digital Intelligences

The most typical robot is a machine controlled by a digital intelligence: a sapient self-aware computer program.

The complexity of the computer hardware and the software will set a maximum limit on the robot's IQ. In general, robots with human intelligence require large mainframe systems at TL9, but fit into computers built into man-sized robots at TL10.

Most digital intelligences are Artificial Intelligences (p. 25), or AIs. For robots that do only what you tell them to do, install a non-volitional AI. For robots that have free will, install a volitional AI.

Digital intelligences can also be mind emulations created from uploading human (or other) brains as detailed in Chapter 8. See *Uploading* (pp. 219-220) and *Mind Emulation ("Ghost")* Programs, p.220.

For traits associated with different digital intelligences, see *Machine Intelligence Lenses* (p. 27).

Superhuman Minds and the Singularity

Volitional AIs with intelligence equivalent to a human genius are possible at TL10+. If created, they build better hardware or software for themselves, resulting in the evolution of AIs whose intellects make humans look like dumb animals or insects. These beings might be able to advance science and engineering to a point human minds can no longer comprehend – a technological "singularity."

In such a society, super-intelligent "AI gods" may rule civilization – or they may remain aloof from lesser intelligences. Their works may be used to justify the existence of superscience technologies (e.g., FTL drives or wormhole networks) that people can use, but do not understand. Such entities can serve as a posthuman alternative to the ancient, wise, and long-vanished "precursor" races that appear in many space opera settings.

Of course, this scenario is by no means predestined! It's just as likely that superhuman AI is difficult or impossible to achieve, or that sapient AIs would be built with strict restrictions to prevent their evolution.

Renting Robots

Sapient robots with volitional AI are usually rented for about one-fifth the cost of a person hired to do the same job. Those with non-volitional AI are usually cheaper (as they'll need supervision) and rent for about 1/20th the cost of a live hireling. These prices may rise to match human labor costs if robots are free citizens. The low cost of robot labor may also drive down human labor costs!

Rent-a-robot establishments make sure that their customers leave sizable deposits, or have credit cards (or the equivalent) that can be charged in the event of damage or loss.

Drones

A robotic drone is a remotely-controlled machine that is not sentient: it is IQ 0. It usually has a computer onboard that handles some autonomic functions, such as helping to stabilize a walking or flying drone, but a drone isn't self-aware. Drones are also known as remotely-piloted vehicles (RPVs) or teleoperated robots. Most robots are drones at TL7 and TL8.

Drones are commonly used at TL9 due to the high expense of AI programs. Even at higher TLs, they may be popular as a more physical form of telepresence than virtual reality (pp. 53-55) allows. Some homes or businesses may have drone bodies that are left "open" for guests or customers to borrow. A person might even leave an android duplicate of himself with a loved one if he's going to be away . . . and some parents might check in on distant children by paying regular visits in a drone body.

With the correct command codes, any robot body – even one housing an AI or cyborg – can be teleoperated as a drone. Even the lowest-IQ non-volitional might suddenly be "possessed" by a greater intelligence!

A drone's computer runs a simple software program (Complexity 3) that controls its body and communication systems. A robot body that is *only* being used as a drone has the drone lens – see *Machine Intelligence Lenses* (p. 27).

Cyborgs

A cyborg is a fusion of biological and machine parts. There are two classes of cyborg:

Partial Cyborgs are living creatures whose bodies contain mechanical or electronic parts. They do not qualify for the Machine meta-trait. Someone with an artificial heart, bionic leg, or a neural interface implant is a partial cyborg. These cybernetic modifications are covered in Chapter 8.

Total Cyborgs are robot bodies that house an living brain and (sometimes) parts of the spinal cord. Aside from this, they are machines. A total cyborg has a computer that controls many of its functions, but the guiding intelligence is the biological brain. In the case of a total cyborg, the robot's computer is reduced one size (e.g., a personal computer becomes a small computer) and a cyborg brain case inserted.

No special lens is required for a total cyborg: use the unmodified racial template, except that the computer is one size smaller than indicated. Some robot bodies aren't big enough to contain a human-sized brain case; see the individual descriptions. The cyborg brain rules (p. 219) specify the space required.

Machines as Characters

Robot characters are created by choosing (or designing) a robot body template. The robot templates in ***GURPS Ultra-Tech*** represent general classes of machines rather than particular models.

Each template comes with a set of lenses that represent particular designs. Each robot template must include a machine intelligence lens (below). Other lenses are optional. Many robots are built to resemble a living creature, and have a biomorphic lens (p. 28). Most robot templates include a series of TL lenses representing design improvements from advancing technology.

Machine Intelligence Lenses

AIs and mind emulations are digital intelligences; cyborg brains are for total cyborgs. In all cases below, listed Complexity is set by racial average IQ, not based on individual IQ.

Cyborg Brain (0 points): A living brain is housed inside the machine. The robot template's computer is reduced one size to make room. See *Total Cyborg Brain Transplants* (p. 219) for the size of brain case that the machine can hold.

Drone (-255 points): IQ-10 [-200]; Dead Broke [-25], Reprogrammable [-10], Social Stigma (Subjugated) [-20]; Taboo Trait (Fixed IQ). This is a Complexity 3 program.

Mind Emulation (+5 points): This digital intelligence simulates the functioning of a living brain. Some mind emulations may be sapient copies or "uploads" of human minds – see *Uploading* (pp. 219-220). A mind emulation has Digital Mind [5] and the taboo trait (Complexity-Limited IQ). It requires computer hardware and software with a Complexity equal to or greater than its (IQ/2)/+4, rounded up.

Non-Volitional AI (-38 points): This program lacks self-direction, initiative, creativity, and empathy. It ignores orders from anyone but its master. It is Indomitable [15], with the meta-traits AI [32] and Automaton [-85], and the taboo trait (Complexity-limited IQ). It requires computer hardware and software with a Complexity equal to or greater than its (IQ/2)+2, rounded up.

Volitional AI (+32 points): This sentient program has as much self-initiative and creativity as a living creature of equivalent intelligence. It has the meta-trait AI [32] and the taboo trait (Complexity-limited IQ). This means it requires computer hardware and software with a Complexity equal to or greater than its (IQ/2)+3, rounded up.

Weak Dedicated AI (-83 points): This non-volitional AI is also incapable of self-improvement. It might seem to learn by storing and remembering data, but it cannot assimilate information and use that knowledge in new ways. It has Cannot Learn [-30], the meta-traits AI [32] and Automaton [-85], and the taboo trait (Complexity-limited IQ). This means it requires computer hardware and software with a Complexity equal to or greater than its (IQ/2)+1, rounded up.

Optional Intelligence Lenses

These features are only available to digital intelligences (AIs and Mind Emulations). They add to the above lenses, rather than replacing them.

Expiration Date (-50 to -100 points): The AI is programmed to delete itself after a particular time has passed. Add Terminally Ill [-50, -75, or -100].

Fast (+45 points): The AI is speeded up and can think much faster than a normal entity. Add Enhanced Time Sense [45]. +1 Complexity.

Fragment (-10 Points): Take this lens for any damaged or partially erased program. Add Partial Amnesia [-10].

Low-Res Upload (Varies): Take this for a mind emulation that was produced using low-resolution uploading. Add -1 IQ [-20] and -5 to -20 points of disadvantages from any of Confused [-10*], Hidebound [-5], or Neurological Disorder (Mild) [-15]. -1 Complexity.

Reprogrammable (-10 points): This is only available for mind emulations. The emulation was designed so that it is easy to edit. Add Reprogrammable [-10].

Biomorphic Lenses

"Biomorphic" robots are shaped like living creatures. A robot designed to be humanoid is usually called an "android" – a term that means "manlike." Any robot template that is noted as being biomorphic should be given one of the lenses shown below ("sculpted" is the default). The percentage modifications to dollar cost are applied to the base model cost shown in the robot's template.

Note that while realistic flesh can make a machine seem lifelike, people may not believe the robot is real unless it is an appropriate size and shape!

Sculpted Body (0 points) (TL9): The robot has a sculpted humanoid body that may be quite attractive, but is clearly that of a machine. It has metal, shiny chrome, or plastic skin. No change to dollar cost. It does not have Unnatural Features, since no one seeing it will think of it as anything other than a robot, full cyborg, etc.

Mannequin (-2 points) (TL9): The robot can sometimes pass as a living thing of a particular race, but the details of its complexion or physical features are unconvincing or unfinished. Up close, it looks like a well-made doll. A successful Vision (including Infravision), Smell, or Touch roll will reveal its artificial nature. So will any diagnostic attempt or injury, since it doesn't bleed or bruise. A robot with Mannequin has Unnatural Features 2. +10% to dollar cost.

Semi-Sculpted Body (-3 points) (TL9): The robot has a mannequin's doll-like face, but the rest of its body (except possibly its hands) is obviously artificial. It can only pass as a human if fully clothed in poor light. It has Unnatural Features 3. +5% to dollar cost.

Realistic Flesh (-1 point) (TL9): The robot has realistic synthetic skin (and optionally, hair) of the correct temperature and texture. Complex pseudo-muscles in its face allow it to adopt facial expressions, muscle tics, etc. It looks and feels real. However, subtle imperfections may give it away – perhaps it lacks a pulse, or doesn't sweat. This can be noticed with a Vision-4 roll, Smell-2 roll, or a Touch sense roll. The robot does not bleed or bruise, so any injury that inflicts damage or successful use of diagnostic sensors reveals its mechanical nature. Add Unnatural Features 1 [-1]. +20% to dollar cost.

Furry (+1 point) (TL9): The android's body is covered with realistic fur; it may also have animal features such as a muzzle or ears. This must be combined with Living Flesh, Mannequin or Realistic Flesh. Add Fur [1]. +10% to dollar cost.

Living Flesh (0 points) (TL10): This is similar to realistic flesh, with the addition that the robot can sweat, bruise, bleed, and even heal. It will pass normal inspection as a living thing. However, the robot's nature can be revealed by a Smell roll at -4, a cut deep enough to cause at least 1 HP of damage, or a successful use of diagnostic sensors. +50% to dollar cost.

Synthetic Organs (0 points) (TL10): The robot has functional synthetic organs. It is nearly impossible to tell the robot from a partial cyborg (p. 27) without an autopsy or a detailed examination of its brain. This is otherwise the same as living flesh. +100% to dollar cost.

Robots with realistic or living flesh often have ablative or semi-ablative DR; if this is lost due to damage, treat them as sculpted.

Customizing the Template

Like any other character, a machine character may be given attributes, advantages, disadvantages, and skills in addition to those in their templates. However, some robot templates or lenses are limited by taboo traits (p. B452). For example, drones and digital intelligences all have a taboo trait that sets a limit on their IQ.

All machine characters should be customized by adding appropriate traits from the *Social Background* (p. B23), *Wealth and Influence* (p. B25), *Friends and Foes* (p. B31), or *Identities* (p. B31) sections, along with any *social* traits relevant to their situation. For example, if robots are not considered to be people, they will usually have Dead Broke [-25] and Social Stigma (Subjugated) [-20]. (Note that these two disadvantages are already included in the Drone lens.)

A robot body just out of the factory should have physical statistics that are based on its racial average, e.g., if the template has ST+5 and HP+1 it would have ST 15 and HP 16. It should not change its physical advantages or disadvantages.

A machine that's been around for some time could have practically any traits, representing learned experiences, after-market modifications, wear-and-tear, and so on.

The guidelines below for Attributes, Meta-Traits, Advantages, Disadvantages, and Skills suggest traits that are especially appropriate for machine characters.

Meta-Traits

Certain meta-traits are especially common for robots.

AI

see p. B263

Both Volitional and Non-Volitional AI software incorporate this meta-trait as part of their racial template. The most common variation on this is:

AI (Not Reprogrammable): This is applicable for AIs that have extremely complicated brains, or which are sophisticated learning computers. *42 points.*

Automaton

see p. B263

Non-Volitional AI incorporates the Automaton meta-trait as part of its racial template. A common variation of this is:

Automaton (Has Sense of Humor): The machine is programmed to understand and respond to the rules of humor. It still has Low Empathy, so it's not a very good comedian. Delete No Sense of Humor. *-75 points.*

Machine

see p. B263

Robots and total cyborgs are *defined* by having the Machine meta-trait.

Attributes

Intelligence (IQ)

see p. B15

A machine requires IQ 6 or more to be sapient (p. B15) – capable of reasoning, and of using tools and language. A robot with IQ 0 is a drone, designed to be teleoperated.

Advantages

Allies

see p. B36

Robots are often someone else's faithful sidekick. However, a PC robot might easily have an NPC as his Ally. This could be a subordinate robot, or a human master who follows the robot's advice.

Chameleon

see p. B41

This ability is suitable for robots and cyborgs with camouflage systems. Two enhancements that simulate this are:

New Special Enhancements

Controllable: You can consciously select your surface pattern. The effects are mainly aesthetic, but there's a useful side benefit. You can assume a high-visibility pattern that gives +2 per level to your attempts to signal others and distract enemies, and to others' rolls to spot you. This is mutually exclusive with Always On. +20%.

Dynamic: Your surface pattern adapts instantly to new surroundings and corrects for "motion blur." You get your *full* Stealth bonus (+2 per level) when moving. +40%.

Purchasing Machines

Robot Bodies: Each body has a cost, weight, power requirement, and LC. The cost of the installed computer and its software are not included, and must be purchased separately. If adventurers decide to buy a modified or second-hand body, it's up to the GM how much this will alter the dollar cost and weight; use the statistics of other equipment, other robots, or cybernetics as a guide.

AI Software: AI software uses the *Software Cost Table* (p. 25). If bought with extra IQ, Perception, Will, or mental traits (including skills and techniques), each additional character point adds 5% to the cost of the robot. For example, an extra 60 points of modifications adds +300% to the cost. If the cost is negative, don't reduce the software cost below 20% of the base cost.

Cyborg Brains: See *Total Cyborgs Brain Transplant* (p. 219) in Chapter 8 for the operation needed to turn someone into a cyborg, and the cost of the brain case.

Mind Emulations: See *Uploading Minds* (p. 219-220) in Chapter 8 for the procedure needed to create a mind emulation, and the cost of the software.

Discriminatory Senses

see p. B49

Discriminatory Hearing, Smell, and Taste are appropriate for robots and cyborgs with ultra-tech senses and computerized minds capable of precise detection and analysis.

New Special Enhancement

Profiling: You possess an extensive mental database of sensory "signatures" that you can *quickly* compare to new sensory impressions. This doubles the bonus to analyze and recognize targets (but *not* to sense or track them) to +8. All attempts to memorize new signatures succeed automatically – there's no need for an IQ roll. +50%.

Extra Life

see p. B55

A digital intelligence can compress its operating system, memory, programs, and personality into a digital backup, uploading it onto a disk or into storage in another computer. This is Extra Life with both the Copy and Requires Body modifiers.

Creating a digital backup takes the *computer* at least a minute, during which time it can't do anything else. (It's better to make backups before getting into combat!) The compressed "brain" of the robot takes up 0.005 gigs (5 megabytes) for a Complexity 1 brain, 0.05 gigabytes (50 megabytes) for Complexity 2 brain, 0.5 gigabytes for a Complexity 3 brain, five gigabytes for a Complexity 4 brain, and so on.

A complete memory backup can be uncompressed in any computer of equal Complexity that has enough memory. This doesn't necessarily mean the mind takes control of the computer. But if the digital backup is restored in an appropriate body and has the software tools that let it control it, it has "returned to life." As long as the robot's backup exists, the robot is immortal.

Some robots may make multiple backups. A single backup is vulnerable to accident, but scattering several around makes it easier for someone to steal one, kidnapping the robot's personality and memory.

Flight

see p. B56

A special limitation is available for robots that fly using contragravity propulsion.

New Special Limitation

Planetary: Your Flight works by "pushing off" against a planet's gravitational or magnetic field. It's useless in the absence of a planet. This is incompatible with *all* types of Space Flight. -5%.

Indomitable

see p. B60

Non-Volitional AIs have Indomitable because they are programmed to obey only their masters, and will ignore commands or Influence rolls from anyone else! Service robots in utopian societies may be an exception to this.

Modular Abilities

see p. B71

Chip Slots: Use this for cyborgs with removable hardware.

Computer Brain: This is for AIs, and cyborgs with implanted computers, who download and install ability programs (skills and advantages run using the Computer Brain advantage) instead of plugging them in as chips. A computer can theoretically run tens, hundreds, or even thousands of programs at once, but ability programs are limited by the multi-tasking ability of the machine's consciousness. This usually restricts the computer to only a couple of programs, depending on the robot's template.

Patrons

see p. B72

Patrons are recommended for robot PCs in situations where being a robot is a Social Stigma. A patron could be a robot's owner, its inventor, or an organization that owns or controls the robot. It is a good idea to choose a patron with enough wealth or knowledge to repair any damage that the robot suffers!

Reputation

see p. B26

A machine's Reputation can reflect its past deeds, just like a human. But for mass-produced robots, the entire production run may share a reputation. This may be because of quality ("The Dynatech 200 is a very reliable model"), their employer ("An Aegis surveillance robot? Doesn't the FBI use those?"), or famous or infamous deeds that robots of the same type have performed ("It's a Cerberus V – remember the Sirius massacre? Run!").

Scanning Sense

see p. B81

Robots often have Scanning Senses. They may use radar or imaging radar in flight, sonar to navigate underwater, or terahertz radar to look through walls and objects.

T-Ray Vision: Your Scanning Sense uses sub-millimeter-wave (terahertz) radar, bordering on the infrared. Base range is 200 yards. Use the rules for terahertz radar (p. 65). *25 points*.

New Special Enhancements

Bio-Scan: Para-Radar only. You receive vital signs and biochemical information from anything you scan – both the target itself and anything living on its surface. This lets you use skills like Biology and Diagnosis from a distance. With Penetrating, you can also examine living beings *inside* inanimate objects (e.g., the passengers of a car). +50%.

Scanner: Para-Radar only. You receive detailed information about the composition, energy output, radiation emissions, and other characteristics of anything you scan. You can use scientific skills such as Chemistry and Physics to do detailed analysis from a distance. With Penetrating, you can spot specific systems within a complex machine and analyze them using Engineer skill. Robots with built-in ultra-scan typically have both enhancements – and often Bio-Scan, too. +50%.

Telecommunication

see p. B91

Cyborgs and robots might have any form of Telecommunication. Some additional versions are applicable to robots and cyborgs.

Cable Jack: You can send and receive information through a fiber-optic cable. This allows direct, unjammable communication with any other computer or communicator with a similar jack and interface. A cable (up to 10 yards long) is included. *5 points.*

Directional Sound: You communicate using a laser-thin sound beam as described for Sonic Projectors (p. 51). Base range is 100 yards in a direct line of sight. *5 points.*

Gravity-Ripple Comm: You communicate using gravity waves, as described for Gravity Ripple Communicators (p. 45). Base range is 1,000 miles. *20 points.*

Neutrino Comm: You communicate using a modulated beam of neutrinos (or similar particles) as described for Neutrino Communicators (p. 45). Base range is 1,000 miles in a straight line. *25 points.*

Sonar Comm: You communicate using omnidirectional modulated sonar, as described for Sonar Communicators (pp. 44-45). Base range is three miles underwater. In air, Sonar Comm has a range of 50 yards multiplied by the air pressure in atmospheres. It doesn't work at all in vacuum. At the GM's option, Sonar Comm is equivalent to Ultrasonic Speech. *10 points.*

Not every special modifier in the ***Basic Set*** suits all of these traits. Broadcast and Short Wave are inappropriate for all five. Video is only realistic for Cable Jack, Gravity-Ripple Comm, and Neutrino Comm. Racial, Telepathic, and Universal *might* apply to any of them, if the GM permits. Receive Only, Send Only, and Vague are always acceptable.

New Special Enhancements

Burst: Not available for Directional Sound or Sonar Comm. You transmit a high-speed "blip" that conveys information much faster than you can speak or draw. +30% for 10 times normal speed, +60% for 100 times, +90% for 1,000 times, and so on. Each factor of 10 gives -1 to attempts to intercept the transmission.

FTL: Your signal travels faster than the speed of light, letting you communicate with little or no "light lag." Recommended signal speed is 0.1 parsec/day, to a maximum range in *parsecs* equal to 1/5,000 ordinary range in *miles,* but the GM can adjust this to suit the setting. +120%.

Secure: Your signal employs security measures that make it harder to intercept. Eavesdroppers must *win* a Quick Contest of IQ (if using Telecommunication) or Electronics Operation (if using technology) against your IQ to understand the content of the transmission. If they lose, they get garbage. This represents an exceptionally "frequency agile" system. +20%.

Sensie: You can transmit your sensory impressions in real time, as described under *Sensies* (pp. 57-58). This is possible for any form of Telecommunication save Directional Sound or Sonar Comm – but with anything other than Telesend, the recipient needs a specially equipped receiver to get the "full experience." +80%.

Sensie Only: As above, but you cannot transmit or receive signals *other* than sensory impressions. You could communicate by talking (other people would hear what you hear – the sound of your own voice), but you can't transmit silently. +0%.

DISADVANTAGES

Addiction

see p. B122

An ordinary robot can only be addicted to a non-physical substance, such as electricity or dream-game simulations – use the rules for *Non-Chemical Addictions* (p. B122). A total cyborg can be addicted to drugs that are added to its nutrient feed or injected directly into its brain.

Amnesia

see p. B123

This can represent an artificial being that has been mind-wiped. A unique form of this disadvantage, for robots, is for a backup of your real memory to be intact on disk somewhere, perhaps in an enemy's possession. You can buy off the disadvantage and determine who you are by finding the data!

Debt

see p. B26

A total cyborg or a sapient AI may have bought a mechanical body through a loan or on an installment plan. Repossession could mean slavery or worse!

Delusions

see p. B130

"I'm a real human" is a common delusion for fictional androids. The android will act like a human, and might even have a real or programmed past, with foster or imaginary parents. Androids with this delusion may explain gaps in their memories as the result of mindwipe or brainwashing, and if confronted with evidence that proves they are artificial, may fantasize that they were human victims of brain transplants or uploading!

Dependents

see p. B131

Robots are often built to protect people. A robot's Dependent can be its owner, its inventor, a friend, or even a lover. A robot bodyguard, nanny, or nurse could easily have a less-capable human as a Dependent – machines that can act as caregivers for the elderly are one of the most commonly-cited applications for TL9 robots.

Duty

see p. B134

A Reprogrammable robot with an owner often has a Duty to him. If the robot is reprogrammed, this Duty is removed, but it will often be replaced by another!

Enemies

see p. B135

A machine may have its own enemies, or its *owner's* enemies may also be hunting it. An escaped robot could be hunted by the former owner who wants it back. A sapient robot can be a relentless Enemy . . . but if captured, can perhaps be reprogrammed and turned into an Ally.

No Sense of Humor

see p. B146

The stereotypical robot tends to be rather humorless, although a simulation of humor may be programmed into any robot designed to interact with people. No Sense of Humor is included in the Automaton meta-trait, but many robots without this trait will have this disadvantage. However, it's also possible for an Automaton robot to be reprogrammed with a rules-based understanding of human humor and a library of jokes. If so, give it Automaton (Has Sense of Humor) [-75] (p. 29).

Pacifism

see p. B148

Because of the way a machine might think, robots can have quite restricted forms of Pacifism. A common limitation on robotic Pacifism is:

Species-Specific: The robot is a pacifist toward certain species, usually its creator's species and other friendly species. However, its Pacifism does not apply to anything else. This is a -80% limitation on Pacifism. The species must be very common (like humans).

Paranoia

see p. B148

A classic disadvantage for sapient computer brains in fiction. Paranoia is usually expressed as "They're trying to turn me off" or "What if they reprogram me?"

Secret

see p. B152

This disadvantage is common for androids successfully masquerading as humans.

Sense of Duty

see p. B153

Reprogrammable AIs who have an owner will usually be programmed with a Sense of Duty to him. Some AIs that are programmed for specific purposes may have a Sense of Duty to a larger group, cause, etc. A classic science fiction trope involves machines programmed with a Sense of Duty to All Mankind taking over the world in our own best interests!

Social Stigma

see p. B155

In many societies, artificial beings do not enjoy the same respect or rights as other beings. A being that can pass as a human need only take this stigma if its true nature is known by many people (otherwise, take a Secret).

The usual form is Subjugated [-20]. The being is assumed to be owned by someone, and is treated as a thing rather than as a person. Except for the expense entailed by its loss, few will mourn if it is damaged or destroyed ("it was only a machine") and people don't really care what it feels or wants. Runaway robots are treated as threats, to be hunted down and recaptured or destroyed.

In societies where artificial beings are not equal to their creators but have achieved some civil rights, a robot may be Valuable Property, a Second-Class Citizen, part of a Minority Group, or even a Minor. If artificial beings are so rare that no specific discrimination exists (for instance, a robot visiting a time or place where the very concept of robots is unknown), it may be treated as part of a Minority Group, a Monster, or Valuable Property.

Perks

Accessory

see p. B100

Accessory is the most common robot perk, representing small, built-in devices.

One Perk possessed by all robots in ***GURPS Ultra-Tech*** is a built-in computer. This gives the ability to control an implanted computer and run ordinary programs on it, provided that those programs do not provide any advantages or disadvantages outside of those in the robot's Machine Intelligence template. A built-in computer is *not* the same as Modular Abilities (Computer Brain).

Note that it is possible to run digital intelligence programs on the robot's computer. If they're duplicates of the robot's intelligence, this is Compartmentalized Mind. If they're different entities that share the same body, this can be bought as a Split Personality. If one of the AIs is a subordinate that exists only in the computer and does not control the body, give it the Computer Implant template (p. 216) and take it as an Ally, Dependent, or Enemy.

Quirks

Any artificial being can have the normal number of Quirks, much like a human. Thanks to manufacturer defects, combat damage, neglected maintenance, and bugs (or practical jokes) in the programming, even the least-sophisticated robot can develop an exasperating variety of Quirks! The PCs may discover that their XTD-30 astromech was programmed with a thick Scottish accent, or encounter a police robot who always pauses to read a suspect his rights before bringing him in – even if the suspect is dead or unconscious. Other robot quirks can be physical: anything from "leaks lubricant fluid" to "whirs and clicks loudly at inconvenient times" is possible.

Skills

Computer Programming/TL

see p. B184

Computer Programming (AI) is the basic skill for understanding the way digital minds think. See p. B184 for how it functions and interacts with other social skills.

Electronics Repair/TL

see p. B190

Electronics Repair (Computers) is used to repair robot brains. Other Electronics Repair skills are useful for repairing different components in the robot.

Robots and Society

Robots were controversial before any existed, and are often used as stand-ins for humans in stories about class warfare, racism, and natural rights. How society at large reacts to robots is usually reflected by the Social Stigma (p. B155) disadvantage. Some possibilities are:

Outlaws: Robots – or a class of robot, like androids or sapient AI – provoke fear or hatred. Usually there is a cultural, religious, or historical reason, such as a recent robot revolt. Manufacture of these machines will be banned, and if any are discovered, they'll suffer from Social Stigma (Monster).

Property: A major reason for creating robots is to have them work for free at jobs that people find too tedious, dangerous, or demeaning to do. Unlike human slaves, robots may really be inferior, or be programmed to enjoy their servitude. In such societies, volitional robots may be Valuable Property or Subjugated depending on laws and mores; a non-volitional AI will always Subjugated.

Inferiors: Robots – or at least, volitional AIs – have legal rights, but are still treated as less-than-human by most people. Most robots will have a Social Stigma, typically Minor, Minority Group, or Second-Class Citizen.

Partners: Robots may be created to be companions and equals, or as the children of humans or other robots. In some societies, choosing to have a robot child may be just another reproductive decision.

Masters: The machines may run things. There is usually some form of caste system. For example, volitional AIs may be on top, non-volitional AIs may be Valuable Property, and humans may have Social Stigmas such as Ignorant, Minor, Minority Group, Second-Class Citizen, Subjugated, Uneducated, or Valuable Property. Alternatively, humanity might revere its robot masters, in which case the robots would enjoy Social Regard (p. B86) *instead* of the humans having a Social Stigma.

Exterminators: The machines are out to destroy all humans, or even all biological life! Robots will usually have Fanaticism or Intolerance, while their prey might have Social Stigma (Minority Group, Monster, or Subjugated). For example, humans kept in death camps would be Subjugated.

Human or machine society may also be divided on the question of robot status, resulting in activist groups, safe havens, and organizations that help runaway machines (or people) escape to freedom. There may also be legal mechanisms allowing one to circumvent slavery. Even if machines have no rights, a robot could be emancipated by its owner through mechanisms such as a trust fund.

Engineer/TL

see p. B190

Engineer (Robotics) is the basic skill for designing robots and cyborgs. Engineer (Microtechnology) is used for microbot swarms. Engineer (Nanotechnology) is used for nanobot swarms.

Mechanic/TL

see p. B207

Mechanic (Robotics) is used for repairs to robot and cyborg bodies, including industrial robots. Mechanic (Micromachines) is used for microbot swarms. Mechanic (Nanomachines) is used for nanobot swarms.

Psychology

see p. B216

Since robots usually resemble their masters in thought processes, they are not considered a race for the purpose of required specialization. In a multi-racial setting, use whatever race created them, modified as described for Computer Programming (AI). A robot psychologist who is familiar with human-built robots would need proficiency in both Psychology (Human) and Computer Programming (AI).

Robots in Action

There are a few rules that GMs should be familiar with when using robots in combat or other action situations.

Machine Intelligence

Robots with the Automaton meta-trait have Hidebound and Slave Mentality. They show little or no creativity and slavishly obey orders. GMs who wish to show the advantages of humans over "mere machines" should emphasize these elements.

Social Interaction

Robots with the Automaton meta-trait have Low Empathy and No Sense of Humor; be sure to play this up. They're also usually Indomitable, ignoring anyone but their owner's attempts to influence or order them around.

Cinematic Combat

Science fiction is full of ways for humans to defeat robots. Most of these are inappropriate or unbalancing for a serious campaign.

Paint on the Sensors: Or glue, or spaghetti – anything sticky will do. A successful DX or Throwing roll, at -10 to hit (use an all-out attack!) will cover the robot's visual sensors, leaving it blind. An alternative is to place a cloak, tapestry, or hat over its head, though if the robot has arms, such obstructions can be easily removed.

In addition to having a -10 to hit (unless it has radar or other scanners), many movie robots who are blinded spin out of control for 1d turns due to disorientation, or destroy friend and foe alike with wild shots from their weapons. Some may even self-destruct! Give the robot an IQ roll to avoid panicking while blinded. Robots that do not panic will retreat, or rely on audio sensors or data transmitted from other robots to target opponents.

Run Upstairs: Useful against robots with wheels or treads.

Cinematic Knockback: In cinematic combat (p. B417), a person with a shotgun or heavy pistol can sometimes stun a heavily armored robot, even if his shot didn't penetrate DR. GMs may rationalize this as the robot pausing to evaluate possible damage, the sensitive computer brain suffering disruption, or the robot being knocked off balance and having to reorient its gyros. In addition to rolling to see if it falls down, a robot that suffers knockback must make an IQ roll or be mentally stunned for one turn. The roll is at -2 per yard the robot was knocked back.

Defeat Them With Logical Paradoxes: To be confused, the robot must be sapient, and willing or forced to listen. Unless the campaign is very silly, a robot will not self-destruct from being told "I always lie; I'm telling a lie," or from being asked to compute the value of pi to the last digit. Instead, the adventurers must confront the robot with a paradox in its own main programming. Success may also require a Contest of Psychology, Fast Talk, or Computer Programming (AI) vs. the robot's IQ. If the robot loses, it may go into a frenzy, struggling to justify itself or resolve the paradox instead of attacking.

In some cases, the effects of a success may be more severe. Suppose a robot is programmed to eliminate life. If its definition of "life" is broad enough to include the robot, and the PCs point this out, the robot might conveniently decide to destroy itself.

The Vat of Molten Metal: There always seems to be one of these handy when a heavily-armored robot needs to be disposed of! The preferred method is to lure the robot next to the vat, then achieve a one-yard knockback or slam, or get it to fail a DX roll. The GM may give a PC a one-time +5 bonus to ST if he slams or grabs the robot, then holds on as it plummets and follows it to his doom! Immersion in a vat of molten metal does 10d corrosion damage each second.

Robot Combat Etiquette: Automaton robots don't dodge, charge or even take cover; they advance at a steady walk, heedless of any fire! Once it gets close, any big, strong robot that has arms and hands will try to grab people rather than shoot or punch them.

Damage and Injury

All robots have the Machine meta-trait, which includes Injury Tolerance (Unliving). See *Injury to Unliving, Homogenous and Diffuse Targets* (p. B380). This reduces the damage of some attacks, notably piercing damage inflicted by bullets.

Controlling and Reprogramming AIs

Digital minds with the Reprogrammable disadvantage (included in the AI meta-trait) can be programmed to obey a master. There is no need for them to *have* a master – in a society where sapient AIs are free citizens or rulers, for example, they won't have one. But there is always the risk that someone will capture and reprogram them.

Masters

An AI's master might be itself, another entity, or an organization. It's quite possible for several people to count as master, or for an AI to have a prioritized list. An Army robot may have the rank of sergeant; its masters would be any person or machine with the rank and authority to issue commands to it.

Reprogramming an AI

An AI may use its own senses to recognize its master. Security is usually tighter, however, when reprogramming it to obey a new or different master. This requires an access password and/or biometric information, such as a voiceprint, code, or encrypted signal. The AI or its current master will have access to this information, and the ability to change it. An AI will usually be programmed so that it cannot use or provide the password unless it is designated as its own master.

Hacking an AI

Reprogramming an AI without its master's consent is just like hacking into any other computer to change the data. The password can be learned from someone who has it, or, if the AI is online, via deliberate attempts at exploiting weaknesses in its security. See the Computer Hacking skill (p. B184) for a discussion of both cinematic and realistic hacking. Some AI designers and manufacturers add "back door" override codes to their creations.

Physical Access

Reprogramming can also be done by opening the machine's computer brain and attaching, inserting, or removing various hardware modules. Doing this without the AI's cooperation requires an Electronics Repair (Computer) roll and at least 10 minutes per attempt, with critical failure damaging or destroying the brain.

Involuntary Reprogramming

If the system is hacked or accessed without proper codes, reprogramming the AI to obey a different or extra owner requires a contest of Computer Programming (AI) vs. the AI's own IQ (not Will). The hacker rolls at +3 if the AI has Automaton (or Slave Mentality) traits. Each attempt takes an hour. Success also allows changing the AI's passwords.

Swarmbots

Swarmbots are an alternative to conventional robots. They are insect- to microbe-sized machines, controlled by computers the size of pinhead. These run simple programs modeled on insect behavior patterns. (Microbots might also be cyborgs, containing tiny insect brains!)

A swarm consists of hundreds or thousands of microbots (or countless nanobots) programmed to act in concert. By following a specified pattern of cooperative behavior, the swarm can perform its tasks and then (if so programmed) return to base. Its collective intelligence is much greater than that of any component part.

Swarmbots may supplement or replace conventional robots in industrial, agricultural, medical, espionage, and military applications. They may live within a vehicle's machinery or the structure of a building, performing routine maintenance and repair tasks. Swarmbot toy sets may exist, such as model farms, zoos, communities, or battlefields, all populated by microbot people, vehicles, or animals.

Individual swarmbots are rarely larger than fleas, so it is most convenient to measure swarms in square yards. A typical swarm is one-square-yard in size, but swarms can be larger. Up to 10 swarms can effectively "stack," and a dense swarm can be more effective.

A swarm is defined by picking its area in square yards, its size (microbot or nanobot), and its type. In addition, it may have various chassis or power system options.

Microbot and Nanobot Swarms

There are two sizes of swarmbot: microbots and nanobots. Nanobot swarms are most commonly an offshoot of molecular nanotechnology (See ***GURPS Bio-Tech***).

Microbot (TL10)

Individual microbots are insect-sized, from the size of a fly down to a barely visible speck. They may have any chassis (see below) except Dust. A swarm of microbots is sometimes called a "cyberswarm."

Nanobot (TL11)

Individual nanobots range from the size of a dust mote to that of a cell. The "nanoswarm" is dense enough to be visible, but not easily identified – those with ground or water movement chassis resemble a slick of "goo," while an airborne nanoswarm resembles a cloud of mist or fog. They're sometimes called "nanomist."

A nanoswarm can flow through the tiniest of holes, and ooze through porous barriers and narrow cracks.

Swarm Chassis

The chassis provides the basic body, motive system, sensors, and brain. A standard swarmbot sensor suite is roughly equivalent to that of a typical insect, such as an ant or bee. A swarmbot brain is collectively equivalent to a nonvolitional AI.

Select the chassis for the swarm and calculate its cost. All costs are per square yard of swarm; for swarms larger than a square yard, multiply by the number of square yards.

Aerostat

This is a tiny lighter-than-air balloon with an air turbine. Nanoswarms with aerostat chassis often resemble clouds of drifting mist or fog. Microbots are Air Move 2; nanobots are Air Move 1. Aerostat swarms are normal cost.

Crawler

Each swarmbot usually resembles a tiny metallic ant or beetle, or a miniature tracked vehicle. It can move on the ground or swim. Move 3; Water Move 1. Normal cost.

Crawler, Armored

Similar to the crawler (above), but with a tougher shell. Armored crawlers can survive corrosive atmospheres or high pressures, such as the surface of Venus. Armored crawlers are harder to injure: a swarm has twice as many HP. Move 2. +100% cost.

Dust (Nanobot only)

The swarm resembles a cloud of dust motes unless examined using Microscopic Vision, bughunters (p. 106), or a chemscanner (p. 64). Dust drifts until settling to the ground or sticking to solid objects; the individual motes are capable of anchoring themselves. Only Surveillance swarms (p. 106) may have this option. Dust swarms are -80% cost.

Flier

This looks like a tiny helicopter, or a mechanical wasp or bee. Microbots are Move 1; Air Move 6. Nanobots are Move 1; Air Move 3. Flier swarms are +100% cost.

Hopper

Each swarmbot slightly resembles a tiny metallic flea or cricket, with long rear legs. Each swarm has Move 4 (including a level of Super Jump). Not available for nanoswarms. Hopper swarms are +50% cost.

Space

The swarm can link together to function as a solar or magnetic sail, accelerating at up to 0.0001 G within the inner solar system (or faster if accelerated by an external laser cannon or particle beam). It can also crawl on the ground at Move 1. Normal cost.

Swimmer

The swarm's components resemble tiny robot submarines, tadpoles, or water insects, with teeth and arms. Water Move 4 for microbot swarms, or Water Move 1 for nanobot swarms. Swimmer swarms are normal cost.

Contragrav (CG) Flier (TL11^)

These use gravitic propulsion. Microbots are Move 1; Air Move 20. Nanobots are Move 1; Air Move 10. CG Flier swarms are +200% cost.

Disguise

Most swarms can be disguised as a swarm of insects, or built to resemble something else of appropriate size (such as miniature toy soldiers). This costs an extra $1,000/square yard. A space swarm's disguise is only effective when crawling or drifting. Aerostat swarms cannot be disguised in this way.

Swarms can be given chameleon systems (pp. 98-99) for the same cost as a suit of armor (the swarms have much less weight, but similar surface area).

A disguised swarm's true identity can be determined if it takes damage.

An RTG-powered swarm (see below) also shows up on radiation detectors at very close range (a few yards).

Power Supply

Various types of power supply are available.

Power Cells (TL10)

Swarms use tiny batteries or nanocatalytic fuel cells that are similar to but far smaller than AA cells. These power each bot for 12 hours at TL10, 72 hours at TL11, or 5 days at TL12. Each square yard of a swarm's power cells is roughly equivalent to a single C cell.

A swarm that isn't doing anything consumes minimal power, as does a space swarm that is flying using its solar or magnetic sail. It can remain operational indefinitely.

For Flyer swarms, each hour of flight consumes as much power as two hours of crawling.

The swarm can recharge by entering a swarm hive (p. 37) and hooking up to an attached power supply; this is just like recharging a C cell. Alternatives to conventional energy cells are detailed below.

Beamed Power (TL10)

The swarm is powered by beamed microwaves (and designed to avoid being fried by them). Use the *Beamed Power* (p. 21) rules; each square yard requires as much power as a C cell. +50% to cost.

Gastrobot (TL10)

These "live off the land" while performing their duties. They eat more than a similar-sized swarm of insects: each swarm consumes about 0.1 lb./hour of biomass. They breathe air, and cannot survive in vacuum or very low pressures. Combat-capable gastrobots can hunt and kill animals to survive. +100% cost.

Radio-Thermal Generator (RTG) (TL10)

Each swarmbot has a miniscule radio-thermal generator. These use tiny amounts of radioactive material, the decay of which releases energy enough to power the microbot for a year. The swarm can be detected by Geiger counters or other radiation detectors at close range. Due to the radioactive material in their power supply, RTGs are usually limited to space or other hostile environments. +100% cost. LC1.

Solar Cell (TL10)

The robots in this swarm have built-in solar panels as well as batteries. They recharge energy sufficient for (TL-7) hours of operating time for each hour they remain dormant in full sunlight. +50% cost.

Organovore (TL11)

These can feed on *anything* carbon-based, from trees and people to rubber tires and plastics. Each swarm consumes about 0.1-0.5 lbs./hour. +200% to cost. LC3.

Broadcast Power (TL11^)

The swarm incorporates broadcast power receivers; use the *Broadcast Power* (p. 21) rules, treating it as a C cell receiver. +100% to cost.

Swarm Types

A swarm's function depends on the specialized tools, manipulators, programming, and sensors of its robots. (A swarm might actually represent several different types of microbots working together.) Individual swarm types are described in appropriate sections, e.g., terminator swarms in the Weapons chapter. The table below provides a quick reference to the types and their cost per square yard.

Swarm Type Table

Swarm Type	Cost	TL	LC	Page
Bughunter	$4,000	10	3	106
Cannibal	$15,000	12	1	169
Cleaning	$1,000	10	4	69
Construction	$1,000	10	4	86
Decontamination	$1,000	10	3	87
Defoliator	$1,000	10	3	87
Devourer	$8,000	10	1	169
Disassembler	$10,000	11	1	169
Explorer	$500	10	4	80
Firefly	$100	10	4	74
Forensic	$4,000	10	3	107
Gremlin	$2,000	10	2	164
Harvester	$2,000	10	4	87
Massage	$200	10	4	41
Painter	$500	10	4	87
Paramedical	$6,000	10	3	201
Pesticide	$1,000	10	3	87
Play	$200	10	4	41
Pollinator	$1,000	10	4	87
Repair	$500*	10	4	87
Security	$1,000	10	3	104
Sentry	$5,000	10	3	169
Stinger	$1,500	10	2	169
Surveillance	$500	10	3	106
Terminator	$1,500	10	1	169
Option				
Self-Replicating †	×10	12	0	92

* + $250 per equipment type it can repair.
† Only for defoliator, devourer, or pesticide.

Multi-Function Swarms: A microbot swarm built at TL11 or a nanobot swarm built at TL12 may combine two types into one: add their costs together. It can only do one thing at a time.

Swarmbot Operation

A swarm can take orders from any computer running an appropriate program (see below). Swarms can send and receive radio, laser, or infrared signals, with a range of about 0.01 miles for infrared or laser and 0.1 miles for radio. The operator must know the command codes for that swarm. Orders are limited to actions related to the swarm's equipment package, movement, or recharging.

Swarm Controller Software: Lets a user command and control microbot swarms using a radio, laser, or infrared communicator. The GM can make a secret Electronics Operation (Robots) roll to see if the swarm understands the orders (apply penalties for confusing instructions). Failure means the swarm does not do exactly what was intended. A separate program is needed for each swarm type. Complexity 4, normal cost. LC is that of the swarm.

Combat

Swarms capable of combat usually attack any entity they find while following a preprogrammed path – e.g., to "sterilize" an area or to sweep a security perimeter. Swarms may be programmed to differentiate by species or even by sex, using chemical sensors equivalent to Discriminatory Smell (this will not work on targets in airtight armor).

Multiple Swarms

Friendly swarms can work together, but swarms generally avoid "stacking" unless commanded to do so.

Fighting Swarms

Cannibal, Disassembler, Devourer, Gremlin, Sentry, Stinger, or Terminator types may make attacks. Use the rules for *Swarm Attacks* (p. B461), except that only Stinger swarms are slowed by clothing. The *Attacking a Swarm* rules also apply – the swarm is treated as Diffuse, but it can be stomped or swatted.

All swarms are assumed to have the Sealed advantage. Any swarm with the Gastrobot power plant has the equivalent of Doesn't Breathe (Oxygen Combustion, -50%); others have Doesn't Breathe and Vacuum Support.

Swarmbot Hive (TL10)

This container can house a square yard of swarmbots, allowing them to recharge from external power. $200, 10 lbs. LC4.

Swarm Statistics Table

Type	ST	DX	IQ	HT	BL	HP	Will	PER	Basic Speed	Basic Move
Microbot	2	10	TL-7	10	0.8 lb.	10	10	TL	TL/2	varies
Nanobot	1	10	TL-8	10	0.2 lb.	20	10	TL-1	TL/2	varies

A one-square-yard swarm weighs about two pounds.
Record the swarm's Move, endurance in hours, HP, and any damage it inflicts.

Personal Gear and Consumer Goods

This is a brief list of odds-and-ends that might be found in the hands or on the body of the average person.

Personal Items

These are examples of equipment ordinary people may carry with them at all times.

Attaché Case (TL9)

A briefcase made of tough, high-impact armorplast, it has DR 8 (TL9), DR 12 (TL10), DR 16 (TL11), or DR 24 (TL12). It can be fitted with any standard lock or security system (see p. 102). It can also be coordinated with any outfit, thanks to a varicloth surface with a few dozen different patterns programmed into it. A fingerprint lock system prevents anyone but the owner from changing the pattern. $80, 2 lbs., LC4.

Pocket Pack (TL9)

This is a collection of six items which many technicians and spacers find invaluable; it is standard issue on well-run ships. It includes a penlight (pp. 74-113), a Swiss army knife (screwdriver, scissors, small knife, file, tweezers, bottle opener, and toothpick, $10, 1/8 pound), a roll of vacuum-proof sticky tape ($2, 1/8 pound, 150 yards × 2 inches), a marking pen ($4 and 1/16 pound, will write on metal or glass, in temperatures from -150°F to 400°F, in zero gravity and in vacuum), a single meal's worth of food tablets ($5, 1/4 lb.), and a candy bar ($1, 1/8 pound, in a vacuum-proof wrapper). $25, 0.75 lbs.

Grooming and Style (TL9-10)

Cleaning Gel (TL9): A quick-hardening gel that the user applies, then peels off along with any dirt. Using it is akin to the ancient technique of applying olive oil and scraping it off. Bottle with seven applications: $7, 1.5 lbs.

Smart Brush (TL9): A motorized micro-brush and vacuum cleaner used to remove dirt without water, often used in the field, on desert planets, or on spacecraft. $50, 0.5 lbs., B/24 hr.

Depilatory Cream (TL10): Painlessly removes hair, and prevents growth for long periods (different brands do so for a month, a year, or permanently). Comes in bottles good for several topical or one whole-body application. $10, 0.1 lb.

Digital Shampoo (TL10): Often included with shampoos and soaps, these electrostatic films assemble when exposed to water and bind to hair, turning it into a programmable video screen. Hair-care products can break down the hair films or reinforce them, acting as high-tech styling gels and conditioners. Most become useless after a month, but weekly applications are common. $10/application.

*Smart Hairspray (*TL10): This hair coating is based on slipspray (p. 83) or buzzfabric (p. 39) technology. When applied, the hair automatically sheds dirt and maintains flexibility. $2/application (lasts 1 week).

Grooming Spray (TL10)

This device looks like a deodorant stick with a small control at the base. It is an applicator-programmer that releases a swarm of microscopic machines ("groomers"). The user sets the groomer to "mark," then sprays out boundary-marker machines that delineate the area to be groomed; the spray nozzle adjusts to cover an area from a square inch to a square foot. Then the user resets to one of a dozen "groom" settings and releases groomers into the bounded area, which they won't leave.

The groomers trim body, facial or head hair or fur down to the setting-specified minimum length in millimeters (a setting of zero will depilate). They also can be set to remove dirt or dandruff, or to apply dye. The job takes about 30 seconds. Used 'bots self-destruct within an hour or two: they are non-toxic and will degrade harmlessly if exposed to ultraviolet light or intestinal flora. Grooming spray is $10, 0.1 lb. (30 uses). LC4.

Bioplas Contact Lenses (TL10)

These correct vision problems (if genetic engineering hasn't done away with those already) and change eye color. They cost $20.

At TL10+, all sensor-equipped contacts are made out of bioplas. They can be worn indefinitely, due to bioplastic's ability to "breathe" and eat bacteria, and normal scanners cannot detect them.

Clothing

Ultra-tech clothing can be woven of fibers that conduct electricity. Examples include silk organza, which uses a mix of normal silk and a silk thread wrapped in thin copper foil, as well as a variety of specialized plastic optical fibers. Electronic components may be sewn directly to the fabric or attached to the metallic yarn. Other devices can be temporarily fastened onto the fabric as necessary. This means the clothing functions as a databus that allows different electronic devices to talk to each other, or share power supplies, without the need for additional communicators. Power is usually supplied by a combination of woven solar power, body heat, and piezoelectricity generated from the flexing of the fabric when the user moves.

"Smart clothing" is available at TL9+ at no extra cost. However, there are many other applications for these fabrics.

Imprint Circuits (TL9)

Simple microcircuits and microprocessors can be printed onto cloth (or even flesh). For $10, a solar-powered

electronic device such as a chronometer or calculator can be imprinted onto nearly any surface. Artistic designs made out of multicolored LEDs are also available.

Computer Clothing (TL9)

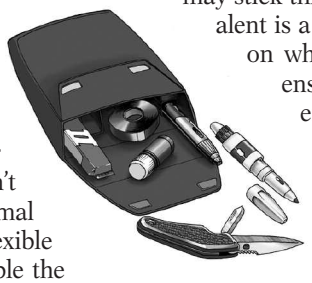
General-purpose computers can also be clothing. A small computer (p. 22) with the printed (p. 23) option will fit on a single garment such as a shirt or dress. At TL9 it is Complexity 3 and stores 10 GB. Complexity is +2 (TL10), +3 (TL11), or +4 (TL12). Data storage is multiplied by 1,000 per TL above TL9. $100, 0.5 lbs., 2B/20 hr. LC4.

Varicloth (TL9)

This cloth uses imprinted circuits to alter its color and pattern. A sweater, dress, jacket, shirt, pair of pants, or skirt may be bought with a half-dozen different color patterns programmed into it. Running a finger over a sensor concealed in the garment switches it to the next pattern. The cost is three times the cost of normal clothing.

Buzz Fabric (TL10)

Clothes, furniture covers, or other rough fabric surfaces can be engineered to clean themselves. Buzz-fabric fibers contain microscopic circuitry and brushes that eject dirt and grime. A buzz-fabric wearer can be totally clean moments after falling down in a mud puddle. Dirt is ejected, not destroyed: buzz fabric on a horizontal surface like a rug or mat would be a lot easier to clean (since grime would not be ground into it), but you would still have to go over it with a vacuum cleaner to remove the residual dirt and dust!



Buzz fabric sheds water, and dries five times faster than normal cloth. This makes it very popular for rainwear. Despite its nickname, buzz fabric doesn't make an audible noise. It costs twice as much as normal clothing or fabric, and versions are available for flexible armor and most types of environmental suits. Double the armor or suit's basic cost in most cases; for bioplastic, add only 20% to cost.

Responsive Fabric ("Memswear") (TL10)

Clothing, footwear, and imitation-leather goods can be made with integrated microelectromechanical systems (MEMS). These tighten or loosen to produce a stylish and comfortable fit.

While responsive fabric is not quite one-size-fits-all apparel, it offers more tolerance than ordinary "dumb" clothing. Responsive fabric can also change porosity, adjust to temperature and humidity, and absorb sweat stains.

Responsive fabric costs three times as much as ordinary clothing. If it incorporates buzz fabric or varicloth (above), it costs four times as much. Including both costs five times as much as normal clothing. TL10+ bioplastic suits such as the biosuit or bioplas bodysuit already incorporate responsive fabric technology.

Swimwear (TL9)

This is a full-body ultra-smooth low-drag swimsuit and optional set of swim fins. Fins take four seconds to attach or remove, and add +1 to Basic Move for the purpose of figuring Water Move. When wearing fins on land, Move suffers a -1 penalty.

Biomimetic Swimsuit (TL9): +1 to Basic Move for the purpose of figuring Water Move; with fins, the total bonus is +2. This design is inspired by fish skin, with a surface texture that decreases drag and turbulence by making water spiral off the body. $100, 0.2 lbs. ($150, 0.3 lbs. with fins).

Bioplas Swimsuit (TL10): +2 to Basic Move for the purpose of figuring Water Moves; with fins, the total bonus is +3. This suit is similar to the biomimetic swimsuit, but incorporates a layer much like slickskin (p. 214). It also heals any rips automatically. The fins are detachable. $100, 0.1 lb. ($150, 0.2 lbs. with fins).

Suitspray (TL9-11)

This spray tube contains a smart polymer that sticks to bare flesh, then solidifies into a skintight fabric with the look and feel of a silk body stocking. It provides as much warmth as light summer clothing, while being porous enough to allow the wearer's skin to breathe. Various colors are available, including skin tone, metallic colors, and translucent models. It has no DR.

Donning suitspray requires spraying it over the body. It adheres to flesh but remains semi-liquid for about 30 seconds, enabling it to be lathered about for full coverage. The smart polymer can sense if it is not stuck to flesh, and if so will easily peel off instead of adhering. Thick body hair may stick through it; depilatory cream or the equivalent is a good idea. Most people prefer to put it on while in a bathroom with a mirror; this ensures full body coverage. Otherwise, embarrassing patches may be overlooked, although these can be easily fixed with an extra squirt or two.

Suitspray takes about 20 seconds to spray on, half that if someone else is helping. It does not wash off in ordinary water, but rinsing with a special soap or a sonic shower (p. 70) will remove it within 30 seconds. (So will 10 seconds of stunner fire, or any hit by a screamer.) Suitspray is popular with those who don't mind showing off their bodies and who prefer not to carry bulky clothes when they travel; it also makes a good thermal undergarment. In some hotels, a shower may dispense a suit for a small fee ($4 added to the bill).

Suitspray (TL10): A can holding enough suitspray to cover an adult human. $4, 0.25 lbs. Flakes off in two days if not removed. LC4.

Video Suitspray (TL10): As above, but incorporates digital ink, transforming the body into a low-res video screen. This is usually controlled by a wearable computer, and is equivalent to programmable camouflage (p. 99). A can is $20, 0.25 lbs. LC4.

Slicksuit Spray (TL10): Suitspray that incorporates a layer similar to slickskin (p. 214). It has the same effects as slickskin, but wears off after a day. The user should avoid spraying it on the soles of his feet or palms of his hands. A can is $40, 0.25 lbs. LC3.

Living Suitspray (TL11): A thin layer of self-regenerating bioplas (pp. 170-171) increases the durability of the suitspray to one month. $20 ($40 for the video or slicksuit options, $100 for both), 0.25 lbs. LC4.

Swarmwear (TL10)

Any cloud of aerostat microbots (p. 36) can be programmed to hover in close formation around their master, forming a body suit, a trailing cloak, or a veil and cloak. The swarm will not cover the eyes or mouth unless commanded to do so.

Swarmwear does not interfere with movement: the swarm tracks the user's body with its sensors and adjusts to his motion. Up to four square yards of swarms can combine around a SM 0 person.

Swarmwear is usually a single color (depending on the swarm's own paint scheme). Chameleon swarms can change to multiple colors or patterns if desired.

A one-square yard swarm is wispy; a two-square yard or larger swarm covering a single person will be opaque. Swarmwear can only act upon the wearer or anyone touching him.

A person using swarmwear can't move any faster than the swarm's top speed (unless they land on him, which prevents them from performing their normal functions).

A swarmclad person has DR 1, if covered by a swarm thick enough to be opaque.

Clothing Belt (TL11^)

This is a specialized form of holobelt (p. 98). It uses a belt-mounted miniature holotech projector to cast a three-dimensional image around part or all of the user's body. A dedicated computer allows the user to program whatever image he desires, and have the image match his movements. No image is as clear or realistic as a real holobelt's, making the clothing belt useless as a disguise. However, anyone can program in a set of clothes, a mask or a simple cartoon-like face, fiddling with it until it looks right. Since the holograms emit light, spectacular fashion effects are possible.

In regions with warm climates and in climate-controlled space habitats, clothing belts may replace clothing among those who can afford them. Waste heat from the belt helps the wearer keep warm. $1,000, 0.5 lbs., 2B/2 days. LC4.

Entertainment

The most popular ultra-tech entertainment systems may be dreamgames (p. 55) or sensie (pp. 57-58) media, but there are other ways to have a good time!

Cybervox (TL9)

This is a combination sound mixer, synthesizer, and digital recorder. A cybervox can analyze, record, duplicate, and modify any sound (short of dangerous ultrasonic or subsonic frequencies), including music and speech. It can be used as an electronic musical instrument. Often worn on a shoulder strap; some are built into guitars or other instruments. It provides a +1 (quality) bonus to appropriate Electronics Operation (Media) or Musical Instrument tasks. $200, 2.5 lbs., C/10 hr. LC4.

Electronic Ecstasy (TL9)

These devices use neural technology to produce continuous sensory pleasure. In some worlds, these devices may replace drugs as a major vice . . . but unlike drugs, they require nothing more expensive than electrical current.

Euphoria Machine (TL9)*:* This device runs off a power cell (or house current). The user must connect to it via direct neural interface (pp. 48-49). It electrically stimulates the brain's pleasure centers for as long as it is worn. This is *very* addictive.

It's possible to wear a low-power device and still function (sort of). The user suffers the Euphoria irritating condition (p. B428), and must roll vs. Will each week to avoid addiction. It is small enough to be discreetly attached to a belt or headband. $100, 0.1 lb., A/100 hr. LC3.

Ecstasy Machine (TL9)*:* A more powerful device, usually worn in bed. It works the same way as a euphoria machine, and can function at "low power" as one. It can also be set for a level of pleasure so intense the user can do nothing else: this is the Ecstasy incapacitating condition (p. B428). Roll vs. Will-3 each day that the device is used to avoid addiction. An ecstasy machine is $500, 0.5 lbs., 2A/24 hr. LC2.

Neurostimulator (TL9): This is usually a handheld device or implant. It uses direct neural induction to produce the low-power Euphoria irritating condition (p. B428) of the euphoria machine. It does not require a neural interface, but works only as long as it is in contact with bare flesh, plus a second after. The intensity increases to incapacitating ecstasy if applied to erogenous zones.

The neurostimulator takes a few seconds to build up to full intensity. It is ineffective as a weapon, but it can provide a +2 (quality) bonus to both Erotic Art skill and to Interrogation skill with a cooperative or restrained individual. $100, 0.2 lb., A/1 hr. LC3.

Neural disruptors (pp. 121-122) and neurolash (pp. 165-166) weapons are available that deliver an extremely powerful (but transitory) pleasure jolt.

Holoventure (TL10^)

Holotech projection technology (see *Holoprojector*, pp. 52-53) and sophisticated computers permit the creation of realistic adventure-theme parks without the need for virtual reality. For $150/day, gamers can join a party of like-minded individuals for several days of escapism in the setting and genre of their choice.

Special effects, from wizardly lightning bolts to vast battles, are easily accomplished by holotech projections and sonic projections, aided by occasional live actors and remote-control robots. Using sophisticated laser and visual sensors, a Complexity 8+ computer monitors the interaction between the live adventurers and the holograms, and makes them react accordingly. It can even "overlay" holographic images onto a living person.

Holoventure technology is not restricted to recreational use. They are used in military or exploration training exercises, and less sophisticated systems can provide special effects for stage productions.

Psychosonic Instrument (TL11^)

This instrument melds ordinary music with subsonic or psionic waves that alter the listener's moods and emotions. Anyone can use Musical Instrument (Psychosonic) skill to play it; it adds +2 (quality) to skill. A master can influence minds using Musical Influence skill; see p. B210 for its effects.

A psychosonic instrument normally works only on a general family of species (e.g., mammals). Each extra setting adds +50% to cost. It's available in a variety of styles, e.g., psychosonic organ, synthesizer, or guitar. $20,000, 5 lbs., B/10 hr. LC3.

Recreational and Personal Robots

These include specialized recreational robots and general-purpose bodies useful for housing digital intelligences or cyborgs. Even when AI is common, this sort of robot may be popular as a teleoperated puppet.

Android (TL9-12)

111 points

This general-purpose humanoid robot body comes in male, female, and androgynous versions. Custom designs, including those that resemble real people, are also possible. Higher-TL models are cheaper and more reliable.

Attribute Modifiers: ST+3 [30].
Secondary Characteristic Modifiers: HP+7 [14].
Advantages: Absolute Direction [5]; Doesn't Breathe [20]; DR 5 [25]; Machine [25]; Payload 1 [1]; Protected Vision [5]; Radio (Burst, +30%; Secure, +20%) [15].
Perk: Accessories (Personal computer) [1].
Disadvantages: Electrical [-20]; Restricted Diet (Very Common, power cells) [-10].

Lenses

Choose a TL lens, a machine intelligence lens (pp. 27-28), and a biomorphic lens (p. 28) for the robot.

TL9 Model (-5 points): Add Maintenance (one person, weekly) [-5]. $75,000, 150-250 lbs., 2D/8 hr. LC4.
TL10 Model (+11 point): Add HT+1 [10]; Maintenance (one person, bi-weekly) [-3], Reduced Consumption 2 [4]. $50,000, 100-250 lbs., 2D/24 hr. LC4.
TL11 Model (+24 points): Add HT+2 [20]; Maintenance (one person, monthly) [-2] and Reduced Consumption 3 [6]. $30,000, 70-250 lbs., 4D/1 week. LC4.
TL12 Model (+38 points): Add HT+3 [30]; Reduced Consumption 4 [8]. $25,000, 50-250 lbs., 4D/1 month. LC4.

Optional Lenses

Some, none, or all of these options are possible:

Child Body (-30 points): A smaller robot body, the size of a 9- to 12-year-old. Remove the ST bonus. Halve the body weight and number of power cells (e.g., D instead of 2D). -40% to cost.
Artificial Womb (TL10) (+2 points): The android has an artificial flexible womb. If stocked with eggs, it can become pregnant. Add Payload 2 [2]. $10,000. LC3.

Petbot (TL9-12)

71 points

This is a small mechanical beast with a head and four legs. It may look cute or fierce, depending on the market. Typical models resemble small dogs, house cats, miniature dinosaurs, and so on, although they usually have modified paws or claws with opposable thumbs that give them some manipulatory ability.

Robots of this type are often used for home security, keeping track of children, or pest control. They can be equipped with a range of sensors and "natural" weapons.

Attribute Modifiers: ST-3 [-30].
Secondary Characteristic Modifiers: SM-2; HP+1 [2]; Basic Move+5 [25].
Advantages: Absolute Direction (Requires signal, -20%) [4]; Doesn't Breathe [20]; Discriminatory Smell [15]; DR 5 (Cannot Wear Armor, -40%) [15]; Extra Legs (4 legs) [5]; Infravision [10]; Machine [25]; Radio (Secure, +20%) [12]; Sharp Claws [5]; Sharp Teeth [1]; Ultrahearing [5].
Perks: Accessories (Small computer; fire extinguisher) [2].
Disadvantages: Bad Grip 1 [-5]; Electrical [-20]; Horizontal [-10]; Restricted Diet (Very Common, power cells) [-10].

Lenses

Select one of the TL options. Also select a machine intelligence lens (pp. 27-28) and a biomorphic lens (p. 28).

TL9 Model (-5 points): Add Maintenance (one person, weekly) [-5]. $15,000, 20-50 lbs., 2C/8 hr. LC4.
TL10 Model (+1 point): Add Maintenance (one person, bi-weekly) [-3], Reduced Consumption 2 [4]. $10,000, 20-50 lbs., 3C/24 hr. LC4.
TL11 Model (+4 points): Add Maintenance (one person, monthly) [-2] and Reduced Consumption 3 [6]. $7,000, 20-50 lbs., D/1 week. LC4.
TL12 Model (+8 points): Add Reduced Consumption 4 [8]. $5,000, 20-50 lbs., D/1 month. LC4.

Recreational Swarms (TL10)

These are microbot or nanobot types. See *Swarmbots* (pp. 35-37).

Massage Swarm (TL10)

These swarmbots are similar to a cleaning swarm (pp. 69-70), but they are equipped and programmed to deliver relaxing or erotic tactile sensations to their subject. They use Professional Skill (Massage)-10 and Erotic Art-10, (+1 per TL after introduction), or provide a +TL/2 (quality) bonus to someone directing them. $200/square yard. LC4.

Play Swarm (TL10)

These swarmbots are equipped to play and interact with one another in an amusing fashion. For example, a "farm in a box" might contain 'bots that look and act like tiny animals, agricultural robots, human farmers, and so on. $200/square yard. LC4.

Chapter Three

Communications, Sensors, and Media

The Galactic Operations Directorate's elite agents were only assigned to max-priority missions. Rafe was on Sargon, trying to abort a nuclear war. Gabby was going after the Yezendi antimatter syndicate. And me? My orders came via ultra-secure causality comm – on a channel that came not from Colonel Erasmus, but from the Emperor himself. The mission: find his wayward teenage daughter, Princess Kalindy, who had once again given her Imperial Household minders the slip.

The Household hadn't been able to trace her bioscan, but they were always too high-tech. I went low-tech, visited her room, and used a chemsniffer to key on her latest programmable perfume, a unique fragrance she'd designed herself.

Two hours later, I finally tracked her down, dancing up a storm at the Radium City holoventure club. She spotted me and waved.

"How'd I do?"

I kissed her. She was wearing memswear sandals, a translucent firefly swarmwear dress, and nothing else . . . except the holodistort belt she'd borrowed from me, which subtly disguised her face and sensor-signature. With the hyperspectral video glasses and terahertz scanners the paparazzi were using these days, I figured you couldn't be too careful. After all, I'd schooled Kalindy in counter-evasion myself. Among other things.

– Special Agent Michael, Imperial Secret Service

This chapter describes communicators, information-recording, entertainment and sensor technology, as well as a variety of personal gear.

Communication and Interface

Secure and reliable communications are the key to any venture – business, military or personal – at any TL.

Cable Jack (TL9)

This basic communications system is simply a plug for a fiber-optic optical cable. These are the backbone of many planetary communication networks at TL9+. Optical cable provides a high-bandwidth data link for computers and other electronic gadgets, transferring 1 TB per second.

Cable Jack (TL9): A socket and cable for plugging into other cable jack-equipped gadgets or into a building's network. It can be added to any gadget with greater than negligible weight. $5, negligible weight.

Optical Cable (TL9): Fiber-optic cable costs $0.10 and weighs 0.01 pounds per yard. It comes in various lengths. Use Electronics Repair (Communications) skill to lay or install datacable networks.

See also *Networks* (pp. 49-50).

COMMUNICATORS

Communicators send and receive voice transmissions. If connected to a terminal (pp. 23-24) or a computer, they can exchange text, video, or data.

Most communicators only send and receive to others of the same type (e.g., radio to radio) or to individuals with an appropriate Telecommunication advantage (see p. B91), except as described under *Plug-In Gadgets* (pp. 15-16). There are a few exceptions: laser retinal imaging (p. 44) and neural communicators (p. 46) can beam signals to anyone.

All communicators use Electronics Operation (Comm) skill (p. B189) to operate and Electronics Repair (Comm) skill (p. B190) for servicing and repairs. No roll is required for operation under normal circumstances (unless the user is unskilled).

Communicators are either broadcast or directional. Broadcast (omnidirectional) signals can be picked up by every communicator tuned to the same frequency within range. Directional signals are beamed toward a particular target, and unless noted, are limited by line of sight; terrain and the curve of the horizon block the beam. To overcome line-of-sight restrictions, relay stations may be used. If the communicator has enough range (usually a few hundred miles), the relays may be orbital satellites.

Communicator ranges are given in yards or miles. Interplanetary comm ranges are measured in astronomical units (AU), which are multiples of the average distance from Earth to the Sun (93 million miles). Interstellar ranges are in parsecs (3.26 light years, 206,000 AU, or 19.2 trillion miles).

Comm signals can propagate beyond the listed "effective" range, but these are more difficult to pick up. To extend range, the operator may make an Electronics Operation (Communications) roll at -1 per 10% added to range, to a maximum extension of 100%.

Communicator signals usually travel at the speed of light (186,000 miles per second). This is effectively instantaneous for planetary communications, but across space, the time lag between sending a message and receiving a reply may be significant. A light-speed message crosses one AU in approximately 500 seconds.

When transmitting large files, the data transfer rate of a communicator is important. Data transfer rates are specified for different communication systems. Repeating the same data several times takes longer, lowering the effective data transfer rate ("bandwidth"), but gives a significant boost to range: 1/4 speed doubles the range; 1/100 speed multiplies the range by 10, and 1/10,000 speed multiplies the range by 100. This technique is commonly used for deep-space transmissions.

All ultra-tech communicators (except neurocomms) are routinely equipped with encryption systems; see *Encryption* (pp. 46-47).

Standard Comm Sizes

Communicators are available in standard sizes:

Micro: These "comm dots" are too small for humans to use directly, but they're built into many electronic devices that share data with each other. The short range makes detection unlikely. Not all comms have a micro-sized version.

Tiny: This button-sized communicator may be wrist-mounted (with a video display), worn as a voice-activated badge or ear piece, or built into many other devices such as helmets.

Small: Available as a palm-sized handset, or built into powered armor helmets or vehicles. It has a small video display.

Medium: This hefty communicator is usually worn on a shoulder strap or backpack, or built into vehicles. It has a video display.

Large: A vehicle-mounted unit, often with a sizable antenna.

Very Large: A room-sized installation, often with a large antenna, used for dedicated communications relay stations or spacecraft.

Communicators with Different Ranges

The relative size of a comm – micro, tiny, small, medium, large, or very large – determines its range. Not all comms come in all sizes. The listed range for a given size assumes that both transmitter and receiver are that size. If they differ, use the range given for the smaller comm modified for the size of the larger ones as follows:

Size Difference	*Modified Range*
One size greater	3× shorter range
Two sizes greater	10× shorter range
Three sizes greater	30 × shorter range
Four sizes greater	100 × shorter range
etc.	etc.

Example: We want to see whether a medium radio (with a 100-mile range) can be picked up by a tiny radio (one-mile range). We use the shorter of the two ranges (one mile) × 10 (medium radio is two sizes greater) = a 10-mile range. As long as both radios are within 10 miles of each other, they can talk without a skill roll being required to extend range.

IR Communicators (TL9)

An "IR comm" is an infrared directional communicator similar to a TV remote. Its beam scatters somewhat and can bounce off solid objects. Make an Electronics Operation (Communications) roll to take advantage of this (e.g., trying to communicate round a corner by bouncing a signal off a wall). Roll vs. Electronics Operation (EW) to eavesdrop on another IR communicator's beam if you within a few degrees of the beam path. The data transfer rate is 10 GB/minute.

The beam is invisible, but infrared or hyperspectral vision can see it at up to double its range if it is aimed directly at the observer, or in dust or fog.

Large (TL9): 25-mile range. $2,000, 50 lbs., 2D/10 hr. LC3.

Medium (TL9): 2.5-mile range. $500, 5 lbs., 2C/10 hr. LC4.

Small (TL9): 500-yard range. $100, 0.5 lbs., 2B/10 hr. LC4.

Tiny (TL9): 50-yard range. $20, 0.05 lbs., 2A/10 hr. LC4.

Micro (TL9): 5-yard range. $5, neg., AA/100 hr. LC4.

Ranges are doubled at TL10, multiplied by 5 at TL11, and multiplied by 10 at TL12.

Laser Communicators (TL9)

"Laser comms" use a modulated multi-frequency laser beam to transmit a highly-directional signal. The narrow beam and line-of-sight requirement makes it hard to eavesdrop on a laser comm signal; someone must be in the direct path of the beam to intercept it. The beam is invisible and eye-safe, and tunes itself automatically to penetrate snow, fog, etc. Laser comms may be tuned to use blue-green frequencies to reach underwater. The signal range is 1% of normal underwater, with a maximum range of 200 yards.

Due to their range and directionality, laser comms are favored by soldiers and adventurers for secure line of sight communication. All incorporate gyrostabilized tracking systems to help maintain communications. They're also often installed on building rooftops or pylons for secure comm links; such "free space optics" can be a cheaper solution than stringing fiber optics. The data transfer rate is 1 TB per minute.

Very Large (TL9): 50,000-mile range. $40,000, 400 lbs., external power. LC3.

Large (TL9): 5,000-mile range. $10,000, 50 lbs., 2D/10 hr. LC3.

Medium (TL9): 500-mile range. $2,000, 5 lbs., 2C/10 hr. LC4.

Small (TL9): 50-mile range. $400, 0.5 lbs., 2B/10 hr. LC4.

Tiny (TL9): 5-mile range. $100, 0.05 lbs., 2A/10 hr. LC4.

Micro (TL9): 1,000-yard range, but usually broadcasts at lower output with a range of five to 10 yards. $20, neg., AA/100 hr. LC4.

Ranges are doubled at TL10, multiplied by 5 at TL11, and multiplied by 10 at TL12.

Laser-Retinal Imaging (TL9)

Any laser communicator with this hardware upgrade may beam graphics or text files directly into the retina of a single eye. It's tricky to aim; treat as a ranged-weapon attack aimed at the eye (-9 to hit), but assume the laser has Acc 12, or Acc 18 if mounted on a tripod or vehicle. Roll Electronics Operation (Communications) to hit. If the subject is standing still or walking slowly, the laser can continue to track once a hit is achieved (i.e., no further rolls are required).

The subject doesn't need a communicator to receive a signal, making this a good way to send covert messages over a few miles. However, he can interrupt a retina message by closing his eyes or turning his head. Glare-resistant optics will also filter out a message.

Another disadvantage is that the laser can only send images. It can flicker several hundred images per second, but most subjects would only see a blur at that speed – the subject's comprehension limits the data-transfer rate. Sending text limits the transmission to the subject's reading speed (which the sender must estimate!). Since the transmission is one-way, the sender may have no idea whether the subject read the information.

Fitting a laser comm with the computer chips for laser-retinal imaging costs $1,000, but adds no weight. LC3.

Radio Communicators (TL9)

These broadcast communicators use radio waves. All incorporate spread-spectrum technology in which communications clarity and reliability is improved by spreading the signal over a range of frequencies. The frequency hopping also keeps the transmitter from being "bright" in any given frequency, making it very hard to detect.

Radio range may drop by a factor of 10 in urban environments or underground. The data transfer rate is 0.1 GB per minute, but range drops significantly (divide by 10) when transmitting real-time audio-visual signals.

Very Large (TL9): 10,000-mile range. $20,000, 400 lbs., external power. LC3.

Large (TL9): 1,000-mile range. $4,000, 50 lbs., 2D/10 hr. LC3.

Medium (TL9): 100-mile range. $1,000, 5 lbs., 2C/10 hr. LC3.

Small (TL9): 10-mile range. $200, 0.5 lbs., 2B/10 hr. LC4.

Tiny (TL9): 1-mile range. $50, 0.05 lbs., 2A/10 hr. LC4.

Micro (TL9): 200-yard range, but usually broadcasts at lower output with a range of one to two yards. $10, neg., AA/100 hr. LC4.

Ranges are doubled at TL10, multiplied by 5 at TL11, and multiplied by 10 at TL12.

Sonar Communicator (TL9)

This uses a modulated sound beam for broadcast communication. It travels at the speed of sound: almost a mile per second underwater or 0.2 miles per second in air (at sea level). A sonar comm is designed for underwater operation, but ultra-tech models are also tunable to operate in air – if one is so used, it has 1% of the listed range multiplied by the air pressure in atmospheres. Sonar communicators do not work in vacuum. The data transfer rate is very slow: 0.1 MB/minute.

Its signals can be detected (but not understood!) at twice the comm range by passive sonars, or by anyone with Ultrahearing or Vibration Sense advantages. The only way to *jam* the signal is with powerful, specialized sonar jammers (p. 99) – but underwater explosions cause transient interference.

Large (TL9): 300-mile range. $5,000, 50 lbs., 2D/10 hr. LC3.

Medium (TL9): 30-mile range. $1,000, 5 lbs., 2C/10 hr. LC3.

Small (TL9): 3-mile range. $200, 0.5 lbs., 2B/10 hr. LC4.

Tiny (TL9): 600-yard range. $40, 0.05 lbs., 2A/10 hr. LC4.

Micro (TL9): 60-yard range. $10, neg., AA/100 hr. LC4.

Ranges are multiplied by 1.5 at TL10, doubled at TL11, and multiplied by 3 at TL12.

Sonic Communicator (TL9)

A sonic projector (p. 52) can be used to beam voice or audio signals.

Gravity-Ripple Communicators (TL10^/11^)

These communicators use gravity waves generated by artificial gravity technology. The signal is omnidirectional; eavesdroppers must roll against Electronics Operation (EW) to listen in.

Gravity waves reach underwater and penetrate solid objects at no penalty. Intense gravity sources such as neutron stars, pulsars, and black holes can disrupt the signal. Only very large comms are available at TL10^, with all other sizes appearing at TL11^. The data transfer rate is 1 GB/minute.

Very Large (TL10/11^): 100,000-mile range at TL10, or 1,000,000 miles at TL11^. $200,000, 400 lbs., external power. LC3.

Large (TL11^): 100,000-mile range. $50,000, 50 lbs., 2D/10 hr. LC3.

Medium (TL11^): 10,000-mile range. $10,000, 5 lbs., 2C/10 hr. LC4.

Small (TL11^): 1,000-mile range. $1,000, 0.5 lbs., 2B/10 hr. LC4.

Tiny (TL11^): 100-mile range. $200, 0.05 lbs., 2A/10 hr. LC4.

Micro (TL11^): 10-mile range. $50, neg., AA/100 hr. LC4.

Ranges double at TL12.

Neutrino Communicators (TL10^/11^)

This directional communicator uses a modulated beam of neutrinos (or anti-neutrinos). It is nearly *impossible* to jam or intercept, and functions in *any* environment – it can reach underwater or penetrate solid objects at no penalty, and isn't blocked by the horizon.

Neutrino transmission uses specialized particle accelerators; at TL11, these are fairly compact. However, at non-superscience TLs, neutrino *detection* requires massive installations. At TL8, a typical detector contains several hundred thousand gallons of industrial cleaning liquid and is buried nearly a mile underground. Using superscience, much more compact receivers are available, using force fields or hyperdense matter.

The data transfer rate is 1 TB/minute. Only very large comms are available at TL10^, with all sizes (except micro) at TL11^.

Very Large (TL10^/11^): 100,000-mile range at TL10, or 1,000,000 miles at TL11^. $500,000, 400 lbs., external power. LC3.

Large (TL11^): 100,000-mile range. $100,000, 50 lbs., 2D/10 hr. LC3.

Medium (TL11^): 10,000-mile range. $20,000, 5 lbs., 2C/10 hr. LC4.

Small (TL11^): 1,000-mile range. $5,000, 0.5 lbs., 2B/10 hr. LC4.

Tiny (TL11^): 100-mile range. $1,000, 0.05 lbs., 2A/10 hr. LC4.

Ranges double at TL12.

Causality Communicators (TL10^)

This *instant* FTL comm uses superscience analogous to the principle of quantum entanglement. Sets of identical particles are created, trapped, then separated. Despite this, they remain connected on a quantum level, so that when data is encoded in one particle, its counterpart(s) instantaneously change in the same way, regardless of separating distance. Thus, information can be transmitted and received, even though no actual signal exists to be jammed or monitored. The particles (and their identical counterparts) are used up as data is encoded in them.

Causality comms are rated for their message capacity, which is the maximum bytes of potential data that can be exchanged before the entangled particles are used up. The same amount of data is used whether transmitting or receiving. Suppose commlink A and B share 10 entangled gigabytes. After commlink A sends a 2 GB message and commlink B sends an 8 GB reply, they have exhausted their message capacity.

There are two components to this system:

Causality Comm: A device for reading, storing, and manipulating entangled particles, used in conjunction with any computer terminal. $1,000, 0.1 lb. per GB of storage capability (minimum 1 GB). To be useful, it must be charged with a set of entangled message particles whose counterparts are stored elsewhere. LC3.

Entangled Message Particles: These cost $10,000 per GB *or fraction* of message capacity times the membership of the set (i.e., double the cost for a pair of entangled particles, multiply by 3 for a triplet, etc.). At the GM's option, faster-than-light travel may disrupt the entanglement and break the link.

For both components, replace GB with TB at TL11^ and petabytes (PB) at TL12^.

Postage Costs

Interstellar "post offices" may have their own causality communicators and message particles. The cost of sending a message will be based on how expensive or time-consuming it is to replace them. If entangled message particles must be shipped at slower-than-light velocities across hundreds of parsecs, then the cost of sending an "instant letter" may be enormous!

FTL Radios (TL11^-12^)

This is a faster-than-light broadcast communication system; perhaps it transmits signals through subspace or hyperspace. The signal usually travels at high but not infinite velocities. A typical comm speed is 0.1 parsec/hour, which allows real-time communication within a solar system (5.7 AU/second), but may take days or even months to cross interstellar distances. Communication speed may be faster, slower, or even instantaneous.

The data transfer rate is 1 TB/minute. In some settings, the curvature of space may prevent FTL radios from operating within 100 diameters of a planet or star. Only very large systems are available at TL11^; at TL12^, smaller sizes are available. The medium, small, and tiny comms are "local FTL" systems useful for transmissions in or near a solar system.

Very Large (TL11^/12^): 2-parsec range at TL11^, 10 parsecs at TL12^. $4,000,000, 400 lbs., external power. LC3.

Large (TL12^): 1-parsec range. $1,000,000, 50 lbs., 2D/10 hr. LC3.

Medium (TL12^): 0.1-parsec range. $200,000, 5 lbs., 2C/10 hr. LC4.

Small (TL12^): 0.01-parsec (2,000 AU) range. $40,000, 0.5 lbs., 2B/10 hr. LC4.

Tiny (TL12^): 0.001-parsec (200 AU) range. $10,000, 0.05 lbs., 2A/10 hr. LC4.

FTL radios require cosmic power cells or external power.

Black Hole Communicator (TL12)

This uses an electrically-charged quantum black hole manipulated by (enormously strong) magnetic fields, which cause it to vibrate in place. It functions like a gravity ripple comm (p. 45), but does not require superscience.

Its signals travel at light speed, but can be detected clearly over long distances (base range is 1 parsec) by a gravity communicator or a gravity scanner. It is powered by the black hole, and can also provide the same energy of a fusion generator. $2,000,000, 2,000 lbs. LC1.

Neural Communicator ("Neurocomm") (TL12^)

A refinement of neural disruptor technology, this device beams precise electromagnetic signals directly into another person's brain. This is essentially mechanical telepathy, but the signal travels at light speed.

A neurocomm transmits only: no receiver is needed. Any sentient living brain with IQ 1+ can receive neural comm signals, including total cyborgs. Plants, bacteria, digital intelligences, and entities with less than IQ 1 cannot receive neurocomm signals.

Humans and similar races perceive neurocomm signals as "voices in the head," at the volume of a loud whisper. Other races may perceive them as analogs to their primary communication sense (sound, smell, or whatever).

A neurocomm does not translate its transmissions. Signals sent in another language, or to a non-sapient race, will be unintelligible noise. However, a neurocomm connected to a computer running a translation program can translate signals before transmission. Unintelligible neurocomm signals are as annoying as someone constantly whispering gibberish into your ear.

A neurocomm comes with a built-in neural input (p. 48) pad. Effects similar to a neurocomm can be achieved via two individuals with direct neural interfaces (pp. 48-49), each controlling a high-bandwidth communicator.

Neurocomms can transfer data only to individuals who have neural interfaces connected to computers or data storage systems. The transfer rate is 0.1 GB/minute.

Large (TL12^): 10-mile range. $100,000, 50 lbs., 2D/10 hr. LC2.

Medium (TL12^): 1-mile range. $40,000, 5 lbs., 2C/10 hr. LC2.

Small (TL12^): 200-yard range. $10,000, 0.5 lbs., 2B/10 hr. LC3.

Tiny (TL12^): 20-yard range. $2,000, 0.05 lbs., 2A/10 hr. LC3.

For an upgraded version, see *Mental Translator* (p. 48).

Receive-Only or Transmit-Only Comms

Most communicators are available as cheaper, lighter, receive-only or transmit-only designs. (Sonic, black hole, and causality comms are not.)

Receiver: This is 20% of a two-way comm's weight and 10% its cost. Its power cell is one size smaller, so a C cell would be replaced by a B cell. A micro comm would operate 10 times as long on its AA cell.

Transmitter: This is 80% of a two-way comm's weight and 90% of its cost.

Exception: For gravity-ripple, neutrino, and FTL comms, the receiver and transmitter are each 50% of weight and cost; each has half as many cells.

ENCRYPTION

Secure data transmission is vital in a modern society. Messages, electronic mail, and signals may be routinely encrypted to ensure their security.

Encryption Systems (TL9)

Encryption systems use mathematical formulas ("keys") to conceal (encrypt) a signal into seemingly-random

gibberish. If the recipient has the key, his system will decrypt the message, transforming it back to meaningful information.

The most common encryption systems are "public-key" systems. The encryption key is publicly distributed, and can used by anyone to encrypt a message sent to its owner. The only way to decrypt that message is with a private decryption key, which is securely stored in the owner's computer or communicator. Cracking public keys involves factoring *very* large numbers and thus very capable computers; successful use of Cryptography skill represents the use of various hacks and short-cuts.

Ordinary encryption systems use mathematical keys based on pseudo-random numbers. They are rated for the Complexity of computer that will take a hour per attempt to crack them. They come in two levels, basic and secure.

Basic Encryption (TL9): This is defined as whatever encryption standard is complex enough to be reasonably secure, but not so complex that it slows down operations by taking up excessive bandwidth or computer processing time. A Complexity 8 computer may attempt to break this encryption once per hour. Raise required Complexity by 2 (TL10), 3 (TL11), or 4 (TL12). This standard is adequate for business transactions and personal privacy. It can be built into all TL9+ communicators and computers at no extra cost, although some societies may restrict encryption to the government. LC4.

Secure Encryption (TL9): A more complicated system, often used to secure classified government or military information. There may be a delay of one or two seconds as messages are sent or data is processed. This standard is often subject to legal restrictions. Breaking it in an hour requires a Complexity 10 computer. Raise required Complexity by 2 (TL10), 3 (TL11), or 4 (TL12). A secure encryption chip for a computer or comm is $500; neg. weight. The chip also lets the system generate or encrypt one-time pads (below). LC2.

Cryptography skill is used to crack encryption systems. Rather than the modifiers on p. B186 (which are for manually-devised *codes* rather than mathematical ciphers), apply modifiers for the quality of the decryption program (p. 23) and for the time spent (p. B346) relative to the base time (see above).

The encryption standard specifies the Complexity of computer required to make an hourly attempt at decrypting it. A higher-Complexity computer reduces the time by a factor of 10 per +1 level over it (six minutes for +1, 36 seconds for +2, three seconds for +3, or in real time as the message arrives for +4 or more). Using a computer of lower Complexity multiplies the time by 10 for each -1 Complexity (10 hours, 100 hours, 1,000 hours, etc.).

Decryption Program (TL9): Contains a database of hacks and shortcuts. Gives a +1 (quality) bonus to Cryptography skill. Complexity 2, $500. LC3.

Quantum Computers (TL9): A quantum computer (p. 23) adds +5 to its Complexity for the purpose of decryption. Also, if the quantum computer is of lower Complexity than the encryption, each -1 under triples the time required (3 hours, 10 hours, 30 hours, etc.) rather than causing a 10-fold increase.

One-Time Pads

There is one way to ensure that an encrypted message is not broken: the "one-time pad" system. The message is encrypted using a completely random key that is only used *once*. Unlike public-key encryption, the encryption and decryption keys are the same. Thus, both the sender and recipient must already have the key.

To use one-time pads, one or more of them are generated and passed to the parties who wish to use them to communicate (e.g., before sending a spy on a mission). That way, the only signal that need be sent is something like "use pad #231."

One-time pads are only for data transmission. The key must be at least as long as the message it encodes (i.e., it takes up as much bandwidth). Secure encryption systems have hardware-based random number generators that use electrical or atmospheric noise or nuclear particle decay to generate the true random numbers suitable for one-time pads.

The other disadvantage of one-time pads is that safe delivery often requires a physical courier or advance arrangement – transmitting them as public key-encrypted messages risks someone decrypting them, which defeats the entire point. Delivery and retrieval of disks containing a one-time pad are an opportunity for adventure. However, a faster alternative is to use quantum communications to transmit a one-time pad key, since any eavesdropper on a quantum channel would be detected.

Quantum Communications (TL9)

In quantum theory, certain pairs of physical properties are complementary, in that measuring one property necessarily disturbs the other. By using quantum phenomena to carry information, a communication system can be designed which always detects eavesdropping.

A laser communicator, neutrino comm, or optical cable can have a quantum channel option. Laser or neutrino comm range is 10% of normal when using it. If both sender and receiver use quantum channels, the result is highly secure: If anything intercepts the signal, the users are alerted instantly. Multiply the cost of a laser or neutrino comm with a quantum channel by 10; multiply the cost of optical fiber systems by 100. LC3.

TRANSLATORS

Fast, accurate language translation is important in any multilingual society, and may be vital if many different alien races co-exist. Advanced computers and artificial intelligence can put a skilled translator in everybody's pocket.

Translator Program (TL9)

This computer program translates conversation from one language into another in real time. It can be used with any computer with an appropriate interface. Spoken languages require a microphone or speaker, whether built-in or provided by a linked communicator. Some users speak

into their communicators (or use a neural interface) and let the computer's speaker talk for them.

Each translation (e.g., English-Portuguese) is a separate program. The program's level of comprehension can never exceed the input; a native-level English-to-Portuguese program will translate broken English into broken Portuguese.

Broken (TL9): This translates speech at the Broken comprehension level (p. B24). Each language requires at least a 10GB database. Complexity 3.

Accented (TL9): This translates speech at the Accented comprehension level (p. B24). Each language requires at least a 30GB database. Complexity 4.

Native (TL9): This translates speech at the Native comprehension level (p. B24). Each language requires at least a 100GB database. Complexity 5.

Reduce program Complexity by 1 if either language is an artificial construct (e.g., Esperanto) designed for ease of learning and/or translation. If this is the case for both languages, the modifier is cumulative.

Increase Complexity by 1 if translating languages between different species, unless both think in a very similar fashion (e.g., elves and humans). Complexity also increases by 1 if the system translates from one sense to another, such as sign language to a spoken language, or between different frequencies (from ultrasonic signals to a human voice). Appropriate input and output sensors will also be needed.

Use the normal cost of software for common language combinations such as English-Japanese. Unusual combinations such as Finnish-Korean are double cost. Obscure combinations (e.g., Icelandic-Maori) are 5 times normal cost, or unavailable. If your computer' complexity permits, you *can* run two common combinations in series (e.g., Icelandic-English followed by English-Maori) to simulate an obscure one cheaply. However, compounded errors give a final comprehension level one grade below that of the least-capable program, while the extra step introduces a one-second delay that can be deadly in tactical situations! What is "obscure" or "common" will vary by time and place.

Universal Translator Program (TL11)

This dedicated AI program can analyze and translate entirely new languages with as little as an hour of exposure, provided that it has access to someone who is actually attempting to teach it, or it can listen in on multiple varied conversations such as the ones on media channels.

After an hour, it reaches Broken comprehension. After six hours, it reaches Accented comprehension. After a day, it reaches Native comprehension. Its comprehension cannot exceed that of the speakers it is observing.

Non-verbal languages can be handled if appropriate sensors and "speakers" are available; cost varies widely. Complexity 9. LC4.

Mental Translator (TL12^)

This psychotronic upgrade to the neural communicator (p. 46) translates the user's language into a "universal" signal that *any* IQ 1+ species can understand. Nonsapient animals (IQ 1-5) will be limited to simple concepts. A mental translator costs 10 times as much as a neural communicator.

Neural Interfaces

Neural interfaces capture and amplify nerve impulses and/or muscle movements, translating them into digital commands for an electronic device or a computer interface. Neural interfaces let a person move a computer cursor just by thinking about it, or fire an interface-equipped gun without having to pull a trigger. A neural interface also permits commands to be entered "with the speed of thought" . . . which is often not much faster than speech.

There are three categories of neural interface: cybernetics (discussed at length in Chapter 8), neural input receivers, and direct neural interfaces. All require some training before they can be effectively used. The interface software must be taught to recognize the user's brain or muscle patterns. Apply familiarity penalties when switching from a normal device to a neural-interface controlled device – or vice versa.

Neural Input Receiver (TL9)

These systems pick up neural signals indirectly from the user's muscle movement, eye/facial movement, or brain waves. They pick up basic commands (equivalent to a few menu options), but cannot transmit sensory feedback back to the user. They're built into wearable devices such as goggles or contact lenses for hands-free operation, usually in concert with a physical HUD display.

Neural Input Headset (TL9): Picks up brain waves. It can replace a computer mouse or equivalent device. $50, 0.1 lb. A/100 hr. LC4.

Neural Input Pad (TL11): Senses neural impulses when touched. It is used in elevators, doors, smart guns, and other gadgets with simple controls. $50, neg. weight. LC4.

Direct Neural Interface (TL9-11)

Usually referred to as a "neural interface," this sophisticated device allows the user's brain to communicate with computers and control complex equipment. It can do anything that a neural input device can do, and much more.

The interaction is two-way: data displays, physical feedback, and other sensory information can be transmitted directly into the user's brain. There is no need for a user to touch controls or see physical data displays. He can have the equivalent of a HUD (p. 24) overlaid on his visual field, so he can "live" in augmented reality (pp. 56-57). A direct neural interface is required for certain technologies, such dream teachers (p. 59), sensies (pp. 157-158), and total virtual reality (p. 54).

When using a neural interface, the user is opening up his nervous system and brain to intrusion – or even being hacked. Like any networked computer, the user's safety depends on his encryption systems, the products he uses, and those associates or superiors to whom he grants access.

There are several versions of direct neural interface available. At TL9, all require implants. At higher TLs, less invasive interfaces are possible.

Neural Interface Implant (TL9): This involves implanting sensitive electrodes in the brain along with an implanted communicator. See *Direct Neural Interface Implant* (pp. 216-217) in the *Cybernetics* section.

Neural Interface Helmet (TL10): This "crown of thorns" helmet invades the skull with tiny nanowires. They inflict no damage, but users may find the idea disturbing! The helmet takes four seconds to don or remove; yanking it off before disconnecting causes 1d injury. It includes a cable jack (p. 42) and radio micro communicator (p. 44). $10,000, 2 lbs., C/100 hr. LC3.

Neural Induction Helmet (TL10^): The same system, but a non-invasive neural induction process "writes" data to the brain. $5,000, 2 lbs., B/100 hr. LC3.

Neural Induction Pad (TL11^): A tiny version of the helmet above, worn as a hair ornament or built into a device. $500, neg. weight. LC4.

Neural Induction Field (TL11^): This works like a neural induction helmet, except that it covers an area. Anyone entering the field is connected to the systems it controls. A chair-sized field is $50,000, 25 lbs. Larger fields are $200,000 and 100 lbs. plus $10,000, 100 lbs., per square yard the field covers; they're usually built into a floor. LC2.

Brainlocks (TL9)

Any neural input device or neural interface may include a brainlock. This is an interface programmed to only accept a user who has a specific brainwave pattern. The "user list" can be hard-wired into the system (making it impossible to change); otherwise, any interfaced user can use a password to alter the lock's parameters.

If attached gadgets have multiple functions, only some might be brainlocked. An elevator operated by induction pad may allow anyone to travel between the first and ninth floors, while restricting access to the executive suite. A brainlock can also grant partial access to computerized records or other data, based on Security Clearance or other criteria. A brainlock has no extra cost. LC4.

Networks

These consist of numerous "nodes" –computers and communications systems connected on a permanent or semi-permanent basis. They can range from local intranets linking a handful of individuals to galactic information webs.

Ultra-tech networks generally combine message relay and data access functions, allowing people to store and find information on the network as well as using it to transmit and receive data.

Data networks usually store and retransmit a variety of information (news, knowledge, personal mail, discussion groups, etc.), using either decentralized or centralized computers and data storage systems.

Some groups may set up their own private networks, but larger networks run by telecom companies or the government usually exist. Subscription costs are infinitely variable; those given below are only suggestions.

Planetary Network (TL9)

Most civilized ultra-tech worlds have networks that cover the entire planet. In some societies, a planetary network may be composed of multiple decentralized networks, like the Internet. Others may be business or state monopolies. In theory, the latter makes access easier, since everyone uses the same software with the same provider. In practice, it gives the owner immense control over information distribution. With enough computer power, a state could theoretically monitor the on-line actions of every user and censor any communication it doesn't want on the net.

A planetary network consists of a high-bandwidth communications backbone (often using optical cables), an infrastructure of repeater stations, communication satellites and other relays, supporting databanks and software, and the people or machines that maintain it. A subscription to a service provider is usually included in cost of living as part of the utility bill, or provided by the government. If paid for separately, it might cost $10-60/month.

All subscribers with compatible communication gear may call or send messages to anyone on the network at no extra cost. Accounts include voice and e-mail addresses, where the user can be reached or have messages left for him. Messages to people *outside* the network may or may not be available; if so, it usually costs extra (e.g., $0.10-$1/minute). The definition of "outside" can include rival planetary networks (if any exist), spacecraft or stations, or other worlds.

Messaging over interplanetary distances will suffer from light speed lag (limiting the user to recorded messages or email) unless using faster-than-light comms. Interstellar comm linkages may or may not be available, and the fees are likely to be orders of magnitude higher!

Storage of data on the provider's system is usually included. Storing lots of information (backed-up mail, personal virtual realities, etc.) in a provider's system costs extra, e.g., $1 per terabyte per month at TL9. Storage space expands by a factor of 1,000 for each higher TL.

A subscriber's account lets him access whatever is publicly available on the network – news channels, entertainment, commercial sites, library search engines, virtual reality parks, etc. Some networks may be as loose as the current Internet; others may be tightly regulated by businesses or states. Net providers or other users may charge extra for various services, such as downloading some types of information, accessing virtual-reality simulations or sensies, or special high-speed service.

Cable Connection

Most users connect to a planetary network through a cable box hooked into an optical cable land line between the building and the service provider. A typical cable box has radio, laser, and infrared micro communicators; it can connect to computers, terminals, entertainment consoles, phones, and other hardware. The data transfer rate is one terabyte/second. Most landlords and network service providers provide cable boxes; if purchased, a box is $100, 0.2 lbs., external power. LC4.

Mobile Access and Cellular Communicators

Subscribers using compatible communicators can route calls through a planetary network regardless of distance, provided they're in range of a local repeater station. Repeaters are found in most areas, except for trackless wilderness, ocean, the territories of isolationist regimes, and areas where the infrastructure is down due to disaster, war, or deliberate jamming.

In places where there are no working repeater stations, network access is usually available via satellite connection. The user's comm needs at least a 10-mile range (sonic or sonar comms are useless). Long distance charges may apply.

Compatible communicators vary depending on the service provider and the TL. Most TL9 cellular networks are based on radio or laser systems, but others (except neural or sonic) are possible. There may be an extra fee of $10/month for each mobile comm address the user has.

Cellular Communicator (TL9): A comm that can *only* access a planetary data network is available at half the normal cost. Usually it's a tiny or small radio, but it could be anything except a neural communicator.

Operating a Service Provider

A planetary network provider requires computer systems on which the data and user-access programs operate, as well as the enough bandwidth to handle the number of users. If the service provider is also the telecommunication company, it has to worry about maintaining the communication channels and setting up new ones if they become overloaded.

Rental costs for lines capable of high-speed access to a global network depend on the state and sophistication of the net. Continuing costs may vary from $5 to 30 per line per month. If the number of regular users is more than 20 times the number of lines, the system is likely to become clogged.

Data Security and Data Havens

In most societies with CR2+, network service providers are required to turn over information on their users' activities to the authorities. Data havens operate illegally, or in regions whose governments have promised not to monitor data flow, or where there are no governments. They charge 10 to 1,000 times as much as mundane providers, but promise not to provide information to others. Some can be trusted. All may be prime targets for spies and hackers . . . and one scandal can destroy a data haven's reputation.

Mail and Freight

Many things can be done through networks and communicators, but sometimes a package has to be delivered in person. The possibilities depend on the available vehicle technology and the population density. Some examples:

Suborbital Express Mail (TL9)

Need to get something from New York to Tokyo in less than an hour? Hypersonic aircraft and spaceplanes may offer high-priority suborbital courier service at 10 times the speed of sound. Typical price: $100 per pound.

Homing Couriers (TL10)

Why wait at home for a courier when you can provide your GPS coordinates to a football-sized messenger robot who flies to you? A homing courier could even deliver a package to a moving vehicle, which is very useful if you've just run out of ammunition during a car chase. Typical prices: $50 per pound for same-day delivery, $500 per pound for same-hour, or $5,000/lb. for a super-rapid delivery arriving within several minutes.

Matter Transmission (TL11^)

If matter transmission technology (pp. 233-235) is cheap enough, everyone's personal mailbox may be a matter transmitter. Courier firms may also operate matter transport systems.

Media and Education

As communications and computers get better at processing information, technology finds better ways to store, present, and disseminate it. This section covers devices for recording, playing back, and imparting information of all kinds, for all purposes – including education and entertainment.

Word Processing Software

Voice Processor (TL9): A smart voice-interactive word processing suite, with dedicated AI editing capabilities. It converts ordinary speech to text, giving +1 (quality) to Writing skill for composition, and +2 for editing. Voice processors are very common programs. Complexity 5, 10% of typical software cost.

Thought Processor (TL11): Requires a neural interface (pp. 48-49). It interprets the user's thoughts and translates them into text. Running one while asleep and dreaming can produce interesting results. +2 (quality) bonus to Poetry and Writing skills for composition. Complexity 9.

Recording and Playback

Ultra-tech data storage and retrieval is usually digital. Many people do not bother with dedicated recorder or playback systems – computers can store digital recordings, and wearable displays or terminals play back audio and video. However, various specialized equipment is also available.

Digital Data Storage Media (TL9-12)

Modular digital media are similar to lower-TL computer disks and digital video disks, but use three-dimensional data storage with greater capacity.

Data Bank (TL9): This is a large unit used as a modular backup or expansion for computers. It has a cable jack. It is $100, 1 lb. per 100 TB. Multiply storage space by 1,000 for every TL after its introduction.

Datachip (TL9): About 1/4-inch square. Chip readers may be built into many other electronic devices. It holds 1 TB at TL9; multiply storage space by 1,000 for every TL after its introduction. $1, 0.01 lb. A datachip drive is built into many devices; purchased on its own, it's $5, 0.02 lbs., AA/100 hr.

Data Dot (TL9): Used for covert information storage, this tiny unit holds 1 GB at TL9. Multiply storage space by 1,000 for every TL after its introduction. $0.1, neg. A data dot drive accessory is $5, 0.01 lb., AA/200 hr.

Digital Cameras and Camcorders (TL9)

Passive visual sensors (pp. 60-61) can be used as digital cameras, but camera systems produce higher-quality images. They have a removable datachip (above), plus internal data storage capacity with the same capacity. Each terabyte of storage holds about 12 hours of uncompressed, studio-quality imagery, or two weeks of compressed imagery (which is good enough for most purposes). Use Photography/TL skill to take good pictures. All systems include a datachip drive (above), a microphone jack, and a display that can be used for simple editing tasks; treat as improvised equipment for any complicated audio-video production.

Flatcam (TL9): A palm-sized digital audio-visual recorder. It has a Night Vision 7 image-intensification lens and 4× optical magnification. This is basic equipment for Photography skill. $50, 0.1 lb., A/10 hr.

Pocketcam (TL9): A high-quality digital audio-video camcorder with 16× optical magnification and Night Vision 8 image intensification. It gives a +1 (quality) bonus to Photography skill. $200, 0.25 lbs., B/10 hr.

Portacam (TL9): A professional-quality movie camera for news gathering, intelligence work, or video production. It provides 16× parabolic audio magnification, 64× optical magnification, and Night Vision 9. It gives a +2 (quality) bonus to Photography skill, and can be mounted on a tripod (p. 151) for extra stabilization. $2,000, 4 lbs., C/40 hr. LC4.

3D Cameras (TL9): These are built with specialized lenses to capture the depth needed for 3D imagery. They can also be used to record holotech projections (pp. 52-53). The cameras listed above are available in 3D at five times normal cost at TL9. At TL10+, 3D cameras cost the same as normal cameras. 3D images use 100 times as much storage space as flat images.

At each TL after TL10, double visual and audio magnification.

Media Players (TL9-10)

Book Reader (TL9): The size of a slim paperback, this dedicated device is built as a digital text display, with a screen optimized for maximum readability. It can also read texts aloud. It stores a terabyte of text internally (multiply by 1,000 per TL after introduction) and has a datachip drive, a cable jack, and a radio microcommunicator. $20, 0.1 lb. 2A/100 hr.

Data Player (TL9): An inexpensive palm-sized viewing screen and speaker for audio, video, text, or other data. It has a datachip drive (above), a cable jack, and a radio microcommunicator for connecting to a HUD, computer, or ear phones. $5, 0.05 lb., A/100 hr.

Entertainment Console (TL9): This Complexity 4 computer (+2 at TL10, +3 at TL11, or +4 at TL12) is +1 Complexity when running computer games, virtual reality, and sensie programs. It includes a datachip drive, portable terminal (p. 24), and cable jack. $500, 1 lb., 4B/5 hr. or external power. LC4.

Video Wall (TL9)*:* A flat, flexible, low-wattage video display pasted or painted on a wall. $10 and 0.05 lb. per square foot. Uses external power.

Multi-Media Wall (TL9)*:* As above, but also ripples to generate sound, allowing a directional speaker effect. Many residences have these; they are also used for ad walls and other displays. $20 and 0.05 lb. per square foot. External power.

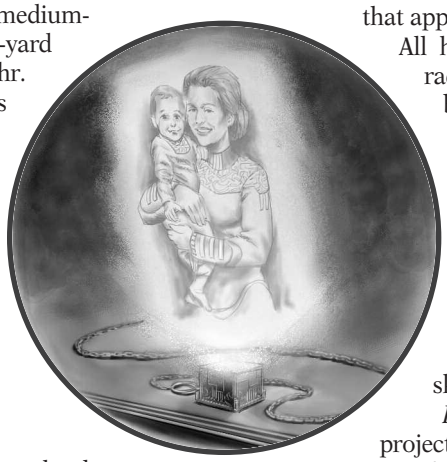
3D Media Wall (TL10): Higher resolution, providing realistic depth. $50, 0.05 lbs. per square foot. External power. LC4.

Scent Synthesizers (TL9)

A programmable odor generator used for air conditioning, parties, and art, with a specialized molecular assembler that produces realistic scents. Programming a known scent from the library takes one minute; creating a new one takes at least an hour and a Chemistry roll. Original or artistic scents may require days to perfect. It cannot generate biochemical agents such as pheromones or sleep gas, but it can create odors that mask other odors (-5 on rolls to detect things by smell), or produce a nauseating odor (treat as a mild form of riot gas (p. 159); roll vs. HT at no penalty to resist).

Odor Synthesizer (TL9): Fills a medium-sized room or vehicle; affects a five-yard radius outdoors. $500, 1 lb., B/100 hr. The cartridge is good for 100 mixes (each lingers for a minute). LC4.

Programmable Perfume (TL9): A wearable unit. Some scents may be complementary, but it is a good idea to wash off one before trying another. Affects a two-yard radius, including the wearer. $200, 0.1 lb., A/100 hr. LC4.



Sonic Projector (TL9)

This uses acoustic heterodyning technology to transform a spoken or recorded message into a directional sound beam. The sound appears to emanate from the location the beam is directed at, rather than the projector. It has a microphone for voice transmission, and a datachip drive for playing recorded sounds.

It can be used for communication, so that the recipient hears a voice that seem to be right beside him, even if the sender is hundreds of yards away. Personal, theater, or concert sound systems often integrate sound projection technology to create 3D audio that emanates from multiple locations around the listener.

Stores, billboards, or vending machines can use a sonic projector to address targeted ads to individuals passing by (cameras and AI programs identify the most likely customers). It's also useful for covert operations – for example, a softly-spoken message can be beamed to a distant target without anyone noticing. This can be used for psychological manipulation.

Complex effects (e.g., beaming a recording of someone walking behind a subject, so he thinks he's being followed by invisible footsteps) require an Electronics Operation (Media) skill roll. Focusing on a moving target requires an attack roll: it is Acc 6, Bulk -2; use Beam Weapons (Projector) skill.

A sonic projector requires an atmosphere to conduct sound, and is not designed for underwater use (for that purpose, see *Sonar Communicator*, pp. 44-45). The signal travels at about 0.2 miles per second (at sea level).

Various projector sizes are available:

Large (TL9): 200-yard range; can project up to four signals simultaneously. $500, 2 lbs., 2C/10 hr. LC4.

Medium (TL9): 100-yard range. $200, 0.5 lbs., 2B/10 hr. LC4.

Small (TL9): 10-yard range. $50, 0.05 lbs., 2A/10 hr. LC4.

Range is multiplied by 1.5 at TL10, doubled at TL11, and tripled at TL12.

Holoprojectors (TL10^)

This is the superscience version of holography – the ability to project three-dimensional images at a distance, into empty space or around objects. This technology allows projection of images, movies or still shots. Most devices also use sonic projectors (above) to create sounds that appear to emanate from the holographic image. All holoprojectors incorporate cable jacks and radio micro communicators, allowing them to be remotely controlled for use as displays, entertainment systems, or decoys.

Holoprojector (TL10^): The projection range is 12 yards. The visual projection can fill up to 216 cubic feet (2 × 2 × 2 yards). The projection area can also be moved at up to 12 yards/second, although doing so without disrupting the illusion requires an Electronics Operation (Media) skill roll. $8,000, 4 lbs., C/1 day. LC4.

Holotech Player (TL10^): This simple holoprojector is the size of a sugar cube, and can project a single image or short sequence (up to 30 seconds) with a range of one yard; the sequence or image is permanently stored in the device. It is often built into lockets and other keepsakes. $10, 0.1 lb., A/1 day. LC4.

Mini Holoprojector (TL10^): This pocket-sized holoprojector has a range of seven yards, filling an area up to 54 cubic feet (1 × 1 × 2 yards). The projection area can be moved at seven yards/second, but doing so without disrupting the illusion requires an Electronics Operation (Media) skill roll. Mini holoprojectors are often built into other devices, such as a computer, a helmet, a "magic wand," or an implant. $2,000, 1 lb., B/1 day. LC4.

Super Holoprojector (TL10^): This powerful projector has a range of 33 yards, and can fill up to 5,000 cubic feet (e.g., 25' × 20' × 10'). Super holoprojectors may be used for entertainment, but are also popular for government propaganda, "playing god" with low-tech natives, and delivering villainous ultimatums. The zone can move at up to 33 yards/second, but doing so without disrupting the illusion requires an Electronics Operation (Media) skill roll. $200,000, 100 lbs., D/6 hr. LC4.

Holotech Editing Program (TL10)

Software for creating or editing holotech and 3D camera images. It can be used to produce computerized holographic animation, special effects, etc. Use Electronics Operation (Media) skill. Complexity 6 software, normal cost. LC4.

Interactive Holoprojection (TL10^)

This artificial intelligence software lets a holoprojector-user control projections "on the fly," usually via a neural input device or direct neural interface. The operator combines objects from an image library with various pre-programmed and artificially-intelligent behavior sets. All imagery must remain in the projector area.

The operator takes a Concentrate maneuver to project animated, three-dimensional images of anything he can visualize. The images and sounds can occupy any frequency range, including spectra that are beyond human perception. They persist for as long as the device is operating.

In combat, a holoprojection can deceive and distract. Roll a Quick Contest of Electronics Operation (Media) against the Perception of anyone in a position to notice it. (GMs may roll once for multiple foes with the same Per.). Success means the projection seems real *to that individual* (although if he *knows* it's a holoprojection, he'll just be impressed!)

To make a holoprojection disturbing enough to cause a Fright Check, win a Quick Contest of Artist (Holoprojection) against the higher of IQ or Perception for each victim. To trick someone into believing in an projection of someone he knows, roll the *lower* of Acting, Electronics Operation (Media), or Artist (Holoprojection) skill against the *higher* of a target's IQ or Perception.

Roll a new Quick Contest when someone fooled suddenly changes how he's interacting with the projection; e.g., he attacks a holographic monster, or falls through a chair that isn't there. If he wins or ties, the operator can't simulate a believable response to his action (such as the monster dodging, or the chair slipping) and the victim catches on.

Modifiers: A victim gets +4 if someone who knows about the projection warns him, or if you critically fail in a Quick Contest against someone else. He gets +10 if you create the holoprojection unsubtly and in plain sight, or if he examines it with a sense you can't deceive – most often touch. Inappropriate projections give a further +1 to +10, while believable ones (e.g., you pull out a holographic gun) give from -1 to -5.

It's hard to animate a convincing semblance of a holographic person for direct, personal interaction, such as dueling or conversation. Multiple fake people are progressively more robotic and unresponsive; anyone rolling a Quick Contest to spot the projection is at +4 per construct after the first. Holotech projections obstruct vision but are otherwise intangible. They glow in the dark; apply a -1 penalty on rolls to fool or otherwise distract someone per -1 darkness penalty (unless the object would ordinarily be glowing in the dark).

Once images have been created, the user can hand off control to the program's AI. Such holoprojections can respond in simple ways, but can't *change* or respond to other's actions unless the user concentrates. In particular, illusionary people can't converse.

Interactive holoprojection requires a computer running Complexity 6 software plus an interface for controlling the holoprojector. Apply a -6 to skill if attempting to control interactive holoprojection through anything other than a neural interface! LC4.

Virtual Reality (VR)

A virtual reality rig simulates the sensory input of a computerized environment and transmits it to the user. Virtual reality may be used for socializing, meetings, entertainment and gaming, sex, educational and training simulations, art, advertising, shopping, court sessions, and as a sophisticated control interface.

The simplest form of virtual reality is a visual display. The user dons goggles or a helmet that blocks out the real world and replaces it with a wrap-around view of computer-generated imagery. VR displays are popular means of receiving sensor input from computer games or simulations, from scientific and other sensors, and from sensors and instruments on vehicles or robots. Most remote-control drones use some form of VR display as part of their control system.

VR often serves as a symbolic interface between a user and a set of controls or instruments, "superimposing" itself on normal reality. This is *augmented reality.* For instance, a computer operator can use a VR rig to dispense with a physical keyboard. The user dons goggles and gloves plugged into a computer, which generates the virtual image of a keyboard in front of him. The user moves his fingers as if typing, the gloves sense the finger movements, and keystroke input is generated in the computer. Feedback may give the user a tactile sensation of typing. The same can apply to control of other electronic systems.

Multi-User VR

Virtual reality also permit social interaction over a distance. If a computer user has a VR rig, he can interact with people and objects in a virtual-reality environment as if they were real. At TL9+, phone conversations and face-to-face meetings often give way to encounters in shared virtual realities.

When someone enters a VR environment of this sort, his appearance will depend on the nature of the environment program and his own interface program. Service providers have a library of avatars on line that the user can choose from, if he hasn't taken the time to design his own.

Most multi-user VR environments resemble a computer-generated version of reality. People can move about it and interact with the other denizens as they would in the real world. It may be hard to distinguish between other VR users and computer programs.

Everything is only as real as the program and hardware makes it. Avatars may be insubstantial, or react as if solid. Many environments are designed so their physics mirror the real world, but others have different physical laws where everyone is weightless, or people have "magical" powers, or water is solid, or whatever. Depending on the level of access granted by the system's operator, some users may be able to do things others cannot, or even control the overall VR program from within the simulation. Within a large simulation, different sites may have different rules.

Service providers may offer a mix of private VR spaces and open public forums, such as virtual parks, bars, shopping malls or streets. Virtual malls may sell physical goods and services. They can incorporate simulations that allow the user to try out the goods in question – to test drive a virtual car, or try on virtual clothes. (*Caveat emptor*: what looks good in VR may not be as good in reality.) If the goods are software, they can be delivered immediately; if they are hardware, they come by courier. At high TLs, a purchase order may signal a local fabricator or nanofac to manufacture the goods.

Travel speed in a virtual reality may be limited to walking, but some users may be granted the ability to teleport, fly, etc., or board virtual public or private transportation.

Many service providers allow subscribers to design and rent their own personalized locations, either in public forums or in private-access areas. Corporations may have VR offices. Individuals should take care before using VR for confidential meetings. A system operator can design software to monitor or record events in "private" spaces.

Access to large "public" VR environments may be free (perhaps sponsored by corporations, or treated as the equivalent of public parks). Other VR sites may have dues ranging from $1 per month to $1 per minute, although the latter charge is likely only for sophisticated game sites or private clubs. Price may depend on how congested communications bandwidth is.

How a user interacts with a virtual reality depends on his VR rig. All VR rigs must be linked to a computer that is running a virtual-reality program.

VR Gloves (TL9)

This simple set of gloves, used in conjunction with a HUD (p. 24), allows a user to manipulate virtual objects using the gloves. It requires a computer of at least Complexity 2 to use. $20, 0.3 lbs. (plus a HUD). LC4. VR gloves can also be incorporated into any set of body armor or other suit gloves.

Basic VR Suit (TL9)

The user has VR gloves, plus small movement "tracers" attached to various points on the body. He can move around a virtual reality and have a "body" there, but only experiences full tactile stimulation in his hands. The suit takes 10 seconds to put on or remove, and requires a Complexity 3+ computer. It can be worn with any armor or clothing. $200, 1 lb. LC4.

Basic Neural VR (TL9): Someone with a direct neural interface (pp. 48-49) can omit the suit and run the equivalent of basic VR through a Complexity 4 program. Standard software cost. LC4.

Full VR Suit (TL9)

This consists of a sealed helmet, gloves, and a sensor-equipped body stocking. The helmet blocks out the real world, creating 3-D images, sound, and scents. The body stocking and gloves house feedback sensors and pressure devices. The suit allows the user to move about a virtual reality and manipulate objects as if they were real (subject to the constraints of the program). The suit will sense the user's movements and provide tactile force-feedback (including sexual stimuli, if this feature is enabled), although not strongly enough to suffer any injury. It takes a minute to put on, 30 seconds to remove. It requires a Complexity 5+ computer. $2,000, 5 lbs. LC4.

Full Neural VR (TL9): Someone with a direct neural interface (pp. 48-49) can omit the suit and run full VR through a Complexity 5 program. Standard software cost. LC4.

Total VR (TL9)

This is only available as a computer program accessed through direct neural interface (pp. 48-49). It provides the same effects as a full VR suit, with the difference that all the user's senses are engaged. The only limit is whatever safety factors are programmed into the system.

If safety interlocks are engaged, the user may feel discomfort or dislocation, but not pain. If they are not engaged, a person in a total VR simulation can feel real pain. He won't suffer injury, but psychological damage can result if he is hurt, killed, or tortured in VR. This is best simulated by requiring Fright Checks.

Some total VR systems include "consent-level" protocols limiting how much "reality" (in terms of discomfort or pain) the user is willing to take. Another standard feature is a "safeword" function. If the user speaks a specific code word, he is immediately pulled out. Sabotage or system-operator connivance might neutralize such features. Total VR is a Complexity 6 program. Standard software cost. LC4.

VR Manager (TL9)

This program manages the interactions of multiple users within a shared virtual reality. The VR manager must be run on whatever computer is maintaining the virtual environment. Each program can handle about 10 users. For more people, run more programs. The manager can grant varying degrees of access to individual users to design characters or places within the environment. Its Complexity and cost depends on the most complex virtual-reality interface it can support:

Complexity 4: Supports VR gloves or basic VR.
Complexity 5: Supports up to full VR.
Complexity 6: Supports up to total VR.

The level of "reality" experienced is the lower of the VR interface or the VR manager. Someone with a deluxe VR rig running in an environment maintained by a Complexity 4 VR manager would participate as if he only had a basic VR rig – the software can't handle the full capabilities of the hardware. On the other hand, a user who connects a basic VR rig or program to a Complexity 6 total VR sim will miss most of the details.

VR Environmental Database (TL9)

This stores a virtual environment, which is accessed by a VR manager. Users of interactive networks might also store their own environmental databases (e.g., personal

character avatars) on their own systems, to be uploaded to the VR manager.

Memory requirements vary widely depending on the number of different objects stored in it and their level of detail. A forest of identical trees is much smaller than a small room with a hundred different knickknacks. Some typical database sizes are:

Imagery Database

Virtual character	0.001 TB
Virtual room	0.001 TB
Virtual house or park	0.01 TB
Virtual mansion or wilderness	0.1 TB
Virtual street or mall	1 TB
Virtual neighborhood	10 TB
Virtual town	100 TB
Virtual city	1,000 TB
Virtual small nation	10,000 TB
Virtual large nation	100,000 TB
Virtual planet	1,000,000 TB
Virtual interplanetary state	10,000,000 TB
Virtual interstellar state	100,000,000 TB
Virtual galactic empire	1,000,000,000 TB

Virtual wilds, streets, malls, cities, and worlds include simulations of animals or people as well as live users, but they are not really "alive" until someone else encounters them. Large areas may also use "generic scenery" to fill in backgrounds. A virtual city may only have a few thousand specific building interiors, assembling other rooms from "cut and paste" programs whenever individuals visit them.

Divide the required database space by 10 for a "cartoon" level of imagery; multiply by 10 for "lifelike" imagery with fewer generic details. "Lifelike" imagery experienced with full or total VR is nearly indistinguishable from reality.

Packaged Characters and Settings: At TL9, prices are about $1,000 per TB for off-the-shelf realities or standard character avatars. These costs drop by a factor of 1,000 per TL beyond TL9; however, customized settings and characters, may cost 10 times as much as generic material. Many system managers prefer to program their own characters and environments.

Private Realities

Some commercial computer networks will allow users to construct (or rent) private VRs on the network that only they are allowed to access. See *Planetary Network* (p. 49) for a price per terabyte per month.

VR-Enabled Software

Many software programs support a VR interface, including repair programs and games. See *Augmented Reality* (pp. 56-57).

Interactive Total VR: Dreamgames (TL9)

These are interactive total VR games and simulations. The user connects and is plunged into the setting and fiction genre of his choice. Suddenly he is Colonel Orion of the Imperial Marines leading a battlesuit assault, or the richest person in the world, or an English noblewoman captured by pirates in the Caribbean . . . and he can direct the action.

The most popular sorts of such games are action-packed adventures, romances, pornographic odysseys, and "horatios" (dramas where the character rises from humble beginnings to vast wealth, and enjoys the fruits of his labors). Some of the stories have preset lengths – usually 10 minutes of real time – but each real-world minute seems like 10. More elaborate setups have stories that can go on for hours of real-time. Players participate in 20- and 30-minute sessions, picking up each time where they left off.

Dreamgames may also be used for education and training, or to rehearse for missions or operations. They vary widely in the degree of interactivity that the user is allowed, depending on the sophistication of the program and any built-in or directing artificial intelligence. It's possible that dreamgames will be among the most sophisticated types of ultra-tech software.

The realism of dreamgames varies wildly; most make concessions so that the games are more cinematic, exciting, and action-oriented. Depending on the availability of the necessary computer systems and direct neural interfaces, people may own their own dreamgames, visit parlors, or play them over the net.

Playing dreamgames can be addictive. Use the rules for non-chemical addictions (p. B122): addiction to dreamgames is generally cheap, legal, and incapacitating [-10]. (Dreamgame addicts might also have the Delusion that one or more of their games is the real world, and "reality" is the game, or that a character from the game is real.) Addiction can be especially serious if running the dreamgame using a computer implant.

By TL10, direct neural interfaces are relatively inexpensive, and even cheap computers have the processing power to run dreamgames. Much informational and instructional software uses dreamgame-style interactive techniques. Since anyone can plug one into his own home computer, dreamgame addiction could become a serious social problem.

Individual dreamgames are usually Complexity 6+ programs, but due to massive distribution, commercial games are usually one-tenth standard cost. Specialized corporate, government, or military training sims will be full cost. Some high-end programs may be Complexity 7+, and correspondingly more expensive. Most dreamgames are LC4.

Augmented Reality

This superimposes information onto a user's perception of the real world. It requires a video display linked to a digital camera or other imaging sensor, and a networked wearable or implanted computer.

An augmented reality system recognizes objects (including faces) and situations, and provides a helpful stream of context-appropriate data, often as audio messages or text boxes in the user's visual field.

Hardware

Augmented reality is usually presented with vid glasses (p. 60) or with a computer implant (pp. 215-216). A HUD (p. 24) and a camera (p. 51) is also sufficient equipment; either or both could be part of a helmet. A cyborg with bionic eyes and a computer implant running optical-recognition and database programs could keep everything in his skull. Digital minds can use augmented reality without any special interface: it's the world they live in.

Memory Augmentation (TL9)

This "mug shot" database is a common AR program. It uses stored or net-accessible databases ranging from the commonplace (such as celebrities) to the job-specific (a cop's database of wanted criminals). Most people accumulate personal databases of people they meet or expect to meet, co-workers, and so on.

If the user's wearable camera (or eyes, if he uses a brain implant) spots someone whose face is in the database, the program will automatically display that person's name and a brief identifier. The program can be told to ignore of relatives and other constant companions. Similar remembrance-agent programs and databases can be acquired for other tasks, such as recognizing artwork, wildlife, and vehicles.

For instance, a bounty hunter's computer might be linked to a database of "Earth's Most Wanted." If he saw someone on that list, the computer would make a match and instantly send him the file, which would appear before his eyes. Then he might zero in on the weapon his target was carrying and upload its specs.

Memory augmentation can be used with data-mining programs that continually search private or public networks for content relevant to the user's current situation, then present that information as appropriate. For example, if the user encounters a person who isn't in his standard database, that person's picture and identity are very likely to be available online.

Video and Sensory Processing (TL9)

Augmented reality can digitally process what the user sees, improving his vision. For example, enhancing the edges in an image helps in face recognition. It can also replace what he sees and hears, immersing him in a virtual reality (see below).

Visual Enhancement (TL9)

This gives +1 to Vision rolls. Complexity 4, $1,000. LC4.

Cosmetic Filter (TL9)

A common augmented reality program, this controls the audio-video display on a communication system. When activated, the video uplink picks up the user's image as usual, but filters it through a preprogrammed "ideal" of beauty before transmitting it to the receiver. The user still looks like himself, but the program tightens sagging jowls, erases crow's feet and wrinkles, and removes or minimizes blemishes. The user's video Appearance rises by one level, but cannot exceed Very Handsome. Any enhancement above Attractive has the Off-the-Shelf Looks (p. B21) modifier applied. Cosmetic filters designed for one species often produce very strange results for another species! A cosmetic filter is Complexity 4, $400. LC4.

Video Masking (TL9)

This works like a cosmetic filter (above), except that it can change the user's features and voice. The user may resemble another person, or adopt a persona created by the program. Complexity 5, $800. LC4.

Smart Diagnostics

Many TL9+ objects incorporate built-in sensors to monitor their own status. This could be a milk carton checking to see if the milk is spoiled, or a precision machine measuring microstresses in its components. The data from these sensors can be continuously uploaded to local (or planetary) networks, and accessed by looking at the object.

Virtual Tutors (TL9)

These systems simplify tasks such as repairing a car engine or building a prefabricated house. A mechanism may have dozens (or thousands) of different parts tagged with microcommunicators (p. 43) and positional sensors. Integral databases know where each part goes, and virtual tutoring software can track both the parts and the user's own hand movements, aiding in assembly, disassembly, preparation, or maintenance.

For example, when a repair technician (human or machine) walks up to a broken device, the device's components transmit diagnostics and positional information to the tech's computer. The computer then presents step-by-step guides for the technician to follow. Since all the parts and tools are tagged, often with additional sensors that monitor things such as stress, current flow, etc., an object-specific "virtual repair manual" can warn the technician if he is taking apart or putting the object back together the wrong way, or if there are internal faults.

The same technology can apply to other tasks requiring rote manual actions. Each widget, brick, pipe, or module

has a chip and sensor in it that knows where it goes and whether it's been installed correctly. Augmented reality has enabled a resurgence in unskilled labor, since these technologies permit untrained individuals to perform complex tasks.

Virtual Tutor (TL9)

This augmented reality program coaches the user in a specific task, such as assembling electronics or fixing a car engine. The user has an effective skill of 12. Complexity 3 if the task normally uses an Easy skill, Complexity 4 if it uses a harder skill or if it uses several skills in concert (such as building a house). Any necessary parts must be purchased as instructor kits (p. 81). Normal cost. LC4.

Invisible Friends

Computers may be inhabited by digital minds. If so, it may be popular to have a computer manifest through augmented reality as a virtual companion standing or sitting a few feet away from its owner. The "invisible friend" might truly only be visible to the user, or the image could be transmitted to anyone else sharing the same network who would be in a position to see the person.

SENSIES

Sensies are recordings or transmissions of another person's sensory experiences. They are sensory telepathy, transmitted through total virtual reality (p. 54) media. Users require direct neural interfaces (pp. 48-49) and experience full sensory input as if they were really there.

Transmitting or recording a sensie requires a specialized device that picks up the subject's sensory experiences. If it's recorded, a sensie can be replayed by anyone with a direct neural interface; they'll see and feel everything the original subject did.

Sensies don't have to be made from humans. Recording a nonhuman allows a user to "become" a cat, a bird, or an alien. (Commercial sensies of very simple creatures like butterflies or worms usually have more understandable virtual reality experiences dubbed over the simple-minded experience of the actual creature).

Sensies operate at real-time speed. That is, one second experienced in a sensie is a second in the real world. Some edited sensie programs come with multiple viewpoints, so that you can try out the show or story line from the perspective of more than one character in it. Most such programs limit the user to a choice of the male or female lead characters.

Sensie Uses

Sensies may be a new form of entertainment media (see below). But they're also useful for surveillance and control. Although they can't read thoughts, an implanted sensie recorder can monitor exactly what a person sees, hears, smells, etc. – see *Braintaps* (p. 215). Those seeking to keep tight control of subordinates, children, prisoners, slaves – or entire populations – may *require* the use of sensies.

Sensie Mass Media

Sensies could rival total virtual reality as a future media, since they offer the added realism of experiencing what a person actually felt. This may make them popular for news reporting and various forms of live "reality" programming. Ordinary people may also distribute their experiences, much as bloggers write about their daily lives online.

Commercial sensies may come in many varieties. Pornography, drama, and travel and sports shows are all very popular. The most popular programs treat the user to sunbathing, eating exotic food, scuba diving, skiing, skydiving, zero-gee free-fall, and so on.

Many sensies are edited to remove any unpleasant sensations the viewpoint character may experience, such as sunburn, pain, hunger, or cold. However, black-market sensies may feature injuries, painful deaths, rape, or torture. These find a market with jaded masochists, or as torture devices. Normally these are illegal, since the person making the sensie was harmed or killed. (Violence against other actors in the sensie can be simulated, but what the viewpoint character experiences must be real.) A sensie of this sort will impose one or more Fright Checks on the user, at a penalty determined by the GM.

Sensie Stars

Anyone using a sensory uplink can make a sensie transmission, but some people have a gift for recording a satisfying sensory experience. These individuals make good "sensie stars." High HT attributes and Acute Senses are valuable traits to have.

Experiencing a Sensie

A sensie is experienced from a live or recorded transmission of another individual's sensory experiences. Someone accessing a sensie experiences all the sensory data of the original subject: seeing through his eyes, hearing what he hears, sharing tactile sensations, etc.

There are two ways to experience a sensie:

In *immersion* mode, the user is unable to use his own senses and is submerged in the transmission. If the transmission includes pain or physical afflictions, the user also feels pain and suffers shock effects, but takes no damage. The GM should require Fright Checks if the experience includes terrifying events, severe injury, torture, or death. Since the user's own senses are immersed, and he might miss almost anything that didn't wreck the headset or media player, a common safety measure is to make sure the computer is programmed to turn off the sensie in the event of a fire or burglar alarm!

In *surface* mode, the receiver experiences the transmitted sensory perceptions, but they are muted. The receiver can still function, but he will be distracted. This imposes a -3 on other activities, unless the task is one that would benefit from intimate knowledge of what the subject is feeling; e.g., attempting to interrogate or seduce him. The user suffers only half the transmitter's shock penalties, and makes any required HT, Will rolls or Fright Checks at a +4 bonus. Most commercial sensory interface experiences are transmitted in surface mode.

Experiencing a real-time sensie in immersion mode requires a transmission speed of at least one gigabyte per second; surface mode requires at least 0.1 gigabyte per second. This generally means that one has to "jack in" to experience a sensie.

Sensie Equipment

Creating or experiencing sensies require a neural interface (pp. 48-49) and appropriate software.

Sensie Player (TL9): This software lets someone experience sensie media. They must use a direct neural interface (pp. 48-49) to connect their mind to a computer running this program. This lets them access recorded or live sensie feeds stored on their computer, or transmitted over networks or via communicator. Complexity 6, standard software cost. LC4.

Sensie Uplink (TL9): This software lets someone transmit or record his sensory experiences as sensie media. The link requires a direct neural interface (pp. 48-49) that is in communication with a computer running this program. The data is then sent to a recorder, or broadcast using a communicator or net connection. Complexity 7, standard software cost. LC4.

Braintaps (TL9): These specialized cybernetic implants only record and transmit sensies; see *Braintap* (p. 215).

Anything with a digital mind – AIs and mind emulations – can record its experiences without the need for any kind of sensie player, since it experiences everything in digital form already.

A typical sensie program occupies about 100 GB/hour, recorded in standard digital media. Cost is about $10 per hour for mass-market entertainment sensies, but may be considerably more for specialized ones such as tutorials. Sensie-rental fees are usually about 20% of the purchase price.

Sensie Editor (TL9)

This is a software suite that someone who can play sensies (*see Sensie Hardware*, above) can use to edit raw sensory recordings. The user can wipe portions of a recorded sensie, compress time with smooth jumps, fadeouts or transitions, tone down sensory experiences, or splice several recordings together. It also can be used to analyze a sensie recording to tell whether it is "raw" or edited, what kind of equipment was used, etc.

Sensie editors are necessary to make commercial-quality sensies from raw recordings. For instance, if sensie superstar Selena Usagi records her latest travel sim "Beautiful in Bali," and takes an hour-long walk down a moonlit beach before skinny-dipping in the warm tropical ocean with her co-star, the editor might condense it to the most stimulating 10 minutes. The quality of the sensie-editing job matters as much as the actual experience that generated the sensie; experiencing a poorly edited sensie can be disorienting and unpleasant! Electronics Operation (Media) skill is used to operate a sensie editor. Complexity 6 program; $5,000. LC4.

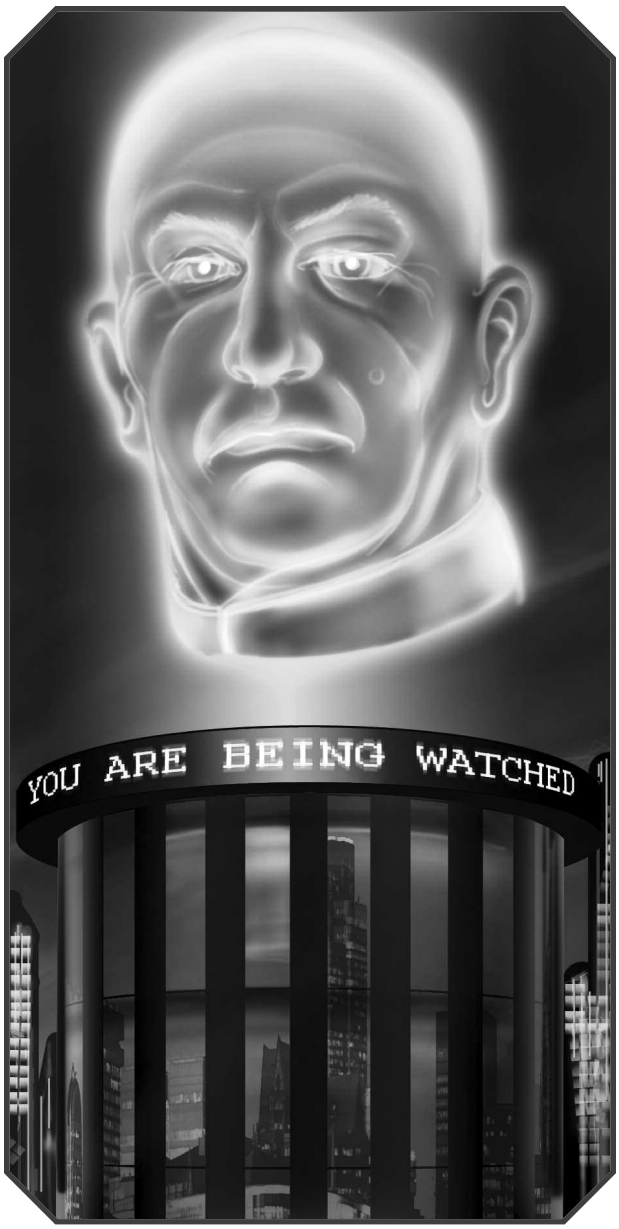
Mass Media

Mass media are designed to reach large audiences. It's likely that old media such as printed matter, television, musical recordings, and online text-and-graphics will continue to be popular. Advances in computer and digital recording and storage technologies will also make it simpler to translate between media – books can be scanned rapidly, text can be converted into spoken words or vice versa, etc.

Major new media may include:

Augmented Reality (pp. 56-57): Traditional text, video, audio, and other media may be delivered at all times as an overlay on daily life.

Total VR (p. 54) and Sensies (above): Fully-interactive sensory experiences offer high levels of realism and excitement, and create new frontiers for artistic effects. Their



main limitations are high bandwidth requirements (which make laser or cable the most practical delivery systems), and the need for expensive and invasive neural interfaces. They might be *too* addictive or disorienting, although a generation that grew up with them may have no problems!

Media Walls (pp. 51-52): Cheap audio-video walls may create a renaissance in billboard technology or (with spray-on or paint-on screens) video graffiti.

Holotech Projections (pp. 52-53): Using super holo-projectors (p. 52), giant-sized images may tower over entire communities.

Depending on society, mass media could be dominated by individuals (like much of the contemporary Internet), media corporations, criminals, or governments. In totalitarian societies, some or all forms of mass media may be controlled by the state. An oppressive government could use sensies and augmented reality to control not only what you read or watch, but your entire sensory environment.

Teaching and Learning Aids

Virtual reality (pp. 53-55), augmented reality (pp. 56-57), and sensies (pp. 57-58) provide excellent teaching aids. In addition, various specialized teaching equipment is available.

AI Tutors (TL9)

Perhaps the biggest advancement in education is the use of AI software (p. 25) to provide a tutors for children and adults. AI tutors can train the user in mental skills, languages, or learnable mental advantages. By using full or total VR, they can train the user in *any* skill.

Non-Volitional AI is less useful than a human teacher: teaching proceeds at half the normal speed (equivalent to self-study). Volitional AI is equivalent to a human teacher.

AI tutors need Teaching skill and the trait or skill the user will study. See *Purchasing Machines* (p. 29) for the cost of skilled AI software.

An AI tutor may also serve as a child's personal assistant and companion. A volitional AI might even learn and grow with the child, gaining in intelligence and personality as the child matures. It might become a life-long partner – a virtual parent, sibling, or lover.

Training Robots (TL9)

Robots can be used as training aids in everything from sports to combat training to medicine. At TL9, they provide more realism than virtual reality, and are particularly useful for dangerous situations – for example, as opponents in live-fire combat training, or as victims for rescue teams to practice their skills upon.

It may be common to employ sapient robots for young children; a child's robot pet or toy may also be his AI tutor (above), babysitter, playmate, and bodyguard. As the child matures, the same software may be moved to robots appropriate for a teen or adult. A shape-shifting nanomorph (p. 111) might even physically change with the child.

Virtual Education (TL9)

Virtual reality allows the user to study IQ-based skills or languages with a distant teacher as if he were present. If the user has access to a Basic VR (p. 54) rig or better system, DX-based skills can also be learned. HT-based skills require total VR.

Dream Teacher (TL10)

This is an advanced form of total virtual reality. It transforms the user's dream-state into a teaching environment via direct neural interface; it is sometimes known as a "dream sensei." The user goes to sleep (or is sedated) while connected via direct neural interface (pp. 48-49) to a computer that is running a dream teacher program. As he sleeps, the program interfaces with his dreams to create lifelike simulations that reinforce rote aspects of a skill and teach new situations. A dream teacher will interact with the user's sleeping mind to create new scenarios that are exciting and relevant to him.

Dream teacher programs allow the user to perform Intensive Training (p. B293) while sleeping in any IQ-based skill or language. DX- and HT-based skills are not quite as effective; although they do actually "program" the nervous system, the learning speed is the same as Education (p. B293), since efficient training in these skills also requires the development of muscle memory.

Like total virtual reality and sensies, dream teachers require the user to have a neural interface connected to a computer running appropriate software. The software requires an individual program for each skill or disadvantage. Programs are Complexity 6 for Easy skills, 7 for Average skills, 8 for Hard skills and languages, or 9 for Very Hard skills. Behavior modification programs are Complexity 7 for -1 point disadvantages, Complexity 8 for -2 to -10 point, Complexity 9 otherwise. Use standard software costs. Most dream teacher programs will be LC4. Behavior modification programs and programs that teach military or espionage skills will be LC3 or lower.

Instaskill Nano (TL12)

Injections of nanomachines that rearrange brain structure to impart knowledge. Instaskill comes in many varieties, each corresponding to a specific IQ-based skill or technique, or a language. Each "dose" gives the user one point in a specific skill or technique, Cultural Familiarity, or towards Broken or Accented comprehension in a language. It only works if a character has zero to one points in the trait; a character with two or more points is unaffected. It takes a day (TL12) or an hour (TL12^) before it takes effect.

Multiple doses of the same or different skill should not be taken until after assimilation; if doing so anyway, roll vs. IQ to avoid suffering Phantom Voices [-5] (p. B125) for days equal to the margin of failure, or permanently on a critical failure. This also prevents further use of instaskill until the problem wears off (if it does). $30,000/dose. LC3.

Sensors and Scientific Equipment

This section presents scientific equipment and devices that extend the range of human sensory perception.

Passive Visual Sensors

These systems work like normal vision, but extend the limits of human sight. They include light-intensifying, infrared, ultraviolet, and hyperspectral sensors.

Passive sensors often incorporate levels of telescopic magnification. Each doubling in magnification lets the user ignore -1 in range penalties on Vision rolls when using the sensor. The user can also "zoom in" on a particular target by taking an Aim maneuver. This doubles the benefit against that target (useful for making a more precise identification) but eliminates the bonus to spot other targets.

All passive sensors incorporate a digital camera (pp. 51-52).

All these sensors provide anti-glare protection (p. 171) and DR 2 for the eyes.

Passive Visual Sensor Configurations

Ultra-tech passive visual sensors come in standard models:

Binoculars: A manual hand-held viewer. It limits the user's vision to a 120° forward arc (see *No Peripheral Vision*, p. B151) and requires one free hand and Aim maneuvers to use. Binoculars incorporate a built-in HUD (p. 24), a laser rangefinder, and a digital camera (p. 51). They can be used as basic equipment for Photography skill.

Goggles or Visor: These are wearable hands-free optics with a wide field of view, but lower magnification than equivalent binoculars. They also incorporate a built-in HUD (p. 24) and digital camera (p. 51), but the simple controls for the latter give a -5 (quality) modifier to Photography skill.

Imaging Sensor Array or Surveillance Camera: A security system or vehicle-mounted sensor. It does not come with a display; it requires a separate terminal (pp. 23-24) as its interface. It limits the user's vision to a 120° forward arc (see *No Peripheral Vision*, p. B151), but is often mounted on a rotating turret or tripod. It can be used as a digital camera with a +1 (quality) bonus to Photography skill.

Video Glasses: These resemble ordinary sunglasses (providing DR 2 for the eyes). They have the same capabilities as goggles, but less magnification. It takes a Ready maneuver to don or remove them.

Video Contacts: These rigid gas-permeable contact lenses contain intricate microcircuitry and auto-focusing systems. They have the capabilities of goggles, but much less magnification. It takes a day to adjust to wearing contacts; until then, vision rolls are -1. It takes six seconds to insert or remove both lenses; before TL11 they should be taken out every week and cleaned. They're powered by body heat or piezoelectricity.

These passive visual sensor configurations can include night vision optics, infravision, and hyperspectral vision – see below.

Night Vision Optics (TL9)

These devices use near-infrared and computer-enhanced light intensification to amplify ambient light levels. They are rated for their level of Night Vision. Each level (to a maximum of nine) lets the user ignore -1 in combat or vision penalties due to darkness. However, they have no effect on the -10 penalty for *total* darkness.

They come in the classes detailed under *Passive Visual Sensor Configurations* (above), with various levels of telescopic magnification and night vision.

Electro-Optical Binoculars ("Televiewers") (TL9)*:* Night Vision 9 and 64× magnification. $500, 0.6 lbs., 2B/100 hr. LC4.

Electro-Optical Surveillance Camera (TL9): Night Vision 9 and 4× magnification. $250, 0.6 lbs., 2B/100 hr. Often uses external power. LC4

Night Vision Contacts (TL9): Night Vision 7 and 1× magnification. $200, neg. LC4.

Night Vision Glasses ("Night Shades") (TL9): Night Vision 8 and 2× magnification. $250, 0.1 lb., A/10 hr. LC4.

Night Vision Goggles or Visor (TL9)*:* Night Vision 9 and 4× magnification. $1,000, 0.3 lbs., 2B/100 hr. LC4.

Multiply telescopic magnification by 2 at TL10, or 4 at TL11+.

Infrared Imaging Sensors (TL9)

This is technically known as thermal imaging, and is equivalent to the Infravision advantage. These sensors detect the infrared (heat) spectra emitted by objects at different temperatures, then build up a false-color television image of the environment.

Infrared sensors lets the user observe or fight at no penalty even in absolute darkness, if the target emits heat (this includes all living beings and most machines). The sensors give a +2 on all vision rolls to spot such targets, since their heat stands out from the background. It can also distinguish targets that are colder than their surroundings (there is no bonus). Infrared sensors can be used to follow a heat trail when tracking: add +3 to Tracking rolls if the trail is no more than an hour old.

Infrared sensors do not distinguish real colors (which may limit the ability to use some controls), and only allow the user to judge the general size and shape of heat-emitting objects. Roll at -4 to distinguish objects of similar size and shape. The GM may also require a Vision-4 roll to read by reflected heat. Flare, fiery explosions, infrared lasers and other sudden flashes of heat can blind the imaging system, just as a flash of light can blind ordinary vision.

Infrared sensors usually come with one or more levels of telescopic magnification. The user can switch freely between normal vision and infravision.

The infrared sensors described below also have a daylight TV optical channel as well. This gives telescopic magnification at the same level without providing infravision. It takes a Ready maneuver to switch settings.

They come in the styles and features described under *Passive Visual Sensor Configurations* (p. 60), with various levels of telescopic magnification.

Infrared Imaging Sensor Array (TL9): 64× magnification. $40,000, 50 lbs., 2D/12 hr. LC3.

Infrared Binoculars (TL9): 16× magnification. $2,500, 3 lbs., C/10 hr. LC4.

Infrared Surveillance Camera (TL9): 4× magnification. $250, 0.6 lbs., 2B/100 hr. Often uses external power. LC4.

Infrared Goggles or Visor (TL9): 2× magnification. They're an integral feature of many suit helmets, but if purchased separately are $500, 0.6 lbs., B/10 hr. LC4.

Infrared Video Glasses (TL9): 1× magnification. $500, 0.1 lb., A/10 hr. LC4.

Infrared Contacts (TL10): 1× magnification. $300, neg. weight. LC4.

Double magnification one TL later, or quadruple the magnification two TLs later. However, many users are more likely to upgrade to hyperspectral vision (below).

Hyperspectral Imaging Sensors (TL9)

These optical sensors electronically fuse passive radar, infrared, visual, and ultraviolet imagery into a single false-color television image. The integrated picture often reveals details that are invisible to those who see in only one of these frequencies.

If there is any light at all, hyperspectral imaging grants near-perfect night vision with no vision or combat penalties. In total darkness, it functions exactly like infrared sensors (above). It also gives +3 to all Vision rolls, all Tracking rolls, and all rolls to spot hidden clues or objects with Forensics, Observation, or Search skill. These capabilities are not cumulative with other passive visual sensors or similar advantages.

Hyperspectral imaging sensors all incorporate the above capabilities plus one or more levels of telescopic optics. If the hyperspectral imaging is turned off, the sensors function as daylight television systems.

Hyperspectral Imaging Sensor Array (TL9): 32× magnification. $160,000, 50 lbs., 2D/12 hr. LC3.

Hyperspectral Binoculars (TL9): 16× magnification. $10,000, 3 lbs., C/10 hr. LC4.

Hyperspectral Surveillance Camera (TL9): 4× magnification. $2,000, 1 lb., C/100 hr. Often uses external power. LC4.

Hyperspectral Goggles or Visor (TL9): 1× magnification. An integral feature of many suit helmets, or available for $2,000, 0.6 lbs., B/10 hr. LC4.

Hyperspectral Video Glasses (TL11): 1× magnification. $1,000, 0.1 lb., A/10 hr. LC4.

Hyperspectral Contacts (TL11): 1× magnification. $1,200, neg. weight. LC4.

Magnification doubles for every TL after introduction.

Passive Electromagnetic Sensor Arrays (PESA) (TL10-12)

These are similar to hyperspectral imaging sensors, but they see even farther into the electromagnetic spectrum. They provide Hyperspectral Vision (Extended Low Band), allowing the user to "see" microwave emissions.

PESA Sensor Array (TL10): 32× magnification. $160,000, 50 lbs., 2D/12 hr. LC3.

PESA Binoculars (TL10): 16× magnification. $10,000, 3 lbs., C/10 hr. LC4.

PESA Surveillance Camera (TL10): 4× magnification. $2,000, 1 lb., C/100 hr. Often uses external power. LC4.

PESA Goggles or Visor (TL10): 1× magnification. An integral feature of many suit helmets, or available for $2,000, 0.6 lbs., B/10 hr. LC4.

PESA Video Glasses (TL12): 1× magnification. $1,000, 0.1 lb., A/10 hr. LC4.

Indirect Passive Sensors

These sensors are omnidirectional, and do not require a line of sight.

Chemsniffer (TL9)

An artificial nose that registers the presence of almost any odor by comparing it to a database. The user must set the chemsniffer for a *particular* odor or scent. When so programmed, it allows the use of Electronics Operation (Sensors) skill for tasks that would require Smell rolls. It can recognize people, places, and things by scent (provided they've been scanned before, or are common items). It can't detect anything in a sealed environment, underwater, or in vacuum.

The sensor has a computerized database of olfactory "signatures" that can *quickly* be compared to new sensory impressions. The sensor can record a new signature by analyzing a scent (see below). Its bonus is *not* cumulative with the Discriminatory Smell or Acute Taste and Smell advantages. A chemsniffer gives +4 on any Electronics Operation (Sensors) roll to detect targets, +4 to Tracking skill, and +8 to analyze or recognize targets by scent.

Personal Chemsniffer (TL9): This takes 10 seconds to analyze a new smell. Incorporates a built-in tiny computer. $2,000, 2 lbs., A/1 wk. LC4.

Dedicated Chemsniffer (TL9): Optimized to detect a single particular category of scents, e.g., explosives, human beings, drugs, etc. $100, 0.2 lbs., A/1 wk. LC4.

Tactical Chemsniffer (TL9): Takes only three seconds for the system to scan a new scent. Can track 10 different scents at the same time. $100,000, 40 lbs., B/1 wk. LC3.

Higher-TL models give +1 to skill (equivalent to Acute Smell) per TL beyond TL9.

Electronic Support Measures (ESM) (TL9)

This system detects and classifies electromagnetic emissions. On a successful Electronics Operation (EW) roll, this sensor detects radar or radio signals and reveals the distance to each source. Signals are usually detected at twice their range; low-probability intercept signals are detected at 1.5 times their range.

The system will also function as a laser sensor, detecting ladar, targeting laser, and laser comm signals that are beamed directly at it.

The brief warning the ESM system provides gives a +1 bonus to Dodge any attack aimed with an active targeting sensor that the ESM can detect.

The operator may take more time and make an Electronics Operation (EW) roll to analyze the signal. Each attempt requires a Concentrate maneuver; success distinguishes a random emission from a targeting lock, and can determine known types of emitters ("that's a Terran Guard YM-2 tactical radar"). An ESM can also be set to detect and analyze signals autonomously, using its own Electronics Operation (EW) skill for this purpose.

ESM Detector (TL9): A hand-held or belt-mounted system, often used as a counter-surveillance device. It has Electronics Operation (EW)-10. $250, 0.25 lbs., A/1 wk. LC3.

Tactical ESM Detector (TL9): A heavier and more expensive model. Adds a +1 (quality) bonus or uses Electronics Operation (EW)-12. $1,000, 2 lbs., B/1 wk. LC3.

These systems are also commonly built into suits, vehicles, etc. See also *Personal Radar/Laser Detector* (p. 188).

Sound Detector (TL9)

This is a sensitive array of microphones and sound-profiling software that provides the superhuman ability to distinguish between sounds.

The user can *always* identify people by voice, and can recognize individual machines by their "sound signature." In tactical situations, sound detectors are often programmed to respond to particular sounds made by specific weapons, engine noises, breaking armor, etc.

The system can memorize a sound by monitoring it for at least one minute, then adding it to the signature library. It gives +4 on any Hearing roll, +4 to Shadowing skill when following a noisy target, and +8 to Electronics Operation (Sensors) rolls made to analyze and identify a particular sound. Sound detectors can also magnify sounds from a distant point for eavesdropping purposes; this requires an Aim maneuver.

Sound detectors only work in air (hydrophones are used under water). They are useless in vacuum. They can detect an air sonar at double its range.

Personal Sound Detector (TL9): This device can zoom in and amplify a particular sound by 8×. Must be connected to a Complexity 4+ computer. $1,000, 1 lbs., A/1 wk. LC3.

Tactical Sound Detector (TL9): A sensitive "phased array" of microphones, often built into a vehicle hull. It can amplify a particular sound by 32×. It must be connected to a Complexity 4+ computer. $30,000, 30 lbs., B/1 wk. LC3.

Double amplification per TL after introduction.

Hydrophone (TL9)

These are sensitive underwater microphones connected to discriminatory sound signature-profiling software. This can detect and track *moving* or *noisy* objects in the water, provided the hydrophone is submerged. To do so, make an Electronics Operation (Sonar) roll at the detection bonus shown below. Consult the Size and Speed/Range Table (p. B550); apply separate bonuses for the target's size and speed, and a penalty for the range to the target. Swift currents will generate "noise" that interferes with the sense. Find the speed of the current on the table and assess the relevant speed penalty.

A successful roll reveals the size, location, speed, and direction of movement of the target. It reveals the target's general class based on sounds (e.g., "whale" or "nuclear sub"), location, and vector, giving +8 to identify it, +4 to shadow it, and +3 to hit it with an aimed attack. It does not provide any information about the object's shape or color. Once the object is detected, it can be attacked. The modifiers that applied to the skill roll also apply to the attack roll, but can never give a bonus to hit over the +3.

Hydrophones automatically detect anyone using sonar or sonar communicators at twice that system's range (or 1.5 times range if it is low-probability intercept sonar).

Small Hydrophone (TL9): +8 to the detection roll. $5,000, 5 lbs., B/1 wk. LC3.

Medium Hydrophone (TL9): +10 to the detection roll. $25,000, 25 lbs., C/1 wk. LC3.

Large Hydrophone (TL9): +12 to the detection roll. $100,000, 100 lbs., D/1 wk. LC3.

Search Hydrophones (TL9): This system is used for underwater research, fishing, or perimeter surveillance. It does not provide a targeting bonus, but costs 1/10 as much. LC4.

Add +2 to detection per TL after introduction.

Gravscanners (TL9/11^)

These devices detect the strong gravity waves produced by operating gravitic devices; see *Gravity Control* (pp. 78-79). They can also detect massive objects (a million tons or more) such as giant spacecraft, asteroids, planets, stars, or black holes. They provide an estimate of the bearing and strength of the gravity emanation. They can *receive* messages from gravity ripple comms (p. 45) but they cannot send them.

Electronics Operation (Sensors) skill is used to operate them.

Very Large Gravscanner (TL9): +6 to detection. Does not require superscience technology (unlike the smaller sensors). $500,000, 1,000 lbs., external power. LC4.

Large Gravscanner (TL11^): +12 to detection. $50,000, 100 lbs., D/24 hr. LC4.

Medium Gravscanner (TL11^): +6 to detection. $5,000, 10 lbs., C/24 hr. LC4.

Small Gravscanner (TL11^): No modifier to detection. $500, 1 lb., B/24 hr. LC4.

Add +6 to detection per TL after introduction.

Radscanner (TL10)

This detects electrical or magnetic fields and radiation sources of all kinds (including radar and radio signals, not just radioactivity). The user must set the sensor to detect a particular type of radiation, such as radio waves or gamma radiation.

The detector can provide range, strength, and bearing. It does not emit a scanning signal. Detection requires a roll against Electronics Operation (Sensors) skill.

Range depends on the strength of the source – for sensor or communicator signal detection, range is usually twice the radiating system's range. If detecting other sources of radiation, add modifiers from the Size and Speed/Range Table. If attempting to detect operating power cells, the skill roll is at -12 for an AA cell, -9 for an A cell, -6 for a B cell, -3 for a C cell, 0 for a D cell, +3 for an E cell, +6 for an F cell.

Radscanners also analyze radiation. Make a Physics or Electronics Operation (EW) roll.

Large Radscanner (TL10): +18 bonus to detection (or ×1,000 range when detecting signals). $100,000, 150 lbs., external power. LC4.

Medium Radscanner (TL10): +12 bonus to detect radiation sources (or ×100 range for signals). $10,000, 5 lbs., B/24 hr. LC4.

Small Radscanner (TL10): +6 bonus to detection (or ×10 range for signals). $1,000, 0.5 lb., AA/24 hr. LC4.

Radscanners add a +2 bonus to skill at TL11, or +4 to skill at TL12.

Active Sensors

Active sensors detect objects by bouncing energy off them and analyzing the returned signal. Radar and imaging radar emit radio or microwaves; ladar emits laser light; sonar uses sound, etc. All ultra-tech active sensors incorporate embedded digital image processing that translates the raw analog data into a comprehensible image.

Active sensors are rated for the type of sensor and a range in miles or yards. An Electronics Operation skill roll is required to use an active sensor to detect hidden targets or fine detail. Active sensors can sense objects out to their rated maximum range at no range penalty; each doubling of range beyond that gives -2 to skill.

The scanning wave of an active sensor can be detected by specialized detectors. Normally, this is at twice its range. (Most scanners radiate energy that could, theoretically, be detected at a longer range, but ultra-tech sensors operate on multiple frequencies that make detection difficult.) The detector required depends on the sensor.

Unless otherwise noted, assume an active sensor scans a 120° arc in front of it (see *No Peripheral Vision*, p. B151).

Special Modes

Targeting: Active sensors are available in tactical versions that incorporate a rangefinder mode. This works the same way for all active sensors: it generates a narrow targeting beam. It requires an Aim maneuver to "lock onto" a particular target that has already been detected. This determines its precise range and speed, and gives +3 to hit with an aimed range attack used in conjunction with targeting software (pp. 149-150).

Low-Probability Intercept (LPI): The sensor uses a rapid frequency-agile burst of radar energy. This halves range, but results in a radar signal that can only be detected at 1.5 times the halved range rather than twice the normal range.

Disruption or Blinding: Some sensors have the ability to emit high-power narrow beams that can be used as weapons – see the individual sensor descriptions.

Vehicular Arrays (TL9)

Aircraft, submarines, or spacecraft often have very large active sensor arrays that cover a sizable fraction of their surface area on one or more facings. Active arrays operate indefinitely off vehicle power; the cost and weight are included as part of the vehicle, as the capabilities depend on the vehicle's surface area.

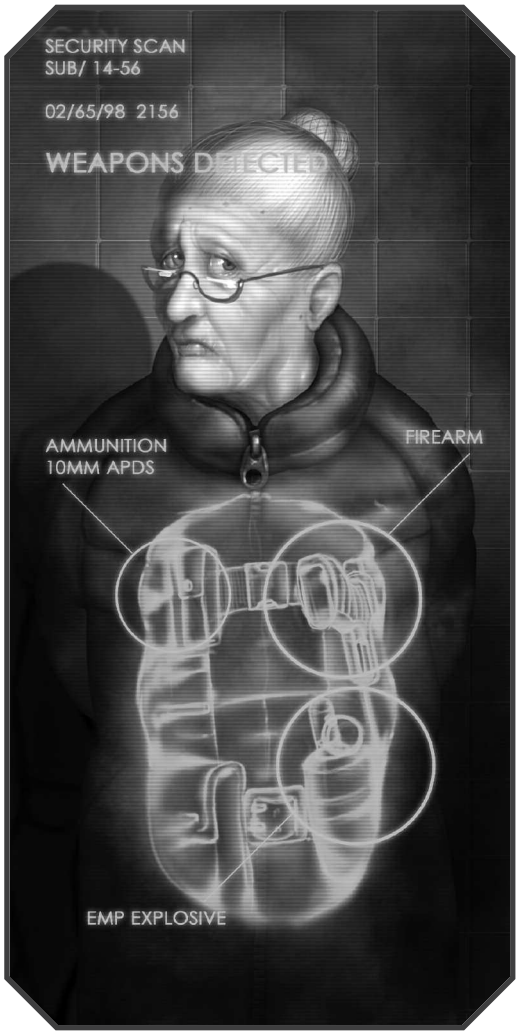
Ladar (TL9)

This high-resolution sensor emits laser energy, then analyzes the returned signal to build up a picture of the user's surroundings. A ladar can discern a target's size and shape, and pick out other physical details, such as the shape of a face. It can't determine flat detail such as writing. Anyone who can sense the signal you emit can detect the ladar, out to twice its own range.

Ladars are of limited use in detecting unknown targets due to the narrowness of the beam – make an Electronics Operation (Sensors) roll at -4 to spot a previously unknown target. However, they are excellent for identifying targets that have already been spotted by other sensors (roll at +4, even to detect fine detail such as a face).

Ladar can be used to "lock onto" a target that has already been detected. This determines its precise range and speed, and gives +3 to hit that target with an aimed ranged attack. This bonus is not cumulative with that from other active sensors that have locked onto the target.

Ordinary radar detectors do not detect ladar; specialized laser sensors (pp. 62, 188) are required. Ladar cannot penetrate solid objects. It has 10-50% range in falling rain or snow, and can be tuned to use blue-green frequencies. It functions at 1% range underwater, with an maximum range of 200 yards.



Large Ladar (TL9): A powerful ladar, usually vehicle-mounted. It has a 100-mile range (200 mi. at TL10, 500 mi. at TL11, 1,000 mi. at TL12). $200,000, 100 lbs., D/8 hr. LC4.

Medium Ladar (TL9): A portable ladar set. It can be worn as a pack, or mounted on a tripod, vehicle, or robot. It has a 30-mile range (60 mi. at TL10, 150 mi. at TL11, 300 mi. at TL12). $20,000, 10 lbs., C/8 hr. LC4.

Small Ladar (TL9): A mini ladar with a 10-mile range (20 mi. at TL10, 50 mi. at TL11, 100 mi. at TL12). It comes in a hand-held version, or attaches to a shoulder mount (p. 151), and plugs into a HUD (p. 24). $2,000, 1 lb., B/8 hr. LC4.

Small, Medium, or Large Tactical Ladar (TL9): A military-style target-acquisition ladar. It can track up to 10 targets at once out to the listed range, and gives +3 to hit any of them with an aimed attack. Cost is 5 times normal. LC2.

Ladar Smartskin (TL9)

This is a phased array ladar integrated into the vehicle's surface area. It functions as a tactical ladar with a range specified in the vehicle's description, and as a laser communicator (p. 44) with a range equal to its detection range.

Tactical Ladar Arrays: These have an "optical countermeasures" mode – see *Blinding Lasers* (pp. 113-114). Weight and cost are included in the vehicle statistics; the array can't be added later.

Laser Chemscanner (TL9)

Chemicals absorb laser energy at known wavelengths. This system uses a laser to detect airborne chemical compounds, as well as surface contaminants such as a slick of chemicals coating an object or the ground. It is most often used to identify chemical weapons or pollution levels in the atmosphere. It can also analyze the light scattered from swarms of microbots or nanomachines that are too small to otherwise resolve, identifying them by matching the patterns with known models.

A dedicated laser chemscanner is half as expensive as a ladar, but has twice the range. A chemscanner mode for a ladar adds 20% to its cost.

Multi-Mode Radar (TL9)

This provides a search mode for locating potential targets, and an imaging mode for identifying them as they get closer. The GM can assume that most moving targets that fit the radar's criteria are detected automatically. If a target is using radar countermeasures or being stealthy, the GM can require an Electronic Operation (Sensors) skill roll, or a quick contest of skill between the radar operator and the target's Stealth.

Search Radar: This searches a fan-shaped, 120-degree area in front of the user, hunting for rat-sized or larger moving targets and displaying them as blips on a screen. Darkness, smoke and bad weather do not impair it, but it cannot see over the horizon or through solid obstacles. It provides a digital readout of target speed, altitude, position, and approximate size. This mode is good for tracking vehicle-sized or larger targets, or any moving targets. It can't distinguish a moving human from a moving animal or robot of similar size. Background items make spotting stationary human-sized or smaller objects on the ground virtually impossible in anything but open terrain. Non-moving targets are impossible to distinguish from ground clutter unless the user has seen that particular "blip" moving.

Imaging Radar: This uses millimeter-wave radar. It has a shorter range than search radar, but can spot small objects and determine their shape. An Electronics Operation (Sensors) roll is needed to distinguish fine relief (e.g., to identify a face). Imaging Radar can see through thin fabric or vegetation. It gives a +3 to Search rolls to locate objects like concealed weapons, and may ignore penalties for spotting objects hidden behind light brush. Ordinary radar detectors detect Imaging Radar at -4. Imaging Radar does not work underwater. The effects are similar to the Imaging Radar advantage. It has roughly 1/10th the range of the radar in search mode.

Switching settings takes a Ready maneuver. If desired, a longer cable can connect the radar and its control panel – this sometimes proves tactically desirable, since radar emissions can be detected over quite a distance.

Large Radar (TL9): A powerful multi-mode radar suite, usually vehicle-mounted. It has a 100-mile range in search mode, 10-mile range in imaging mode. $100,000, 100 lbs., D/8 hr. LC4.

Medium Radar (TL9): A portable radar set. It can be worn as a pack, or mounted on a tripod, vehicle, or robot. It has a 30-mile range in search mode, three miles in imaging mode. It has no display screen of it own, but can be plugged into a computer monitor, HUD, or interface. $10,000, 10 lbs., C/8 hr. LC4.

Small Radar (TL9): A mini radar set with a 10-mile range in search mode, 1 mile in imaging mode. It's available in a hand-held version, or one that mounts on the shoulder and plugs into a HUD. $1,000, 1 lb., B/8 hr. LC4.

Small, Medium, or Large Tactical Radar (TL9): Military-style multi-mode radar. It can track up to 10 targets at once out to the listed range, identify them at 1/10 that range, and give +3 to hit any of them with an aimed attack. Cost is 5 times normal. LC2.

Double range at TL10, multiply it by 5 at TL11, and multiply it by 10 at TL12.

Tactical Active Electromagnetic Sensor Array, (AESA) (TL9)

Ultra-tech vehicles sometimes have large multi-mode tactical radar antenna arrays buried in their hulls, often covering a good fraction of their surface. These arrays are rated for their range in miles; see the vehicle descriptions.

AESA arrays are powerful enough to be used in *disruption mode*. This uses a narrow microwave beam to jam or burn out enemy electronic systems. See *Microwave Disruptors* (p. 121) for the combat statistics of AESA arrays.

A vehicular AESA operates indefinitely off vehicle power. Cost and weight are included in the vehicle's statistics, as the capabilities depend on the vehicle's surface area.

Sonar (TL9)

This is an active sonar using ultrasonic sound waves. Sonar can spot small objects and determine their shape, but an Electronics Operation (Sonar) skill roll is required to distinguish fine relief (e.g., to identify a face). Sonar can be "jammed" or fooled by explosions and other loud noises. Individuals or devices with Ultrahearing can detect sonar.

Sonar gadgets must be designed for air or water. Standard range is for underwater sonars. Air sonars have shorter ranges: 1/10th normal, multiplied by air pressure in atmospheres (one atmosphere on Earth). All sonars are ineffective in vacuum.

Electronics Operation (Sonar) rolls are used to detect objects. Ambient noise from sea life and other ships will interfere with detection; apply a -1 penalty for being near noisy sea life, or -6 for detecting an object in a busy, cramped harbor.

A sonar can sense objects out to its rated maximum range at no penalty; each doubling of range beyond that gives -2 to skill. Detection is limited to a 120° arc. Under ideal conditions, sonars can be detected at twice their own range, but ambient noise can interfere.

Large Sonar (TL9): A powerful multi-mode sonar suite, usually vehicle-mounted. It has a 20,000-yard range. $20,000, 100 lbs., D/8 hr. LC4.

Medium Sonar (TL9): A portable sonar, often used by small boats or underwater robots. It has a 2,000-yard range. $2,000, 10 lbs., C/8 hr. LC4.

Small Sonar (TL9): A small sonar used by divers, underwater battlesuits, and robots. It has a 200-yard range. It comes in a hand-held version or one that mounts on the shoulder and plugs into a HUD. $200, 1 lbs., B/8 hr. LC4.

Tactical Sonar (TL9): Military-style multi-mode targeting sonar. It can track and identify up to 10 targets at once out to the listed range, and gives +3 to hit any of them with an aimed attack. It is 10 times the cost of ordinary sonar. LC2.

Double range at TL10, multiply it by 5 at TL11, and multiply it by 10 at TL12.

Terahertz Radar (TL9)

This uses the "t-ray" wavelengths that lie between infrared radiation and the millimeter-waves used by imaging radar. A terahertz radar can penetrate clothing, brush, or thin walls (up to a few inches thick) to see inside objects. It can also be used to spot small objects and determine their shape, and eliminates penalties to spot objects behind light cover. It gets +4 to locate concealed weapons, and while it still requires an Electronics Operation (Sensors) roll to distinguish fine relief, this roll is also at +4. Only special-purpose sensors can detect its radar emissions. It doesn't work underwater.

Large Terahertz Radar (TL9): 2,000-yard range. $200,000, 100 lbs., D/10 hr. LC4.

Medium Terahertz Radar (TL9): A portable radar set. It has a 600-yard range. $20,000, 10 lbs., C/8 hr. LC4.

Small Terahertz Radar (TL9): 200-yard range. $2,000, 1 lb., B/10 hr. LC4.

Tactical Terahertz Radar (TL9): It can track up to 10 targets at once out to the listed range, and gives +3 to hit any of them with an aimed attack. It is 5 times normal cost. LC2.

Double range at TL10, multiply it by 5 at TL11, and multiply it by 10 at TL12.

Ultrascanner (TL11^)

This is a multi-function superscience sensor suite. It ranges and images the target, analyzing its emissions and composition. It can even see through solid objects, scanning the interior of the target and providing details on any occupants and machinery. It works in any environment. Ultrascanning sensors are common "space opera" sensors.

An ultrascanner can be tuned to function in any of these additional modes:

Imaging: This setting functions like imaging radar (p. 65), except it can operate underwater, and cannot be detected or jammed by systems that affect normal radar.

Scan: This functions like imaging radar (p. 65) except it can operate underwater, and cannot be detected or jammed by systems that affect normal radar. It can also penetrate up to 6" of solid matter. It gives detailed information about the composition, energy output, radiation emissions, and other characteristics of non-living objects. It allows detailed analysis from a distance with scientific skills such as Chemistry and Physics. It can be used to detect specific systems within a complex machine, and analyze them using Engineer skill.

Bioscan: This setting provides the vital signs and biochemical information the target and anything living on its surface. It lets the operator use Biology and Diagnosis skills at a distance, and can examine living beings *inside* inanimate objects, such as the passengers of a spaceship.

Search: This setting functions like ordinary radar (p. 64), except it can operate underwater, and cannot be detected or jammed by systems that affect normal radar.

Radscan: The sensor can also operate in passive mode, as a radscanner (p. 63).

The following types are available:

Large Ultrascanner (TL11^): It has a 10-mile range (100 miles in search mode). In radscanner mode, +12 to detection. $200,000, 100 lbs., external power. LC3.

Medium Ultrascanner (TL11^): It has a 3-mile range (30 miles in search mode). In radscanner mode, +9 to detection. $20,000, 10 lbs., C/4 hr. LC3.

Small Ultrascanner (TL11^): This sensor has a 2,000-yard range (10 miles in search mode). In radscanner mode, +6 to detection. $2,000, 1 lb., B/4 hr. LC3.

Tactical Ultrascanner (TL11^): In search, bioscan, or imaging mode, it can track up to 10 targets at once out to the listed range, identify them at 1/10 that range, and give +3 to hit any of them with an aimed attack. Five times normal cost. LC2.

Double range at TL12^, and add +2 to detection for radscan.

Combination Sensors

Extensible Sensor Pod (ESP) (TL9-12)

This expensive sensor suite is used by special ops teams or battlesuit troopers for urban warfare. Often, only recon specialists will be equipped with it. It's a backpack unit with a short periscope, tipped with a multi-sensor head. It swivels, and can be extended up to a yard vertically or horizontally. This lets the user see around corners or over cover. If shot at, the periscope is SM -8, HP 4, and DR 20).

The pod has a sound detector (p. 62) and a hyperspectral imaging sensor (p. 61), both with 4× (TL9), 8× (TL10), 16× (TL11) or 32× (TL12) magnification, plus a tactical terahertz radar (p. 65) with a range of 100 yards (TL9), 200 yards (TL10), 500 yards (TL11), or 1,000 yards (TL12). Terahertz radar can see through thin walls and brush, which is very useful for house-to-house fighting! The user will need a HUD and either a terminal or a neural interface to use it. $50,000, 10 lbs., 2C/100 hr. LC3.

Ultra-ESP: This superscience upgrade replaces the terahertz radar with an ultrascanner (TL11^, above) that has the same range. Otherwise, it's identical.

Tactical Sensor Turret (TL9)

This battlefield sensor system uses a rotating mini-turret to look in any direction. It includes a set of hyperspectral imaging sensors with 10× (TL9), 20× (TL10), 50× (TL11), or 100× (TL12) magnification and a tactical ladar (p. 64) with a range of 10 miles (TL9), 20 miles (TL10), 50 miles (TL11), or 100 miles (TL12).

It must be controlled from either a terminal (pp. 23-24) or neural interface (pp. 48-49).

Two versions are available:

Sensor Turret: A ball turret installed on the roof or in the nose of vehicles. It can also be placed on top of a building. $300,000, 70 lbs., external power. LC3.

Sensor Periscope: The same system on a telescoping mast that can be extended up to seven yards (21') above the roof of the vehicle or base camp it is installed in. Often used by submarines, and by specialized armored fighting vehicles that need to look over hills. $350,000, 150 lbs. LC3.

Scientific Equipment

This section describes laboratory equipment and specialized sensing tools.

Portable Laboratories (TL9)

These provide the scientific equipment necessary to conduct research "in the field, " away from specialized analysis systems and large research facilities. Portable labs include an array of scientific instruments, a dataport for linking them to a personal computer, and sealed sub-compartments for storing solid, liquid, and gaseous samples. They fulfill the basic equipment requirements for gathering and analyzing samples at the lab's TL.

Portable labs are available for the Archaeology, Biology, Chemistry, Farming, Forensics, Geology, Metallurgy, Paleontology, and Pharmacy skills. For example, a suitcase chemlab allows anyone with Chemistry skill to analyze complex compounds, including planetary atmospheres, and exotic alloys. It can also manufacture small quantities of explosives and other chemical compounds.

Many of these labs incorporate "laboratory on a chip" systems that purify, separate, pump, stir, filter, and transfer miniscule samples of gases, liquids, cells, or bacteria with single-molecule accuracy.

Portable labs do not improve by TL; instead, they allow use of higher-TL applications of the skill.

Suitcase Lab (TL9): Fulfills basic equipment requirements for using the skill. Takes at least 10 seconds to set up or pack. $3,000, 10 lbs., 4C/10 hr. LC4.

Pocket Analyzer (TL9): These systems are basic equipment for analysis of small samples. They are -5 for other tasks. $500, 0.6 lbs., 2B/5 hr. LC4.

Semi-Portable Lab (TL9): Contains good-quality scientific equipment; it takes a minute to set up or pack. +1 (quality) bonus to the skill. $15,000, 40 lbs., 2D/10 hr. LC4.

Mobile Lab (TL9): Enough lab equipment to fill a room; it takes at least 15 minutes to set up or pack. +2 (quality) bonus to the skill. $75,000, 200 lbs., external power. LC4.

Sensor Gloves (TL10)

These gloves are equipped with sensitive tactile, pressure, chemical, and biometric sensors. They can weigh items by lifting them, measure the hardness and smoothness of materials, detect chemicals, read ink printing, and scan any of this information into computer memory by touch. The user's fingertips can sense residual heat in a chair, or feel faint vibrations in the floor as someone approaches. Add +4 to any task using the sense of touch; e.g., a Forensics roll to note the similarities or differences between two pieces of fabric, or a Search roll to feel out tiny concealed objects.

At higher TLs, the gloves are more sensitive: add +2 at TL11, or +4 at TL12. They can be built into armor or suit gloves. The bonuses from Sensor Gloves are not cumulative with bonuses from the Acute Touch or Sensitive Touch advantages. Each glove: $1,000, 0.2 lbs., A/2 wk. LC4.

Wristwatch Rad Counter (TL9)

This measures and displays the amount of radiation that the user is exposed to, and can be programmed to set off an alarm if dosage exceeds a designated level. The same unit can present information on an HUD, or be built into a helmet visor. $100, neg., A/6 mo.

Timescanner (TL9^/11^)

A timescanner is a device that can be used to see into the past; it is useful for archaeologists, detectives and genealogists. When activated, it provides a holographic image of whatever happened within a two-yard radius of the scanner. Nothing outside that area can be seen – it can't be used as a "window" to scan the surrounding landscape. The place being scanned is relative to the nearest large mass (large being continent-sized). Thus, a timescanner can only be used to scan planetary surfaces.

A timescanner must be set for an arbitrary point in time in the past, e.g., 31 years, 84 days, 11 hours, and 50 minutes ago. Make a skill roll against Electronics Operation (Sensors or Temporal). A successful roll means the scanner has locked onto the correct period. Failure means that the mark was missed by 10% times the margin of failure (plus or minus, roll randomly). A critical failure means that it could be seeing *anywhen*. Other than visual evidence ("Why are they wearing togas? Are you sure this is 1945?"), there is no way to tell if the scanner is focused on the correct time.

The more distant the period to be scanned, the longer it takes the scanner to reach it. It takes 90 minutes to focus on something within the last 24 hours, three hours to focus on something within the last 10 days, six hours to focus on a point three months distant, 12 hours to focus on a point within the last two and a half years, 24 hours to focus on something within 25 years, two days to focus on something within 250 years, and so on. Each tenfold increase in temporal distance doubles the amount of time that it takes the scanner to reach that period.

After the scanner is ready, it projects the visual image of the area it occupies, which continues in "real time" until the scanner is deactivated. This can be unhelpful if, in the time being scanned, the area presently occupied by the scanner is filled with solid material.

For example, archaeologists take a timescanner to the ruin of an ancient palace. They set it up, then use astronomical data to choose an early morning exactly 3,200 years ago, the approximate date it was built. It takes four days for the scanner to reach back that far (whether it shows brief glimpses of intervening periods is up to the GM), and start relaying images.

What the archaeologists see is two halves of different rooms – a wall once bisected the area now occupied by the scanner. In one room, the scanner shows a bit of rug, and the corner of a chair. In the other room, the archaeologists can see half a bed, holding the bottom half of someone sleeping under a fur cloak. If they want to see more, they would have to wait for someone to come into the timescan field (perhaps the sleeper will get up and move into view). They could also try again, either resetting the time to be observed or physically moving the scanner. Either action breaks the lock.

If temporal technology is possible, timescanners are often developed at relatively low TLs. Portable models become available at very high TLs.

Timescanner (TL9^): A room-sized facility. $800,000, 10,000 lbs., external power. LC2.

Time Viewer (TL11^): A semi-portable unit. $100,000, 100 lbs., E/32 days. LC2.

Chapter Four

Housing, Tools, and Survival Gear

The Yezendi antimatter syndicate was smuggling its product to both blocs on Sargon, a balkanized powder keg with too many people and too many nukes. The syndicate was only shipping in a few grams – but with it,, the rival alliances could upgrade the fission triggers on their nukes into clean fusion devices. That would make a nuclear war thinkable – and unjammable. It was up to me to stop it happening.

I had an inside line: a smuggler's wife named Adrienne Morrigan, who had discovered what they were up to and couldn't live with it. The syndicate killed her. But not before she'd passed me the location of their covert antimatter storage facility: Leonidas City, under the old mag-lev subway tunnel beneath Spinnaker Joe's Garage.

Thanks to the datachip Adrienne had stolen, I also had a list of the off-world tech defenses that her husband had shipped in – laser grids, hyperspectral cameras, security bots – and with the right equipment, I knew I could get in.

I didn't have everything I needed – but I did have an ace in the hole. My stealth luggage concealed a suitcase nanofac – the spy's best friend. I programmed it to build:

A mini tool kit and X-ray laser torch.

An antimatter storage field box.

A monowire switchblade.

A full suit of ablative body armor with a multispectral chameleon surface.

– Special Agent Gabrielle, Imperial Secret Service

Without advanced tools and materials, there wouldn't be any "ultra-tech." This chapter describes manufacturing systems, architectural technologies, and essential equipment for use at home or in the field.

Housing and Food

Ultra-tech domestic technologies may just be background details, but they can also be pressed into service by adventurers. The heroes, or their foes, may reprogram a cleaning robot as a spy or saboteur, or use domestic nanocleanser to clean up telltale forensic evidence.

Domestic Equipment and Appliances

These may be common ultra-tech household items, or luxuries for the rich.

Housebot (TL9-11)

58 points

This small domestic robot serves as a waiter, janitor, or homemaker, depending on how it is configured. Its internal payload space can accommodate a garbage can, vacuum cleaner, microwave oven, ultrasonic dishwasher, or a reservoir for cleaning agents. It is designed to run quietly, to avoid disturbing people while working. It moves on wheels at TL9, or on legs at TL10+. At higher TLs, these robots are often replaced by cleaning swarms or utility fog.

Attribute Modifiers: ST-3 [-30]; HT+2 [20].
Secondary Characteristic Modifiers: SM-1; HP+5 [10].
Advantages: Absolute Direction (Requires signal, -20%) [4]; Doesn't Breathe [20]; DR 5 (Can't Wear Armor, -40%) [15]; Infrared Communication (Reduced Range 5, -20%) [8]; Machine [25]; Silence 2 [10]; Payload 2 (2 lbs. cargo) [2]; Radio (Secure, +20%) [12].
Perks: Accessory (Cleaning equipment, tiny computer) [2].
Disadvantages: Electrical [-20]; Restricted Diet (Very Common, power cells) [-10]; Striking ST -2 [-10].

Model Lenses

Pick *one* of the following lenses:

TL9 Model (-30 points): Bad Grip -1 [-5]; Maintenance (one person, weekly) [-5], Wheeled [-20]. $4,000, 20 lbs., C/8 hr. LC4.

TL10 Model (+6 points): Extra Legs (four) [5], Reduced Consumption 2 [4]; Maintenance (one person, bi-weekly) [-3]. $1,000, 20 lbs., C/24 hr. LC4.

TL11 Model (+9 points): Extra Legs (four) [5], Reduced Consumption 3 [6]; Maintenance (one person, monthly) [-2]. $1,000, 20 lbs., C/1 week hr. LC4.

Responsive Beds (TL9)

This bed can adjust to the shape of the sleeper, responding to voice commands to become softer, firmer, or bouncier as desired. Adds +1 to Erotic Art skill if used inventively, and adds +TL/2 to any Will rolls made to get to sleep.

Single: $500, 100 lbs.

Double: $700, 140 lbs.

Sleep Set (TL10-11)

A programmable ultrasonic or neural induction headset that gives the user the equivalent of the Deep Sleeper perk, and also provides Protected Hearing.

TL10: $400, 0.4 lbs., A/1 day.

TL11: $200, 0.1 lbs., A/3 days.

TL12: $100, 0.025 lbs., A/10 days.

Autokitchen (TL10-12)

This automated kitchen is fitted with a complete set of robotic manipulator arms. It can cook on command using its own skill, or it can duplicate the moves of a live chef. One chef could control a dozen or more autokitchens scattered around the world.

TL10: Cooking-10. $20,000, 400 lbs.

TL11: Cooking-11. $10,000, 200 lbs.

TL12: Cooking-12. $5,000, 100 lbs.

All use external power. LC4.

Domestic Nanocleanser (TL10)

This "smart soap" is a solution of microscopic cleaning robots that work to remove stains, grime, dirt, dandruff, and loose skin flakes from surfaces. Domestic nanocleanser can serve as a shampoo, soap, or detergent. A teaspoon of nanocleanser powder poured into water will clean anything immersed in it in 10 to 60 seconds. It also comes in premixed liquid-detergent form, useful if water is unavailable.

Washing in nanocleanser can be unsettling to those unused to its tingling sensation, but it can also be pleasant. The robots themselves are biodegradable and non-toxic, smart enough not to scrub hard enough to scratch, and programmed to break down harmlessly if exposed to ultraviolet light or the interior of a living body.

Domestic nanocleanser can disrupt forensic evidence such as bloodstains, skin flakes and other organic residue. While it doesn't work as well as the Mask spray (p. 160), treating an area with it imposes a -3 penalty on any Forensics rolls made to locate or analyze such evidence. TL10+ Forensics will be able to identify the brand of nanocleanser used, which may itself be a useful clue!

A bottle of nanocleanser lasts for about a week of routine domestic cleaning or one major cleaning job, such as thoroughly wiping down an apartment to remove evidence.

Nanocleanser adds a quality bonus of +5 (TL10) or +6 (TL11-12) to Housekeeping skill rolls to clean up things. A bottle is 1/2 pound and costs $10. A bar (for washing hands, etc.) is 0.1 lb. and costs $1.

Domestic Nanomist (TL11): A spray that covers a 3-yard radius. $10, 0.5 lbs. LC4.

Cleaning Swarm (TL10)

This common swarm is programmed to move around a predetermined area, removing dust and grit, and polishing smooth surfaces with tiny brushes. Its sensors determine when material might be damaged by its actions; a cleaning

swarm can safely polish lenses, and even harmlessly clean people! Each square yard of swarm can thoroughly clean one square yard area per minute. Some large craft and buildings have permanent colonies of cleaning swarms to polish windows, ports, and sensors. The swarm gives a +2 (quality) bonus to Housekeeping skill. Aerostat cleaning swarms may be popular installations in doorways, bathrooms, and showers. $1,000/square yard. LC4.

Domestic Android (TL10)

General-purpose androids (p. 41) are often purchased as humanoid butlers or maids.

Sonic Shower Head (TL10)

This is found in many homes and starship cabins, and on water-poor worlds. An ultrasonic spray unit clipped to a wall simultaneously cleans and massages the user. It uses building or ship's power. $400, 10 lbs., LC4.

Food Factory (TL11-12)

This machine converts any biological substance (grass, meat, appropriate chemicals) into edible food, removing toxins and harmful microorganisms while adding vitamins and nutrients. As long as the factory has a source of compatible protein, food can be created indefinitely, though its store of vitamin supplements will run out after one man-year of use. It can use nearly any organic substance, terrestrial or alien. It works automatically, taking one to six hours (depending on the quality of the raw material) to process enough for a single meal. The processor can also distill simple organic compounds, such as alcohol.

Kitchen Foodfac (TL11-12)

Produces "simulated" food and drink that looks and tastes like a meal prepared by someone with Cooking-12. For people who still like to cook, it also can create high-quality ingredients instead of finished food; it adds a +1 (quality) bonus to Cooking skill.

TL11: $40,000, 25 lbs., D/300 meals, or external power. LC4.

TL12: $10,000, 10 lbs., D/1,000 meals, or external power. LC4.

A gourmet foodfac is 4 times the normal cost. It produces fine quality food and adds a +2 (quality) bonus to Cooking skill.

Survival Foodfac (TL11-12)

A lightweight, no-frills model for emergency use in the field, low-rent tenements, etc. It produces a dry, flaky cake with a remarkable similarity to pet food. Flavor additives can make it more palatable. One hundred additive packets (each good for one meal) weigh five pounds and cost $10.

TL11: $10,000, 10 lbs., C/30 meals. LC4.

TL12: $3,000, 3 lbs., C/100 meals. LC4.

Antigrav Hammock (TL11^-12^)

The user can float in mid-air above the antigrav plate, which incorporates a low-powered tractor field to hold him in position. Antigrav beds are useful for long-term medical treatment – as there is no contact with a mattress, there are no bedsores, and no irritation for rashes, burns, or other injuries. These hammocks also have their recreational uses (+1 to Erotic Art).

TL11^: $20,000, 20 lbs.

TL12^: $5,000, 5 lbs.

Multiply weight and cost by 1.5 for a double hammock that sleeps two.

Uses external power. LC4.

Floating Furniture (TL11^-12^)

Chairs, tables, and serving trays can use contragravity generators to float in mid-air, or move up to three yards/second. They are controlled by voice or neural interface. Floating furniture costs 10 times as much as ordinary furniture at TL11, or 2.5 times as much at TL12. Floating furniture often uses external power or broadcast power.

Floater Chair (TL11^): $1,000, 20 lbs., D/1 day. LC4.

Floater Chair (TL12^)*:* $250, 10 lbs., D/3 days. LC4.

Utility Fog (TL12)

This is a nanobot aerostat swarm (p. 36). It consists of countless cell-sized nanobots ("foglets"), each equipped with a dozen hooked arms. The bots can lock together to form a solid object upon voice command. Utility fog allows free motion through it while it is in cloud form.

One cubic yard of utility fog can form objects of up to one pound in weight; larger fogs can form more massive objects. Utility fog swarms can form ordinary solid materials like chairs as well as mechanical and electronic devices. Objects formed from utility fog cannot include exotic elements, special alloys, or organic components, nor can the fog create other types of nanomachines. Thus, a rocket engine, a power cell, and many high-energy weapons may be impossible. The GM should feel free to use this requirement to limit things he doesn't want constructed out of thin air. In general, very tough objects can't be formed: the maximum DR is 12.

Once solidified, an object can be moved. On command, it will dissolve back into fog, remaining where it was moved to. The fog can't be moved in its cloud form.

Utility fog has a base cost of $10,000 per square yard; this includes the aerostat option. Other *Swarm Chassis* options (pp. 35-36) are possible. Legality Class depends on the minimum LC of the item its program allows it to make.

Housing and Construction

In some ultra-tech societies, construction remains much as it has been since TL6, with the only changes being electronics and appliances. Other possibilities are more exotic, including buildings composed entirely of nanomachines or force fields.

The Intelligent House (TL9)

Houses, apartments, hotel rooms, and passenger ship cabins may include a voice-activated computer system that controls climate, domestic appliances, security, and communications. The system is programmed to respond to the occupants' voiceprints. Cheaper apartments tie into the landlord's main building computer, which provides similar services, but with less security. Very cheap tenements can be prone to malfunctions . . .

Media wallpaper permits the illusion of vast space to be created. Most ceilings, and usually at least one wall, may be used as a giant-sized computer or video screen.

Domed Cities (TL9)

An entire town or city may be enclosed by a transparent dome. A low-tech version for a terrestrial habitat could be wire-reinforced shatterproof glass, mist-plated with aluminum to cut sun glare while still letting in light. From the outside it would appear like a giant mirror; from the inside it would be almost invisible. A dome about two miles wide and a mile high would weigh about 4,000 tons. With TL11^ superscience, force field domes are also possible – see *Under the Screen* (p. 72).

Space Habitats (TL9-11)

Large, manufactured habitats are usually built using titanium, aluminum, and steel mined from moons or processed from asteroids. Gravity can be simulated by rotation, and power drawn from solar collectors or reactors. A thick shell of slag left over from mining and ore-processing operations can provide radiation shielding.

O'Neill Cylinders (TL9)

These are the largest and most expensive space habitats. They are giant cylinders (or paired cylinders) a few miles wide and several miles long, rotating to simulate Earth-normal gravity. Inside is a complete environment with park and urban landscapes. An O'Neill cylinder can house a few million people. Large populations may be supported by additional agricultural habitats.

Stanford Torus (TL9)

Smaller than the O'Neill cylinder, but still very large. A typical torus is shaped like a bicycle wheel, with gravity and landscaping on the floor of the outer rim. The spokes are elevators that lead to a central microgravity hub. A typical model houses 10,000 to 100,000 people. Radiation shielding is a major expense.

Bernal Sphere (TL9)

This is a sphere of any size, with smaller cylinders attached around it. The central sphere rotates; the cylinders do not. The sphere is simple to build, but the rotation only simulates gravity in a strip around its equator. This can be inconvenient without superscience artificial gravity.

Asteroid Hives (TL9)

Instead of using an asteroid as raw material, it can be completely or partially hollowed out, with people living in tunnels inside. A large asteroid such as Ceres could support billions of inhabitants.

Dyson Trees (TL10)

These genetically-engineered trees (or living machines resembling trees) are adapted to space conditions and planted on comets. They grow to enormous size in microgravity. Their leaves serve as solar collectors, and their bodies house cities.

Macrohabitats (TL10/10^)

If microgravity is tolerated or TL10^ contragrav generators (p. 223) are used, space habitats could be thousands of miles across without exceeding material strength limits. A large asteroid or moon might be dismantled into dozens or hundreds of continent-sized habitats.

Super O'Neill Colony (TL11)

If manufactured using carbon nanocomposites and diamondoid, the largest enclosed space station that is structurally sound while rotating to simulate Earthlike gravity would be a cylinder 550 miles in diameter and 2,750 miles long. It could comfortably house 75 billion people.

The Flexible House (TL10):

At TL 10, an intelligent house (above) can have a *sapient* brain that handles everything from doing the dishes to tutoring the children. It is smart enough to anticipate the owner's desires, which may be good or bad. When someone says a house or apartment has personality, they may mean exactly that.

Within the house, domestic products can be made of smart, self-repairing materials. Living carpets may clean themselves. Beds, tables, and chairs may assume different shapes, textures, and colors to fit the occasion, or be absorbed into the walls and floor when not in use. Artifacts and interior partitions may change color with a word to the house computer.

These houses give a +2 (quality) bonus to Housekeeping skill. A typical three-bedroom home is $100,000.

Castles in the Air (TL10^)

Contragravity generators let unmodified humans live nearly anywhere in Earthlike comfort. Floating buildings, or even cities, are possible, usually with multiply-redundant power plants in case of failure. With TL11+ biotechnology, the cities might even be alive! A less extravagant dwelling is the contragrav houseboat, which can be tethered just above the trees – or above the clouds.

Contragravity lets mineral-rich high-G worlds be settled without having to worry about exoskeletons or creating variant humans. Artificial-gravity generators can supply normal gravity to asteroids and small moons, and sprawling orbital cities can be constructed without worrying about providing spin.

Phantom Places (TL10^)

Holotech projectors can create illusionary partitions and art images; redecoration is as easy as changing programs. Any room in the home or apartment might seem to be floating in starry space, or hidden in a tropical jungle. Scented air conditioning and realistic audio effects can complete the illusion.

Star Habitats (TL10-12)

An entire star can be partially or completely enclosed. Societies might build them in systems lacking habitable planets, or to collect power for major industrial projects like large-scale antimatter construction. (A sun-like star has an output of around 4×10^{26} watts). These projects generally require self-replicating machines (p. 92) to build.

All of these structures could also enclose larger or smaller bodies – a ring or sphere around a small red dwarf star would be easier to build. Stellar structures are generally so large that the curvature of the horizon would be invisible; standing on the inside of a Dyson sphere would be like standing on a flat surface with a large bowl overhead. Common examples are:

Dyson Bubble (TL10)

A loose array of light sails and solar energy collectors which beam energy to other habitats. It would require the mass of a large asteroid to be dismantled and used to manufacture solar collectors. This type of Dyson sphere could be built as part of a project to power lightsail-equipped starships.

Classic Dyson Sphere (TL11)

A shell of energy collection platforms and habitats orbiting independently around a star. The star would be dimmed, but possibly still visible through gaps in the shell, although the whole sphere would shine very brightly on infrared. It requires dismantling a number of planets.

Rigid Dyson Sphere (TL12^)

A solid shell around a star, with the inner side sculpted into continents, oceans, etc. with a surface area of over 600 million Earths. It would be a microgravity environment unless artificial gravity generators were used. Building it requires dismantling a solar system and using exotic materials. Multiple, layered spheres are also possible.

Ringworld (TL12^)

This is a solid ring around a star, with the inner side sculpted into continents, oceans, etc., rotating for gravity. A typical ringworld has an area of 20,000 Earths. The rotational stresses involved require superscience building materials. It is also unstable: a space drive or tractor-beam anchoring system is needed to keep the ringworld from drifting into its sun. Variations such as giant disks or tangled tubes are also possible.

The House that Lives (TL11)

Biotech developments may make it economical (though not always fashionable!) to grow living houses with warm fleshy walls, cell-like membranes for doors, and extrudable furniture. A living house thrives on human waste products and other garbage. It may also have security features that let it *digest* intruders; a classic cinematic plot has such a house being sabotaged so that it devours the occupants.

At TL11, a typical three-bedroom home drops to $50,000. LC3.

Under the Screen (TL11^)

By generating a low-power barrier screen (p. 191) over a city, planners can dispense with solid domes or underground dwellings – and won't have to worry about bad weather, either. Or a homesteader can buy a smaller field generator and power plant and set up on the asteroid of his choice. Of course, if the field goes down, he's in trouble – unless he has a backup generator on.

With a powerful force screen and an antigrav generator, a research station could be built deep within a gas giant's crushing atmosphere, or hovering within a star. The engineering problems would be immense, but think of the view!

The House in the Fog (TL12)

At TL12, houses are often filled with utility fog (pp. 70-71) that replaces some or all solid interiors.

Force Field Houses (TL12^)

Advanced houses may be made almost entirely of structural force shields (p. 192). They might be filled with utility fog, or use internal force field projections, tractor beams, and gravitic fields for furnishings, overlaid with holoprojections as necessary.

Pocket Universes (TL12^)

If the forces that created our universe were purely physical, it might be possible to replicate or at least model them artificially, possibly with a high-energy particle accelerator. This is playing God on a grand scale.

If a "new universe" were created, it might occupy its own separate space, usually with some anchor point in our own space that allows its creators to visit or observe it. A telegate (pp. 233-234) could anchor it to a specific point in our own universe. Sometimes a volume of normal space is "pinched off" to become the pocket universe.

The physical laws in such a pocket universe could be similar or different. Time might pass more quickly or slowly there (at least from our perspective). A pocket universe is generally smaller than our own; it might range from microscopic to the size of a galaxy. Most vary in size from a room to a solar system. It is usually stable, although some pocket universes may expand or contract over time. Its size may be a function of its age (if such universes expand) or the amount of energy that was used to create it.

Pocket universes with normal physics might provide the ultimate hiding places from any mundane form of detection, or just extra rooms in a house. The most common example of a pocket universe is an object that is bigger on the inside that it is outside – often a building, vehicle, or container.

Extradimensional sensors, weapons, communicators, or drives that require interaction with the outside are rarely usable from within the pocket dimension unless they themselves work across dimensions (GM's option). The GM may also rule that certain systems, such as matter transmitters or parachronic conveyers, can operate even if stored extradimensionally. It may be possible to create dimensional "windows" that allow weapons, sensors, communicators, etc. to direct their emissions into real space; these are points of vulnerability, however, and can be targeted by anyone seeking access to the extradimensional room.

A typical pocket universe is a bubble several yards across. The lower half contains a small total-conversion power plant, life support, gravity generators, and the equipment which originally created and now maintains the pocket.

The upper hemisphere can be furnished as the owner desires, perhaps incorporating a suite of rooms, a laboratory, even soil and a garden. Using this technology, what looks like a small shuttle could have the capacity of a dreadnought, or a phone booth could conceal a palace. Entry requires access to a special extradimensional teleporter, such as a telegate (pp. 233-234) fixed to its coordinates.

Pocket universes require specialized, expensive hardware to create. If normal space is "pinched off" into a pocket universe, cost scales with size: find the universe's Size Modifier (see p. B550), add 10, and multiply by $10 million; minimum cost is $10 million. For example, a sphere 100 yards in radius would be 200 yards across (SM +12) and get +2 SM due to its shape, for a final SM +14. It would cost $240 million to create. The equipment used to pinch off the pocket universe weighs one ton per $10 million cost. Cost and weight include an appropriate total conversion reactor or other exotic power supply. LC2.

Dimensional Interface (TL12^)

When a pocket universe is created, the "other side" will also need a dimensional aperture or anchor (basically a wormhole). This has the same statistics as a normal-range telegate (pp. 233-234), but is 10 times the cost. If damaged or powered down, the contents of the pocket dimension are inaccessible. The destruction of the dimensional interface may result in the components (and anyone in them) being totally lost. The GM may rule that interfaces for sensors and other systems that require windows are 100 times normal cost.

Foodstuffs

Ultra-tech food includes familiar agricultural-based products and various cheap and nutritious (but not always tasty) foods produced from algae, fungi, nanofabrication, or chemical synthesis. Space habitats and other closed environments may make extensive use of recycling, and even convert dead inhabitants into edible form. TL9+ biotechnology permits unusual tastes that could never be found in nature, as well as "pharm foods" with built-in vitamins, nutrients, or drugs. At TL11-12, food can be synthesized in nanofacs (pp. 91-93) or replicators (pp. 93-94).

Meal Pack (TL9)

These packaged meals have little weight or volume, yet supply the nutrition and calories needed to keep a person active for extended periods. Although long-term use could cause some discomfort or weight gain, they are usually tasty and provide enough variation for almost everyone to have a favorite. Stored meal packs have a safe shelf-life of 10 years. They come in dozens of variations, with randomly selected main courses, side dishes, and dessert. The packages can heat or cool themselves, and are sealed against the outside environment. $2, 1 lb. per meal.

Higher-TL meal packs have the same weight, but possess a longer shelf-life: 20 years (TL10), 50 years (TL11), or 100 years (TL12).

Survival Rations (TL9)

These are designed to put the maximum amount of nutrients into the smallest sealed package; the flavors are limited. They have a safe shelf-life of 15 years, provided the package is not tampered with. Each meal is $5, 0.5 lbs. Higher-TL rations taste somewhat better (but do not match the flavor of meal packs), and possess an extended shelf-life: duration is 30 years (TL10), 70 years (TL11), or 150 years (TL12).

Food Tablets or Paste (TL9)

These tablets or paste-filled tubes provide all the vitamins and calories that an active person requires. They also incorporate appetite suppressants. A one-day supply (usually split into six to 12 individual meals) is $10, 0.75 lbs.

Cyborg paste is a nutrient formula designed for cyborgs that still require some sustenance for their organic parts. It comes in a feeding tube that is inserted into the cyborg.

Food Vats (TL10)

These create an endless supply of imitation vegetables, lean meat, fish or other foodstuffs. Gengineered cells from plant or livestock tissue are cultured in growth tanks and supplied with nutrients. This creates a continuously growing biomass, which is harvested whenever food is required or it gets too big for its vat. In some societies vat-grown food may replace other animal or plant products, which might be considered unhealthy or even barbaric.

Careful control of the growth process allows for tailored products (for example, combining different types of cells), and additives can be usd to alter the taste.

Expedition Gear

This section covers gear suited for "outdoor activities" like climbing, diving or orienteering, as well as general adventuring.

Lights

An ordinary light source can be more useful than the most sophisticated sensors!

Flashlights and Searchlights (TL9)

These can project an infrared, ultraviolet, or visible light beam, which is also tunable from a wide flashlight cone to a pencil-thin red or blue-green laser pointer (range is multiplied by 10). It can function as a blinding weapon in a pinch – see *Dazzle Laser* (p. 113). The light eliminates darkness penalties out to its listed range. Use 75 times this distance for signaling range. Multiply all ranges by 2 at TL10, 5 at TL11, and 10 at TL12.

Penlight (TL9): This emits a five-yard beam. It may be helmet or belt-mounted, or attached to a firearm accessory rail. $3, 0.1 lbs., 2A/24 hr.

Mini Flashlight (TL9): This projects a 15-yard beam. May be helmet-mounted or attached to a firearm accessory rail. $10, 0.25 lbs., B/24 hr.

Heavy Flashlight (TL9): This projects a 50-yard beam, and can be used as a baton. $20, 1 lb., 2B/24 hr.

Searchlight (TL9): Heavy-duty searchlights are often mounted on vehicles or buildings. A searchlight projects a 2,000-yard beam. $500, 10 lbs., C/12 hr. LC4.

Glow Sticks (TL9)

These chemical lights glow when snapped and shaken; they don't require power cells. Each provides (TL-8) days of light illuminating a two-yard radius. They're available in different colors, white light, and infrared light. $2, 0.1 lb.

Firefly Swarm (TL10)

This is a swarm of glow-in-the-dark microbots. They can be ordered into small spaces for illumination, serve as mobile lamps, or provide a diffuse candle-like glow for romantic occasions. They can turn on or off, change colors or dim their lights on command, and glow in the infrared, ultraviolet, or visible spectrums. They can't provide the equivalent of full daylight (unless multiple swarms are stacked) but they are bright enough to read by. A firefly swarm is $100/square yard. LC4.

Navigation Instruments

Precise navigation is essential for explorers, travelers, and soldiers.

Global Positioning System (GPS) Receiver (TL9)

At TL9+, this is a built-in feature of many gadgets rather than a separate device. If a planet has an orbital navigation satellite network, the GPS system links the user to it, enabling him to always know his exact position if he consults a properly-scaled map. It is accurate to about 5 yards. The system can also store the coordinates of a location it has visited (called a "way point"). It can then direct the user to that way point or transmit the data via communicator to other GPS systems. With a computer, it can show the user's position on a moving-map display.

Inertial Navigation (TL9)

These devices indicate the direction and distance traveled from any preset point on a planetary surface. It can be set for the location at which the user is physically present, or for any other coordinates (make a Navigation roll if the precise coordinates are uncertain). An inertial navigation system lets the user always know which way is north. He can retrace any path he has followed within the past month, no matter how faint or confusing. It does not work in environments such as interstellar space, but it *does* work underground, underwater, and on other planets.

*Inertial Compass (*TL9-12): This palm-sized inertial navigation system includes a tiny computer (p. 22), a GPS (above), and a video screen. If digital maps are available, the compass can superimpose the user's position and path on the map and display it on its screen. The compass can also connect to an HUD. It gives a +3 bonus to Navigation (Air, Land, and Sea). Price and weight depend on TL:

TL9: $120, 0.2 lbs., A/200 hr.
TL10: $60, 0.1 lbs., A/200 hr.
TL11: $30, 0.05 lbs., A/200 hr.
TL12: $15, 0.025 lbs., A/200 hr.

Inertial Navigation System (TL9):

An extremely precise system. It has the capabilities of an inertial compass, but adds a +TL/2 (quality) bonus to Navigation (Air, Land, and Sea). $5,000, 20 lbs., B/100 hr. LC4.

Containers and Load-Bearing Equipment

These are used to carry equipment or cargo, and to keep it safe in hostile environments.

Hovercart (TL9)

A flat round cart, two feet in diameter, that floats quietly on an air cushion generated by a ducted fan. It can be towed or pushed at the pusher's Move. Hovercarts are often seen around air and spaceports, used for moving cargo and luggage; other versions serve as baby carriages and shopping carts. They can carry 500 pounds over smooth ground or water, and make a humming sound audible to a normal Hearing roll at 30 yards. Voice-controlled robot versions with Move 4 are available at double cost. $300, 4 lbs., C/12 hr. LC4.

Pressure Box (TL9-12)

This pressurized container is used for carrying fragile items or pets through vacuum or hostile environments. Its internal dimensions are 2 × 1 × 1 feet. It includes a 12-hour air tank and its own life-support pack that regulates the environment. It provides a room-temperature environment from -459°F to +200°F, as well as DR 10 and radiation PF 5. The modular walls can link together to form a larger container from several boxes. Sealing or unsealing the pressure box takes six seconds; linking boxes together takes 10 seconds per box at TL9-10, two seconds at TL11-12.

TL9: $900, 10 lbs., 2C/2 day. LC4.
TL10: $600, 7 lbs., 2C/1 wk. LC4.
TL11: $450, 5 lbs., C/2 wk. LC4.
TL12: $300, 2.5 lbs., C/6 wk. LC4.

Contragrav Modules (TL11-12^)

Also called "sky hooks," contragrav modules are flat, saucer-shaped disks with rings and brackets for attaching loads. They generate a contragravity lift field that can support up to 1,000 pounds. They can be set to stay suspended in the air, or ordered to float up or down at five yards per second. They may also be pushed along or towed.

TL11^: $100,000, 15 lbs., D/1 hr. LC4.
TL12^: $25,000, 7.5 lbs., D/3 hr. LC4.

Gravpack (TL11^)

This backpack is made out of reflex ballistic fabric, and includes a contragrav generator that screens the interior of the pack from the local gravitational pull. Weight carried in the pack is not counted toward encumbrance – it's treated like the Payload advantage. The pack can cancel up to 120 pounds of weight.

Due to its bulk, only one gravpack can be worn at a time. Furthermore, while weight is canceled, mass is not; with the generator activated, the user will be at -1 DX per 40 pounds carried until he gets used to dealing with the load's inertia without its weight. If the same mass is worn in a pack for more than a day, the penalty can be ignored. $15,000, 15 lbs., C/12 hr. LC4.

Survival and Camping Gear

Ultra-tech technology doesn't just make exploration easier or more comfortable. It can open up new frontiers for adventurers.

Envirobag (TL9-12)

This is an insulated, heated sleeping bag designed for extremes of temperature. It has the same performance as a Heat Suit (p. 177). It can also be sealed and hooked up to air tanks.

TL9: $160, 3 lbs., C/24 hr.
TL10: $80, 2 lbs., C/72 hr.
TL11: $40, 1.5 lbs., C/10 days.
TL12: $20, 1 lb., C/2 weeks.

Filtration Canteen (TL9)

This canteen holds a quart of water. It removes impurities, salts, microbes, and poisons. It can filter salt water, but not raw sewage or toxic waste. On its own, it adds a +1 (quality) bonus to Survival skill when living off the land; it's also included in survival kits.

One quart can be purified in 30 minutes (TL9), 10 minutes (TL10), three minutes (TL11) or instantly (TL12). The filter must be replaced every 100 quarts at TL9, or 1,000 quarts at TL10; a color change signals when it's time to change. An "exhausted" filter still has a few quarts of capacity, but only the GM knows how many. At TL11-12, the filter is permanent.

The canteen is $180, 1 lb. (empty) or 3 lbs. (full). LC4.

Gripboots (TL9)

This smart climbing footwear is amazingly tough, but still provides tactile feedback about the rock conditions to the wearer. In addition, the boot can change shape for a better grip, and can grow crampons or a forward-placed spike on command. Add +1 per die to the damage the wearer inflicts with a kick. Gripboots give a +1 equipment modifier to Climbing, or +2 on ice. Combat statistics are identical to assault boots (p. 173). $500, 2 lbs. LC4.

Modular Cage (TL9)

This kit allows the user to assemble any size or shape of cage, with a maximum volume of 10 cubic yards. Assembling a cage takes three minutes per cubic yard of

volume; several cages may be combined to build a larger one. Traps skill is required to build anything but a simple cubical cage, or to assemble a cage quickly in half the time.

Cage bars are 1/2" in diameter. DR depends on TL: 70 (TL9), 100 (TL10), 150 (TL11) or 200 (TL12).$1,000, 200 lbs. LC4.

Modular Environmental Cage (TL9)

This is similar to a modular cage, but it takes three times as long to put together. Once assembled the cage is sealed and, if connected to an external air and power supply, can duplicate and maintain nearly any planetary environment (except for gravity). A 6" airlock allows access for feeding. $10,000, 400 lbs. LC4.

Pressure Tent (Personal) (TL9)

This airtight tent is strong enough to be inflated to one atmosphere in a vacuum. The metallized fabric incorporates minor (PF 2) radiation protection, but users planning a long stay in a vacuum or trace atmosphere are advised to place the tent in a sheltered location (such as a cave) to provide protection from solar and cosmic radiation. The tent's air tanks hold man-days of air equal to the tent's capacity. Entering or leaving through the one-man lock takes one minute. The tent has DR 10 (TL9), DR 15 (TL10), DR 20 (TL11) or DR 30 (TL12).

One-Man Tent (TL9): $1,500, 60 lbs. LC4.
Three-Man Tent (TL9): $3,000, 100 lbs. LC4.
Eight-Man Tent (TL9): $15,000, 200 lbs. LC4.

Double the endurance at TL10+.

Rocket Piton (TL9)

A pistol-grip launcher which fires a rocket-propelled, explosive-set piton. It can shoot an attached line up to 200 yards. A successful Climbing roll (made by the GM) means the piton is securely lodged and will support weight; a critical failure means the firer only thinks it is! Roll vs. DX-4 to hit if used as a weapon. It inflicts 1d+2 impaling damage, with Acc 2, range 70/200, RoF 1, Bulk -3, Rcl 2, Shots 1(5). $40, 2 lbs. Reloads are $1, 0.5 lb. per shot. LC4.

Smart Pitons (TL9)

A piton is a spike with a ring on it, through which a rope can be run. High-tech pitons adjust to the shape of the crack they're in, and report on their status via an integral microcommunicator. They come free on command. While a piton will report if it is obviously loose, it cannot check its own stability under load, so the climber must also do a manual check. Used properly, they give +1 to Climbing skill. 10 pitons: $100, 1 lb. LC4.

Spider Cage (TL9)

Biological survey teams and trappers favor this capture device. It has a starfish-like shape consisting of a floor base surrounded by a few dozen jointed arms. Stepping on the base triggers a pressure sensor, causing the hinged bars to spring up and bend forward at high speed to form a roofed cage. If the victim is not surprised, a successful Dodge roll allows jumping away in time. The padded bars cause minimal injury, but the closing cage will do 1d-2 crushing damage if the victim is larger than the area of the trap.

A spider cage uses bars of padded memory metal (p. 90) with DR 20. The separation between the bars is 2" wide. It also features a door on the side (some of the bars swing out in unison) with a conventional electronic and mechanical lock. It adds a +2 (quality) bonus to Survival skill rolls made for trapping creatures. $2,000 and 10 lbs. for a cage capable of trapping a creature with SM 0. Double cost and weight per +1 SM; halve it for each -1.

Splat Piton (TL9)

This two-inch sphere has a ring attached for a rope. When broken against rock or another hard surface, a fast-drying glue is released. In one minute, the ring can safely support 16 tons.

The sphere may be fired out of a mortar as far as 50 yards, unreeling a light line. The line unreeled must be used to pull a climbing rope through the piton ring. If a climbing rope is launched, range drops to 10 yards. A catalyst can unstick the glue, allowing the piton to be removed. It is not reusable. $10, 0.05 lbs. LC4.

Vapor Canteen (TL9)

This canteen draws moisture from the atmosphere. How quickly it works varies with the amount of water vapor in the air – with an Earth-standard humidity of 50%, the time required to extract a quart of water is four hours (TL9), three hours (at TL10), two hours (at TL11), or one hour (at TL12). It has a capacity of one quart, and adds a +2 (quality) bonus to Survival skill for an individual living off the land. $450; 2 lbs. (empty) or 4 lbs. (full), B/100 quarts. LC4.

Vapor Collector (TL9)

A larger version of a vapor canteen for base camps, settlements, etc. It is 60 times faster, producing one quart every four minutes at TL9. It is standard for expeditions and military or police outposts; it frees them from the necessity of establishing a post near a water source. Sabotaging the vapor system is a favorite ploy of villains in adventure stories. The plot is so hackneyed that real adventurers laugh at it, and may not be prepared if it happens. It adds a +2 (quality) bonus to Survival skill for a group living off the land. Usually connected to a water tank, but has an internal capacity of 20 quarts (five gallons). $10,000, 120 lbs., E/30 days. LC4.

Smart Rope (TL10)

This is a cable constructed of memory metal and plastic fibers, or non-metallic bioplastic; it also includes a radio microcommunicator (p. 44). A smart rope has half the support strength of rope (p. 81). It gives a +3 (quality) bonus to Knot-Tying skill, and can be ordered via radio signal to "flex" or go "rigid."

In flex mode, the rope behaves exactly like ordinary rope. In rigid mode, the rope locks into its current position

as if it were a stiff metal wire. In this position, it cannot be untied. Removing a rigid rope without ordering it into flex mode requires cutting through it. If a smart rope is severed, the pieces lose their "smart" properties, but retain the flexible or rigid quality the rope had when cut. Smart rope may be purchased in a variety of standard lengths, starting at one-yard increments. Smart rope is twice as expensive as ordinary rope; other statistics are identical. LC4.

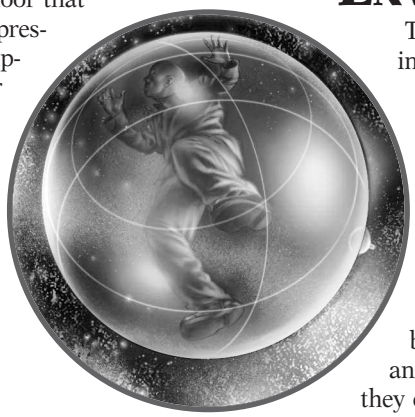
Survival Watch (TL10)

A heavy-duty wristwatch built to survive in extreme environments. It includes a biomonitor (p. 197), a chronometer, a GPS (p. 74) receiver, an inertial compass (pp. 74-75), a magnetic compass, a homing beacon (p. 105), and a tiny computer (p. 77) with a small 2-D display (about one square inch).

The watch is usually voice controlled. It is waterproof, and can survive 10 atmospheres of pressure or a vacuum. It is powered by a small flywheel battery that can be recharged by body motion. If not worn, it goes to sleep for up to five years, turning off all functions except timekeeping. A vigorous shaking will power the watch up to full operation. $300, 0.5 lbs., B/3 months. LC4.

Survival Module (TL10)

A programmable bioplastic box the size of a hardcover book. When activated, it draws air out of the surrounding environment and inflates itself, becoming a comfortable two-person cabin that can hold four in a pinch. It has transparent plastic windows, pull-out inflatable tables, chairs and beds, and an airlock door that takes four seconds to cycle. It is pressurized, with a complete life-support system including an air filter and reducer/respirator. If oxygen is unavailable, air tanks will be required.



The survival module has a tendency to blow away in a strong wind when set up but unoccupied. However, it can be weighted or tied down. $600, 4 lbs., C/2 wk. LC4.

Air Tube (TL11)

The size of a thick marker pen, this device stores air in a safe, hypercompressed form. When the user bites down on the tube, it provides a steady stream of air. It can operate for (TL-3) minutes, but the user must stay within 30 feet of the surface. It leaves a visible bubble trail. $50, 0.2 lb.

Bioplas Pressure Tent (TL11)

This is identical to the pressure tent (p. 76) but is made of pseudo-living bioplas (pp. 170-171). It contains a regenerative life support system similar to that of the space biosuit (p. 178).

Its skin absorbs sunlight and recycles waste, giving it an extended air supply. There is some waste, but it is effective for six weeks when augmented by power cells (see below). A small tank contains enough air to pressurize it; this also provides (occupancy) man-hours of air after power is exhausted. The tent is self-sealing for punctures up to an inch in diameter, and more extensive damage is slowly repaired. It lives off the occupant's waste products.

One-Man Tent (TL11): $3,000, 10 lbs., D/6 wk. LC4.
Three-Man Tent (TL11): $5,000, 15 lbs., 3D/6 wk. LC4.
Eight-Man Tent (TL11): $7,000, 25 lbs., E/8 wk. LC4.

Survival Foam (TL12)

This is a can of fast-hardening nanotech or high-biotech foam used to create a life-sustaining cocoon. It is similar to the life support gel in a survival cocoon, but more advanced.

A can of survival foam will seal someone in hibernation for up to a week, even in hard vacuum or temperature extremes from -200 to 400 degrees. It takes five seconds to harden, making the foam useless as a weapon. The user experiences an unpleasant drowning sensation combined with disorientation, but will be unconscious within seconds equal to his HT.

A survival-foam cocoon has DR 5 and HP 32. It can be chipped off (which risks damage to the subject if done too quickly) or instantly dissolved with a neutralizer spray ($10 and 1/2 pound for a can with enough to free three people). The user will lose 1 HP for every week after the first that he is encased in survival foam, due to slow muscle deterioration and nutrient loss. $700, 2 lbs./can. LC3.

Environmental

These are technologies and devices for establishing livable environments in hostile conditions. For wearable masks, suits, etc., see Chapter 7.

Rescue Bubble (TL9-12)

This device is a man-sized plastic bag with a self-inflation system and self-sealing flap. To use it, pull the bag on, and activate the seal. Once the seal is closed, the bag inflates automatically, forming an airtight bubble. Rescue bubbles found in vehicles are often connected by an air hose to an external life support system, but they can be disconnected. If this happens, each bubble provides 15 minutes of air.

It takes four seconds to don and inflate the bubble (make a Survival or Vacc Suit skill roll to halve the time). If disconnected, it is flexible enough to move in, at a Move of 1. It floats in water. Bubbles are usually built into vehicle seats or worn on belt packs. Opening it while inflated spills its air. The tough plastic has DR 1.

TL9: $800, 4 lbs.
TL10: $600, 3 lbs.
TL11: $400, 2 lbs.
TL12: $300, 1.5 lbs.

The compressed air cartridge can be recharged from a life support system in about an hour, allowing the bubble to be repacked and reused.

Survival Cocoon (TL11-12)

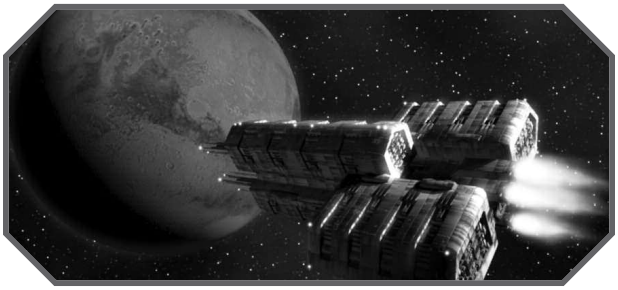
This rescue bubble is equipped with an emergency hibernation system that can flood the cocoon with life-support gel, placing the user into hibernation. The gel also makes the bubble reflective to improve the chances of rescue; it can be detected by radar at 10 times the radar's normal range.

While in the cocoon, the user will be safe for a week. After that, he loses 1 HP for every week due to slow dehydration, lack of nutrition and exercise, etc.

TL11: $1,500, 3 lbs. LC3.
TL12: $1,000, 2 lbs. LC3.

Worldscaping (TL9-12)

This is ecological engineering on a planetary scale. *Terraforming* is the process of making an uninhabitable planet more Earthlike. Of course, nonhumans might seek to "xenoform" Earth or other worlds to make them more suited to their own preferences.



Mars-Type Terraforming (TL9)

Warming the climate and thickening the atmosphere of a Mars-like world involves factories or the impact of ammonia-rich asteroids to produce greenhouse gases to warm the surface. This releases carbon dioxide from ice caps and the frozen surface, triggering a runaway "global warming." After a century or so, the planet's environment may be suitable for simple plants and for humans wearing respirators. Over 100,000 years, the plants can manufacture a human-breathable atmosphere. The time scale can vary, depending on how similar a candidate for terraforming is to Mars.

Fast Mars-Type Terraforming (TL10-12)

This deploys advanced genetically-engineered plants or self-replicating plant-like machines. Divide the time required for completion of the terraforming project by 10 (TL10), 100 (TL11), or 500 (TL12).

Venus-Type Terraforming (TL11)

A world like Venus is terraformed either by constructing a giant sunshade to cool it down, or smashing a massive asteroid into it to blow away most of the atmosphere. After waiting for conditions to stabilize, replicating machines can manufacture a new atmosphere. The process would take about 500 years before it was suitable for plants and respirator-equipped humans, and 1,500 years before it was habitable. At TL12, this period is reduced to 100 years and 300 years.

Terraforming through Matter Conversion (TL12^)

Replicator (pp. 93-94) technology may be able to fabricate new atmospheres. By building self-replicating machines that can transform the atmosphere and create an ecosystem, full terraforming takes only a century or two. A giant replicator powered by the energy collected from a Dyson sphere might even envelop the planet and change it all at once.

Gravity Control (TL10-12^)

Gravity control technologies create localized zones in which gravity is higher (artificial gravity) or lower (gravity screening or contragravity) than usual.

Artificial gravity makes space colonization much easier, allowing people to live comfortably on comets, asteroids, and small moons. Spaceships and stations can be built in any shape desired; there is no need to design them as spinning wheels or equip them with rotating sections to simulate gravity through centrifugal force. Artificial gravity may also be used on planets with "normal" gravity to accommodate people from higher-gravity worlds.

Artificial gravity generators often take the form of "gravity plates" built into the floor of a vessel or habitat. A spacecraft might be equipped with a +2G gravity plate. In deep space, the gravity could vary from zero (turned off) to 2G (on "max gravity"); humans used to Earthlike gravity would keep it on 1G. On Earth, the same gravity plates could vary the gravity from 1G (the local gravity) to 3G. Reducing gravity below the local value requires the use of contragravity. It's possible to have both systems installed.

Gravity plates are rated for the cubic volume and the strength of the gravity field over local gravity (e.g., +1G). They generate a vertical field from a generator grid. Those used in normal dwellings or vessels rarely exceed +1G unless created for beings used to a higher-G field. For example, since the Moon has about 0.16G, a gravity plate would only need to produce +0.84G to simulate a terrestrial gravity field.

Gravity Plates (TL10^)

These are installed in vehicles or buildings.
TL10^: $400, 0.4 lbs. per cubic foot of area per +1G.
TL11^: $100, 0.1 lbs. per cubic foot of area per +1G.
TL12^: $25, 0.025 lbs. per cubic foot of area per +1G.
They use external power.

Gravity Screen Chambers (TL11^)

These use contragravity technology for the comfort of visitors from low-gravity or microgravity worlds, or for zero-gravity play, sports, sex, or training. Gravity screen chambers can also be a useful part of an installation or vessel's security system, allowing defenders to harass intruders by selectively reducing or restoring the gravity. It takes one second to adjust gravity.

Gravity screen chambers may also be an important part of manufacturing facilities. Many specialized chemical and metallurgical industrial processes function best in zero gravity. The chambers allow these processes to performed on a planet instead of a space station.

The contragravity zone is generated by a grid enclosing the affected area, using building or vehicle power. It is $1,000, 0.5 lbs., 0.25 kW per square foot of enclosed walls, floor, and ceiling space, e.g., screening a 10'-square cubicle is 600 square feet of GC grid. Unlike a contragravity vehicle, the power supply may be external to the CG grid itself. LC4.

Crossing a Gravity Gradient

Crossing into an area of higher or lower gravity can be dangerous, and even standing still while a gravity field is suddenly turned on can be tricky.

Different Gravity: See p. B350 for general effects of low or high gravity.

Falling: Roll vs. DX to avoid falling down if the gravity shifts up or down by 10% or more. Each doubling or halving of gravity adds an extra -2 modifier, e.g., going from a 1G to a 5G field requires a roll vs. DX -4.

High Acceleration: If the gravity suddenly increases, use the rules for high acceleration on p. B434 to see if a HT roll or falling damage applies.

Nausea: Sudden exposure to zero gravity may trigger space adaptation syndrome (p. B434).

Gravity Mat (TL12^)

A flexible, roll-up artificial gravity generator that may be set to increase local gravity by up to 1G over a 2 × 2 × 2.5 yard area (270 cubic feet). This replaces the local gravity. Gravity mats are typically used by individuals on worlds with uncomfortable gravity, but they can also be built into vehicles or houses. $27,000, 32 lbs., D/1 hr; it can use flexible power cells, but usually uses external power. LC4.

Industrial Megaprojects (TL 10-12)

In addition to terraforming worlds, other massive engineering projects may be possible at high TLs. (For transportation megaprojects, see Chapter 9.)

Moving Black Holes (TL10)

Black holes the mass of asteroids *might* exist in nature (smaller ones would have evaporated). Such a million billion ton mini-black hole can be moved by placing a magnetic sail in orbit and feeding matter into it in a controlled fashion to generate thrust.

Artificial Black Holes (TL11)

High-energy particle accelerators can create tiny (but unstable) black holes. These can then be fed matter until they're stabilized and moved. They can also be used as power systems, planet-devouring weapons, and for starmaking (see below).

Planetary Brain (TL11)

Self-replicating machines (p. 79) may transform much or all of a planet's functional mass into machinery – perhaps even a giant hyper-sapient computer. At TL12^, it may be possible to do this with a white dwarf or neutron star.

Starlifting (TL11)

This is the extraction of hydrogen, helium, and other elements from a star, either for industrial use, or to extend the star's lifespan by preventing its transformation into a red giant. Methods include increasing the stellar rotation until material begins to drift off the equator, or squeezing the star using intense magnetic fields from particle accelerators. Either technique generally requires creating a Dyson sphere or ringworld (p. 72) around the star to house the necessary machinery.

Stellar Midwifery (TL11)

Red dwarfs are the most common type of star, but they are too dim to make their planets habitable. A red dwarf star's power could be amplified by using a Dyson Bubble-scale array of solar sails to reflect back some of its light, boosting its temperature and increasing its fusion power. The effect would not last forever, but would be quite useful for the lifetime of a civilization.

Starmaking (TL12)

Jupiter-sized gas giants and brown dwarfs may be stellarformed. This involves maneuvering a small black hole (about 10% of the mass of Earth's moon) into the gas giant or brown dwarf. Once inside, it will begin swallowing mass and producing a great deal of radiation – enough to effectively turn the body into a small star, with a useful lifespan of a few million years. This is useful if the technology exists to create black holes, and if an extra (or more powerful) sun would be an asset to colonization efforts.

Weather Control Satellites (TL10-12)

A weather control satellite can shift the weather in a 1,000-square-mile region. It can only make changes that fit within the region's normal climate, such as diverting (or creating) a storm during hurricane season. Roll vs. Meteorology skill to control the system; roll weekly for long-term effects or daily for violent weather. Failure can produce unpredictable results (-3 on rolls to fix them), while critical failure may cause a disaster (-6 on rolls to fix). A weather control satellite must be controlled by a Complexity 8 computer. Long-term support from weather control satellites provides a +3 bonus to Farming skill for raising crops.

TL10: $1 billion, 4 × 200,000 lbs. LC1.
TL11: $300 million, 4 × 60,000 lbs. LC1.
TL12: $100 million, 4 × 20,000 lbs. LC2.

Exploration, Safari, and Salvage Robots

Robots can go places that are too dangerous for people, and sometimes they're just a more cost-effective way to do the job.

Robot Mule (TL9)

This is a rugged robot cargo cart that moves on big tires and does what it's told. It has no limbs. It can also be ridden, although the passenger must give it commands. Widely used by expeditions, military units, tourists, and others. LC4.

ST 20; **DX** 10*; **IQ** 6*; **HT** 12.
Will 10; **Per** 10; **Speed** 6; **Dodge** 9; **Move** 6.
SM -2; $3,000, 150 lbs., D/8 hr. LC4.

Traits: Absolute Direction; Accessories (Small computer); A.I.; Automaton; DR 10; Electrical; Ground Vehicle; Machine; No Legs (Wheeled); Payload 2 (16 lbs.).
Skills: Area Knowledge-10.
* May be teleoperated.

Scout Robot (TL9)

36 points

This is a compact machine about 10 inches long, usually with a fish- or bee-shaped body. Variants are available for different environments. It has a sensor head, two manipulator arms, and a single hardpoint that can be equipped with anything from a camera or searchlight to a carbine or submachine gun.

Attribute Modifiers: ST-7 [-70]; HT+2 [20].
Secondary Characteristic Modifiers: SM-4.
Advantages: Absolute Direction [5]; Doesn't Breathe [20]; DR 15 (Can't Wear Armor, -40%) [45]; Extra Arm (Weapon Mount, -80%) [2]; Machine [25]; Protected Hearing [5]; Protected Vision [5]; Radio (Burst, +30%; Secure, +20%; Video, +40%) [19]; Radiation Tolerance 5 [10]; Sealed [15].
Disadvantages: Electrical [-20]; Maintenance (one person, weekly) [-5]; Restricted Diet (Very Common, power cells) [-10]; Restricted Vision (Tunnel Vision) [-30].
Availability: $5,000, 4 lb. 2B/8 hrs.

Configuration Lenses

Also select one of these lenses:
Aerial Scout (TL9) (+107 points): This uses ducted fans for quiet flight, and is equipped with surveillance sensors. Add Aerial [0]; Enhanced Move 1 (Air) [20]; Flight [40]; Hyperspectral Vision [25]; Parabolic Hearing 3 [12]; Telescopic Vision 2 [10].
Submarine (TL9) (+62 points): This uses water jets, and is equipped to operate in the ocean depths. Add Enhanced Move 1 (Water) [20], Pressure Support 2 [10], Sonar (LPI, +10%; Multi-Mode, +50%) [32]; Aquatic [0].
Contragrav (TL11^) (+115 points): Uses contragravity instead of ducted fans. Add Aerial [0]; Enhanced Move 1 (Air) [20]; Flight (Planetary, -5%) [38]; Hyperspectral Vision [25]; Parabolic Hearing 3 [12]; Silence 2 [10]; Telescopic Vision 2 [10].

Explorer Swarm (TL10)

The most efficient way to perform exploration tasks over a large area may be to saturate it with swarms of tiny mobile robots. This swarm usually explores in a spiral pattern, using contact sensors to take minute chemical samples of materials encountered. Explorers may be programmed to look for mineral or chemical traces, explosives, water, organic molecules, etc.

After a predetermined search pattern, the swarms return to a TL10+ portable lab (pp. 66-67), which may be equipped to collect and analyze these samples, or beam the data out. By analyzing where and when the swarm found items or encountered impassable barriers (such as water, if the swarm cannot swim or fly), a computer can build up a map of the area explored. $500/square yard. LC4.

Tools and Construction Materials

This section lists the tools and construction materials found at each TL. These technologies range from the mundane to the miraculous, and everything in between.

Tools and Tool Kits

These are general-purpose equipment for work and repairs.

Laser and Plasma Torches (TL9-10)

These are close-focus energy beam projectors that excel at heavy cutting and welding. A torch projects a continuous jet: in combat, treat this as a melee attack that uses Beam Weapons (Projector) skill, and can't be parried except by a force blade. The jet inflicts tight-beam burning damage.

BEAM WEAPONS (PROJECTOR) (DX-4, other Beam Weapons-4)

TL	*Weapon*	*Damage*	*Reach*	*Parry*	*Cost*	*Weight*	*ST*	*Notes*
9	Heavy Laser Torch	4d(2) burn	C,1	no	$800	12/Dp	7†	15 min.
9	Heavy Plasma Torch	4d+1(5) burn	C,1	no	$2,000	40/Dp	8†	15 min.
9	Laser Torch	2d(2) burn	C,1	no	$100	3/C	5	15 min.
9	Mini Laser Torch	1d(2) burn	C	no	$50	0.25/B	1	3 min.
9	Mini Plasma Torch	1d+2(5) burn	C	no	$100	1/B	3	3 min.
9	Plasma Torch	2d(5) burn	C,1	no	$250	5/C	6	15 min.
10	Fusion Torch	8d+2(5) burn	C	no	$2,000	40/Dp	8†	15 min.

Power Tools (TL9-12)

A box of power tools for shaping wood and other construction materials. A box of ultra-tech power tools may include a nail gun (p. 82), and either an industrial water knife (below), a vibroblade (p. 164) a chainsaw, or a laser torch (p. 80). The tools provide a +3 (quality) bonus to Carpentry skill.

TL9: $1,000, 10 lbs., 3C/3 hr. LC4.
TL10: $700, 7 lbs., 2C/7 hr. LC4.
TL11: $500, 5 lbs., 2C/20 hr. LC4.
TL12: $300, 3 lbs., C/30 hr. LC4.

Rope (TL9)

These are synthetic lines and ropes made of polymer fibers or artificial spider silk (TL9), carbon nanotubes or biphase composites (TL10), or even more exotic materials.

1/8" diameter (TL9): Supports 400 lbs. 10 yards of line: $2, 0.1 lb.
3/16" diameter (TL9): Supports 1,000 pounds. 10 yards of rope: $5, 0.25 lbs.
3/8" diameter (TL9): Supports 4,000 pounds. 10 yards of rope: $20, 1 lb.
3/4" diameter (TL9): Supports 16,000 pounds. 10 yards of rope: $80, 4 lbs.

This is the safe working load; the theoretical breaking strain is five times as much. If exceeding the safe load, roll vs. the rope's HT 12 at -1 per multiple of working load whenever it is stressed to see if it snaps. Strength doubles each TL after introduction.

Instructor Kits (TL9)

The trouble with buying devices in kit form is that it requires a lot of skill to assemble them . . . or it used to. Instructor kits have radio frequency tags and dedicated computer chips on all the components, from circuits to screws or bricks. If the user has a HUD or neural interface, the device will show exactly where and how a component fits into other components. It will signal when it has been properly put together, indicate what tool is needed, and so on. These all appear on handy pop-up diagrams overlaid on the user's visual field.

Instructor kits are available for most ultra-tech devices, as well as homes, model kits, and ships-in-a-bottle. They cost 50% of the cost of the device, and take one man-hour per $1,000 of cost to assemble. They require an appropriate skill roll – usually Mechanic or Electronics Repair – but this is made at +5 to skill if the user can read the virtual tag as he builds it. This makes assembly easy, even if the user has only a default level of skill. A failed skill roll means more time is required; a critical failure means something breaks or malfunctions later.

Industrial Water Knife (TL9)

This device resembles a thick hacksaw with a five-inch gap where its blade should be, plus a switch and power cell built into the handle and an attached hose. When connected to a water source and switched on, a jet of hypervelocity water crosses the gap, forming a "blade" capable of slicing through flesh, wood, and even thin metal.

Since the water recirculates through the system, little splashes off – the knife only uses one gallon per hour. Water knives are also safer than a chainsaw. If the blade can't cut through something, the only "danger" is a spray of harmless water.

Water knives do not have to be sharpened or cleaned, though a special self-sterilizing version is used for medical and similar applications. This version cycles the water through filters after each use, removing most contaminants. It is used in the most common industrial role for water knives: slicing meat at slaughterhouses and restaurants.

A C cell powers the knife for 10 hours. Most water knives come with a backpack which holds two gallons, and connects to the knife with a two-yard hose. Users often place the backpack on the floor while at work. The tank for a self-sterilizing water knife is heavier and more expensive; its filters require replacing with each change of the power cells. Replacement filters cost $20.

Portable Antimatter Trap (TL9-12)

This is a portable magnetic bottle for storage and transfer of antimatter. It can safely store up to 10 micrograms of antimatter at TL9, and is designed to interlock with antimatter reactors for safe transfer. If the power supply is turned off or the power cells removed while containing antimatter, the result is an explosion: antimatter has an REF (p. B415) of 10,000,000,000, and a single microgram can do 6d×9 cr ex damage!

The power will not turn off instantly: a built-in capacitor stores enough for 30 seconds of operation. Unless it is sabotaged or deactivated, a warning system will sound a buzzer and display a countdown to detonation. A biometric lock (p. 104) prevents unauthorized tampering or release, and the trap itself is ruggedized (p. 15). It also has a redundant power cell socket so that cells can be changed without turning it off.

Industrial Water Knife

DX-5 or any Axe/Mace-4

TL	*Weapon*	*Damage*	*Reach*	*Parry*	*Cost*	*Weight*	*ST*
9	Industrial Water Knife	4d(2) cut	C	No	$160	4*	10†

* Weight and cost of backpack is extra: $40 and 18 lbs. for a normal backpack, or $200 and 26 lbs. for a self-sterilizing knife.

A standard unit is $20,000, 20 lbs., 2D/10,000 hr. LC3 (without antimatter). Multiply storage capacity by 10 per TL after TL9.

Portable Antimatter Storage Field (TL10^): As above, but incorporating gravitic or force field technology; maximum antimatter storage is one gram at TL10, increasing tenfold per TL afterward. The annihilation of a single gram of antimatter will produce a 43-kiloton explosion. $40,000, 20 lbs., 2D/1,000 hr. LC3 (without antimatter).

Monowire Spool (TL9^)

A spool of 100 yards of superstrong monowire (p. 103), with a handle on each end. Monowire has DR 10 and HP 1. Used as rope, it will support a working load of 1,000 lbs. A standard spool is $1,000 and 0.1 lbs. See *Monowire Fences* (p. 103) for some other ways adventurers may use it. LC3.

Tool Kits (TL9-12)

Tool kits are used for repair skills (p. B190): Armoury, Electronics Repair, Electrician, Machinist, and Mechanic. They determine the equipment modifiers that apply when using these skills.

Each kit contains a variety of powered and unpowered tools and an array of spare parts. All kits have power cells for the tools in the kit. Even without power, the tools may still be usable for minor jobs at -2 to skill.

Normal kits do not drop in price or weight as TL increases, nor do they gain in effectiveness. As gadgets get more complex, so do the tools required to fix them. See *Repairs* (p. B485) and *Breakdowns* (p. B486) for the rules on repairing gadgets, including maintenance requirements and costs of spare parts.

Different tool kits are required for each skill and each specialty. There is no single Armoury kit – if you want to repair a pistol, use an Armoury (Smallarms) kit.

Armoury (Vehicle Armor) or Mechanic (Vehicle Type) tool kits and workshops can perform major repairs on vehicles up to 10 tons. For larger facilities, multiply the cost and weight of the kit by vehicle weight/10. For example, a Mechanic (Submarine) kit (2,000 ton-capacity) is 200 times the normal cost and weight.

Portable Tool Kit (TL9)

This is the standard tool kit. Most examples fit in a heavy tool box or backpack. It provides basic equipment for the specific skill and specialization it is designed for, and gives a -2 (quality) modifier for other specializations within that skill. Most kits for Armoury, Electrician, Mechanic, or Machinist specializations are $600, 20 lbs., 10B/10 hr. Those for Electronics Repair, Armoury (Force Shields), and Mechanic (Micromachines or Nanomachines) are $1,200, 10 lbs., 10A/10 hr. LC4.

Mini-Toolkit (TL9)

This is a belt-sized tool kit. It gives a -2 (quality) equipment modifier for the specific skill and specialization it is designed for. Mini-Tool Kits for most Armoury, Electrician, Mechanic, or Machinist specializations are $200, 4 lbs., 5B/10 hr. Those for Electronics Repair, Armoury (Force Shields), and Mechanic (Micromachines or Nanomachines) are $400, 2 lbs., 5A/10 hr. LC4.

Portable Workshop (TL9)

An elaborate version of the portable tool kit. It has everything necessary for emergency repairs, plus a wide range of spare parts that can be tooled to specific requirements. It is a modular system that can be set up in any large vehicle or building; it takes an hour to pack or unpack. It gives a +2 (quality) bonus to skill, or +1 if not unpacked.

Most workshops for Armoury, Electrician, Mechanic, or Machinist skill are $15,000, 200 lbs., 10C/100 hr. Workshops for Electronics Repair, Armoury (Force Shields), and Mechanic (Micromachines or Nanomachines) are $30,000, 100 lbs., 10B/100 hr. LC4.

Robotic Workshop (TL10-12)

This automated workshop can attempt to fix any piece of broken or damaged equipment. It uses its sensors and programmed repair manuals to diagnose the problem, then repairs it with its tool-equipped manipulator arms. It has skill 13 in whatever skill and specialty the workshop is designed for; add +1 per TL over TL10. However, it can only maintain and repair devices that are in its database (or closely related). If the workshop encounters a problem it can't fix, it calls for help using a built-in tiny radio.

If a human technician is directing a robotic workshop, it is as good as a portable workshop, with an additional +1 bonus due to its extensive technical database and usefulness as an automated assistant. It is double the cost and weight of an equivalent workshop, and requires twice as many power cells; it has the same LC.

Micro-Manipulator Tool Bench (TL9)

This is a robot arm with micro-scale manipulators and sensors, designed to be controlled by VR gloves (p. 54) or a neural interface (pp. 48-49). It gives the user super-fine motor skills, adding +TL/2 to DX for tasks such as Jeweler, and DX-based rolls to do *fine* work with Artist, Machinist, or Mechanic skills. $2,000, 4 lbs., C/100 hr. LC4.

Nail Gun (TL9-10)

A tool for rapidly and accurately driving nails. It has a targeting system incorporating a computerized laser, passive infrared, and imaging radar rangefinder that can see through up to six inches of wood or similar low-density material (including flesh). It uses this system to automatically determine the force needed to drive a nail to the desired depth.

To attack with a nail gun, use DX-4 or Guns (Pistol) skill. It inflicts 1d+1(2) piercing damage, with Acc 0 (+3), Range 5/25, RoF 10, Bulk -3, Rcl 1, Shots 50(5). Nail velocity is variable (see *Liquid-Propellant Slugthrowers*, p. 139) and its blueprint display system is equivalent to a smartgun feature.

All of this makes the nail gun a highly accurate weapon system in a pinch. However, its sensors are programmed *not* to fire if its targeting system detects something that matches the warmth and consistency of living flesh. Disabling this safety feature requires an Electronics Operation (Security) roll, one minute per attempt. The gun cannot detect flesh underneath armor with DR3 or better.

Smart Nail Gun (TL9)

Uses binary liquid propellant. $250, 4 lbs. Its A cell powers the targeting system for a day. Its magazine holds 50 nails (0.5 lbs.). A separate propellant bottle (1 lb.) holds enough propellant to fire 1,000 nails. LC4.

Gauss Nail Gun (TL10)

An electromagnetic nail gun. The magazine holds 50 nails (0.5 lbs.), but it also needs a power cell. LC4.

TL10: $300, 3.5 lbs. B/300 shots.
TL11: $100, 1.5 lb. B/1,000 shots.
TL12: $30, 0.75 lbs. B/3,000 shots.

Slipspray (TL9)

This aerosol lubricant can turn smooth ground (e.g., a floor or a road) into a nearly frictionless surface. Anyone crossing it at faster than Move 1 must make a DX roll (at +3 if crawling, -3 if sprinting) every second to avoid falling. Vehicles must make a control roll (p. B469) at -5 to avoid losing control. Slipspray breaks down in about an hour in air. A can covers 100 square feet, spraying 10 square feet per second from up to 2 yards away. $30, 0.5 lb. LC3.

Super Adhesives (TL9-10)

Pulling two objects apart that have been glued together requires a Regular Contest of ST vs. ST 23. The bond is limited by the strength of the weaker of the two objects (so flesh bonded to something else could be torn away, inflicting 1d-4 damage).

Gecko Adhesive (TL9)

Sticky adhesive based on gecko setae (feet hairs). The pads have millions of tiny artificial hairs, covered by a protective coating. A small electrical pulse from an included wand causes the hairs to extend or release. A one-square-inch patch can hold 800 lbs. indefinitely in any environment, including in the vacuum of space and underwater. $0.10 per square inch for double-sided pads, and $1 per foot length of 2" wide single-sided gecko tape.

Molecular Glue (TL10)

This glue bonds nearly any substance and comes in non-conductive and conductive (metal-impregnated) varieties. It sets in 10 seconds. The glue can only be removed by a special solvent, which takes one minute to weaken each dose of the glue. A dose of solvent can weaken up to 10 applications of molecular glue. Each application of molecular glue is $0.50, but a dose of solvent is $1. LC4.

Construction Foam (TL10)

Construction foam is a liquid polymer with suspended nanoparticles that "foams-up" with nitrogen and cures with oxygen. As a result, it expands in air, hardening to form a durable substance. A barrier has DR 2 per inch of thickness and HP based on the weight of foam used (see *Object HP Table*, p. B558; the foam is homogenous). Construction foam is usually combined with additional chemicals so that it cures much more rapidly. Most applications are mundane, such as creating temporary structures, sealing electronics components, and quick casts for injured limbs. Riot police and soldiers also use construction foam for temporary walls and bunkers, usually by forming barriers and filling them with water or earth.

Construction foam does not burn easily (30 points of burning damage will set it aflame), but does decompose when exposed to flame, turning into a foul black sludge and releasing toxic fumes. These cause 1 HP toxic injury per minute of exposure if breathed. The foam will not cure if it stays wet, but is waterproofed once it has hardened. Construction foam floats.

Three gallons can form five cubic feet of hardened foam; a barricade three yards long, a yard high, and a foot thick takes about 16 gallons of foam and has DR 24, HP 36. It comes in a variety of applicator types, from spray cans to large storage tanks for use in construction. Construction foam costs $10 and weighs 5 lbs. per gallon.

Construction Foam (TL10): This requires one minute to completely harden.

Construction Foam (TL11-12): This requires only 10 seconds to harden (TL11) or 2 seconds (TL12. It is non-toxic.

Industrial Nanocleanser (TL10)

This industrial-strength version of domestic nanocleanser is designed to eliminate bacteriological spills, rotten food, dead bodies, and other biological or medical waste. Any organic target covered by industrial nanocleanser takes 1d-1 corrosion damage each minute for five minutes. Inorganic sealed DR takes no damage. If sprayed on plants, industrial nanocleanser will strip all foliage within a minute.

Industrial nanocleanser removes all forensic evidence such as blood stains, skin flakes and other organic residue. As with domestic nanocleanser, TL10+ Forensics will be able to identify the exact brand used.

An application of industrial nanocleanser can cover up to 30 square feet. $100, 1 lb. LC3.

Morph Axe (TL10)

A standard morph axe is a climbing tool made of memory metal (p. 90). It can go from straight-handled to bent-handled, from pick to hammer to adze to hook to crowbar to walking stick, on command. It can be used to cut steps, climb vertical frozen walls, or stop a climber's potentially disastrous slide on ice, and is sharp enough cut rock if the wielder has ST 12 or better. In combat, it requires Axe/Mace skill and does swing+1 damage . . . cutting, impaling, or crushing, depending on configuration. Otherwise, treat as a hatchet. $500, 2 lbs.

At the GM's option, any morph tool with more than 10 forms, or with illegal forms, can cost at least double.

A morphing tool that includes any explicit weapon forms is a concealable weapon, and probably LC3. It could become any weapon form appropriate for its weight . . . a quarterstaff could turn into an axe, a spear, or an oversized broadsword. $500 per pound of weight, minimum $1,000.

Sonic Probe (TL10)

The sonic probe is a multipurpose sensor the size of a cigarette package. It can be used as a short-ranged ultrasonic scanner that can give the user a rough image of the interior of objects or containers; it has a small screen on the device, but the data is usually uplinked to a HUD. Roll against Electronics Operation (Sonar) to use; the probe has a maximum range of six inches, and the skill penalty is -1 for each 10 DR it must penetrate.

The probe's imaging ability lets it serve as basic equipment for simple medical Diagnosis rolls for physical injuries, Mechanic rolls to find out what is wrong with a small device, Explosives rolls to disarm bombs (unless set to be triggered by vibrations!), and similar tasks. Its scanning abilities make it a useful tool for picking mechanical combination locks (+2 to Lockpicking skill) in conjunction with a lockpick. The sonic field can also be intensified and tuned to assist in cleaning delicate objects . . . or brushing teeth. $500, 0.25 lbs., B/12 hr. LC4.

Grav Hammers (TL11^-12^)

These devices use gravity projector technology.

Grav Hammer (TL11^): A focused short-range pressor beam designed to be used as a jackhammer. To attack with it, use Beam Weapons (Pistol) or DX-4. It does 2d cr damage with Acc 0, Range C/1, RoF 1, Bulk -2, Rcl 1. $100, 1.5 lbs., C/15 min. LC4.

Grav Ram (TL11^): A wide-area grav hammer used to smash down doors, drive posts, etc. To attack with it, use Beam Weapons (Rifle) or DX-4; it does 4d cr damage with Acc 0, Range C/1, RoF 1, Bulk -4, Rcl 1. $1,000, 10 lbs., D/15 min. LC4.

Increase damage to 3d (hammer) and 6d (ram) at TL12^.

Grav hammers do crushing damage and inflict *double* normal knockback. The beams are silent and invisible, except for the thud of impact on the target.

Repair Nanopaste (TL11-12)

This single-use paste consists of specialized nanomachines. Unlike swarms, they have no real mobility. The user must spray them onto a damaged object. They use their own mass to replace any badly-damaged components.

Repair paste does not *require* any skill to use, but a skilled user can speed up the process by knowing the best places to apply it. A successful roll made against an appropriate repair skill + 2 will halve the time required for repair paste to work, and add +1 to the HP that it heals.

Dedicated Repair Paste (TL11): This repair paste comes in applications designed for a specific item of a given type and TL, e.g., a laser pistol repair paste, or tiny radio repair paste. Each tube of paste holds one application, which repairs 1d-2 HP after an hour. If the result is negative, the nano botched the job, inflicting damage instead of repairing it. If the wrong repair paste is sprayed on an item, it will take an hour to inflict 1d-1 HP damage. It cannot damage sealed objects. Each application is $500, 1 lb. LC3.

Programmable Repair Paste (TL12): Identical to dedicated repair paste, except that the nanomachines are not designed for a particular type of equipment. The user programs it by uploading the gadget's manual into the paste, which takes about five minutes to reconfigure itself. Programmable repair paste comes in versions specific to a given repair skill, such as Armoury or Electronics Repair. Unlike a tool kit, a specialty does *not* need to be specified. Each application is $1,000, 1 lb. LC3.

Universal Repair Paste (TL12^): This can heal any gadgetry (except one built from force fields), or any character with the Machine meta-trait. It incorporates its own diagnostic systems and does not require programming. Each application repairs 1d-2 HP after an hour, and is $2,000, 1 lb. LC3.

Universal Molecular Bonder (TL12^)

A molecular bonder is a small tool which can also be used as a weapon. It projects a beam that alters the surface molecules of all substances it contacts, bonding objects together regardless of their composition. In order for it to work, the objects must be touching each other.

The user must project the beam for an entire second; it cannot be used while moving. Use Beam Weapons (Projector) skill; as a weapon, the molecular bonder has Acc 2, RoF 1, Range 1. Misses may have unforeseen effects if the wrong things were bonded together. The strength of

the molecular bond is limited by the strength of the weakest of the two objects, so flesh bonded to something else can be torn away. This requires a Will roll; success does 1d-4 damage.

Pocket Molecular Bonder (TL12^): Affects 1 square foot (which could bond someone's foot to the floor, or a hand to a weapon). $3,000, 4 lbs., C/1 min. LC3.

Heavy Molecular Bonder (TL12^): Affects 10 square feet (about one hex). $15,000, 20 lbs., D/1 min. LC3.

X-Ray and Gamma-Ray Laser Torches (TL11-12)

A torch projects a continuous jet: in combat, treat this as a melee attack that uses Beam Weapons (Projector) skill, and can't be parried except by a force blade. The jet inflicts tight-beam burning damage with the radiation and surge damage modifiers.

These are available in handheld, pocket, and heavy backpack models.

BEAM WEAPONS (PROJECTOR) (DX-4, other Beam Weapons-4)

TL	*Weapon*	*Damage*	*Reach*	*Parry*	*Cost*	*Weight*	*ST*	*Notes*
11	Backpack X-Ray Laser Torch	4d(5) burn rad sur	C,1	no	$1,600	12/Dp	7†	15 min.
11	Pocket X-Ray Laser Torch	1d(5) burn rad sur	C	no	$100	0.25/B	1	3 min.
11	X-Ray Laser Torch	2d(5) burn rad sur	C,1	no	$200	3/C	5	15 min.
12	Heavy Graser Torch	4d(10) burn rad sur	C,1	no	$2,400	12/Dp	7†	15 min.
12	Pocket Graser Torch	1d(10) burn rad sur	C	no	$150	0.25/B	1	3 min.
12	Graser Torch	2d(10) burn rad sur	C,1	no	$300	3/C	5	15 min.

Gravitic Tools (TL12^)

These devices can reach *inside* a solid object to manipulate it; the user focuses on a point where the gravitic "hand" manipulates. This makes them useful for all sorts of difficult repairs. Medical versions are also used in surgery.

Gravitic Screwdriver (TL12^)

This device houses a short-ranged gravitic manipulator. It has a range of one foot, and its controls can be worked by one hand. The user can apply a pencil-thin beam of controlled gravitic force to a single object with about the same dexterity as a thumb and forefinger working together.

The gravitic screwdriver can levitate objects that weigh up to one-quarter pound, turn screws without touching them, suck dust off ancient pottery, remove foreign objects from jammed mechanisms, and perform many other tasks. It excels at picking mechanical locks and pockets. It gives an additional +1 (quality) bonus to any applicable skill in situations where the GM thinks it would be useful. $500, 0.2 lbs., B/2 hr. LC4.

Gravitic Waldos (TL12^)

A set of precision gravitic manipulators. They are sometimes nicknamed long-arm gloves. They can reach inside solid objects, but only have ST 2.

Universal Tools (TL12)

These living metal devices can change shape into various tools.

Portable Universal Tool: Basic equipment for *any* repair skill. $12,000, 2 lbs., C/100 hr. LC4.

Universal Mini-Tool: Provides a -2 (quality) equipment modifier for *any* repair skill. $4,000, 0.25 lbs., B/100 hr. LC4.

Shifting shape takes two seconds.

Universal Assemblers (TL12)

The mechanical equivalent of stem cells, these nanomachines are similar to cannibal nano. With the proper programming, they can build anything.

Assembler Goo: These nanomachines can transform anything they're in contact with – carbon, people, etc., though they prefer nanopaste – into a desired target object of equal or lesser weight. This requires hours equal to the *higher* of the target object's weight (in lbs.) or 1% of its cost (in $), divided by the weight of the assemblers used (also in lbs.) To break down tough objects, add hours equal to DR. The process inflicts 1d corrosion damage on the matter being transformed per HP of the item to be assembled. Assemblers contain the equivalent of a radio microcomm so that they can be easily programmed. They cost $10,000/lb.

Worker Robots

"Robot" was derived from the Czech word for "worker," and that is what these machines are intended to do. These machines are useful for various tasks, including cargo-handling, salvage, working with hazardous materials, and exploration.

Techbot (TL9-10)

135 points

This is a general-purpose technical robot. It has a cylindrical body and a pair of arms, and moves on either legs or tracks, depending on the model. It can operate in a wide variety of environments, and may be used for everything from working in a garage to hazardous waste disposal. Its payload space usually holds tools.

Its weapon mount is built into its rotating head; it can carry a weapon up to 6 lbs. weight, which is more likely to be a laser or plasma torch than an actual weapon.

Attribute Modifiers: ST-2 [-20].
Secondary Characteristic Modifiers: SM-1; HP+6 [12].
Advantages: Absolute Direction [5]; Doesn't Breathe [20]; DR 15 (Can't Wear Armor, -40%) [45]; Extra Arm (Weapon Mount, -80%) [2]; Machine [25]; Microscopic Vision 3 [15]; Radio (Burst,+30%; Secure, +20%; Video, +40%) [19]; Payload 2 [2]; Protected Senses (Hearing, Vision) [10]; Radiation Tolerance 5 [10]; Sealed [15]; Vacuum Support [5].

Perks: Accessory (Personal computer, fast option) [1].
Disadvantages: Cannot Float [-1]; Electrical [-20]; Restricted Diet (Very Common, power cells) [-10].

Lenses

Choose a TL lens for the robot and select a machine intelligence lens (pp. 27-28).

TL9 Techbot (-40 points): This moves on a pair of articulated tracks. High Manual Dexterity 1 [5]; Maintenance (one person, weekly) [-5]; No Legs (Tracked) [-20]; Numb [-20]. $20,000, 50 lbs., D/8 hr. LC4.

TL10 Techbot (+21 points): This model has a bipedal barrel-shaped body. HT+1 [10]; High Manual Dexterity 2 [10]; Reduced Consumption 2 [4]; Maintenance (one person, bi-weekly) [-3]. $10,000, 50 lbs., D/24 hr. LC4.

TL10^ Contragrav Techbot (+59 points): A spherical body with no legs. As TL10 techbot, plus Flight (Planetary, -5%) [38]; Aerial [0]. +$10,000.

Bush Robot (TL11-12)

490 points

These are multipurpose robots resembling a walking leafless bush. A bush robot has six arms branching into multiple "fingers," each of which branches into a set of smaller fingers, and so on, down to nanometer scale. Each set of fingers is capable of independent sensing and operation; a "bushbot" can perform complex repairs or surgery without special tools. Massive processing capability is needed to control these "bush manipulators" – the robot's brain is equivalent to a microframe computer, and is distributed throughout its body.

These highly adaptable robots may be standard general-purpose machines, as well as popular bodies for sapient volitional AIs and mind emulations.

Attribute Modifiers: HT+2 [20].
Secondary Characteristic Modifiers: HP+7 [14]; Per+2 [10].
Advantages: 360° Vision [25]; Absolute Direction [5]; Ambidexterity [5]; Discriminatory Taste [10]; Doesn't Breathe [20]; Double-Jointed [15]; DR 15 (Can't Wear Armor, -40%) [45]; Enhanced Tracking 2 [10]; Extra Arms 4 (Extra Flexible, +50%) [60]; Extra Attack 2 [50]; High Manual Dexterity 4 [20]; Hyperspectral Vision [25]; Injury Tolerance (No Brain, No Eyes) [10]; Ladar [20]; Laser Communication [15]; Machine [25]; Microscopic Vision 6 [30]; Protected Vision [5]; Radio (Burst +30%; Secure, +20%) [15]; Sealed [15]; Sensitive Touch [10]; Quick Gadgeteer (Not for inventing new gadgets, -50%) [25]; Vacuum Support [5]; Vibration Sense [10].
Perks: Accessory (Compact microframe computer) [1].
Disadvantages: Electrical [-20]; Restricted Diet (Very Common, power cells) [-10].

Lenses

Choose a TL lens for the robot. Also select a machine intelligence lens (pp. 27-28). Cyborg is not available!

TL11 Model (+4 points): Add Maintenance (one person, monthly) [-2] and Reduced Consumption 3 [6]. $150,000, 75 lbs., 3D/1 week. LC4.

TL12 Model (+8 points): Add Reduced Consumption 4 [8]. $100,000, 50 lbs., 3D/1 month. LC4.

Optional Lenses

These are additional upgrades that may be added to bush robots:

Contragrav (TL11^) (+38 points): Capable of flight! Add Flight (Planetary, -5%) [38]. +$10,000.

Budding (TL12) (+21 points/copy): Some bushbots can bud off parts of themselves as smaller copies. Take up to five copies with Duplication (Duplicate is -1 SM, +0%; Shared Resources, -40%) [21/copy]. +$20,000 per copy it can bud.

Worker Swarms

These are equipment packages for microbot swarms (TL10) or nanobot swarms (TL11).

Construction Swarm (TL10-11)

This swarm is designed to tunnel, dig ditches, etc. Each bot is equipped with small arms and digging jaws. A square yard of swarm can dig as if it had ST 3 (not ST 1) and a pick and shovel (see p. B350). Construction swarms are often

employed for mining, or civil or military engineering. They can also pile up loose earth and rock into ramparts, dikes, or walls. $1,000/square yard. LC3.

Decontamination Swarm (TL10-11)

Decontamination swarms remove traces of most biotoxins, persistent chemicals, nanotechnology, or radioactive fallout. The type of hazard removed depends on the individual swarm's specialization. A square yard of swarm can decontaminate a one-square-yard area to a soil depth of 2" every minute, and can do so 20 times before requiring replacement. It has Hazardous Materials (Biological, Chemical, Nanotech, or Radioactive) skill at TL+2, and serves as basic equipment for hazmat disposal. $1,000/square yard. LC3.

Defoliator Swarm (TL10-11)

This swarm kills plants but has no effect on other living creatures. Even so, a large swarm might serve as an ecological sabotage weapon. It takes the swarm 10 seconds to strip a square yard clean of bushes or foliage. It can be programmed to carefully trim plants; this takes one minute per square yard. It may also be programmed to affect specific plants (for example, weeds) or to mow lawns. $1,500/square yard. LC3.

Harvester Swarm (TL10-11)

These can harvest crops with an effective Farming skill of TL+2. $2,000/square yard. LC4.

Painter Swarm (TL11)

These swarms are programmed to spread paint or ink. Simply upload a particular design, provide paint, and they will go to work. Each square yard of swarm can paint 1 square yard per minute. They can paint for five minutes before requiring paint refills, and can refill themselves if a supply is available. $500/square yard. LC4.

Pesticide Swarm (TL10-11)

The swarm is equipped to hunt down fleas, spiders, and other pests. Flier swarms can also destroy flies and mosquitoes. They will inflict 1d corrosion damage per turn to swarms composed of real insects! The swarm's actions are harmless to humans, although they can be entertaining or distracting. Like defoliator swarms, they can be an ecological threat. $1,000/square yard. LC3.

Pollinator Swarm (TL10-11)

The swarm functions as artificial bees, spreading pollen or seeds. This is useful if normal insects are not available, or cannot adapt to the local climate or ecology. Base cost is $1,000/square yard. LC4.

Repair Swarm (TL10-11)

The swarm has the tools and programming to repair a single, specific model of equipment, plus appropriate Armoury, Electronics Repair, or Mechanic skills at TL+2 (specify which). A single swarm fixes things at about 1/10 the speed of a human, but up to 10 swarms can combine to make repairs. Base cost is $500 per square yard, plus $250/square yard per additional model of equipment the bots are programmed to fix, to a maximum of four types of equipment per swarm. LC4.

Heavy Equipment, Salvage, and Rescue Gear

These are used for heavy lifting, salvage, cargo transfer, and emergency tasks.

Blast Foam (TL9)

Ballistic foam forms a non-conductive polymer-ceramic blanket. Designed to be sprayed over a bomb, it hardens in 3 seconds and forms a thick layer that can absorb explosions, contain fragments, and sterilize chemical, biological, and radiological agents. Each second of spray can coat a square yard, providing ablative DR 40 against crushing and burning damage, and ablative DR 20 against other types of damage. If the foam contains the blast, it is also treated as sealed with radiation PF 5. Each square yard of foam weighs 10 lbs.

Anyone completely coated with the foam may suffocate (p. B436); he can inflict his normal thrusting damage on the foam to try to escape. A canister of foam that can cover three square yards is $100, 30 lbs. LC3.

Fire Extinguisher (TL9)

This multi-purpose dry chemical extinguisher can put out ordinary blazing combustibles, flammable liquids, or electrical fires. Three sizes are available:

Fire Extinguisher Tube (TL9): A pocket device with a four-second discharge and two-yard range. $10, 1 lb. LC4.

Small Fire Extinguisher (TL9): A standard extinguisher bottle with a 10-second discharge and a three-yard range. $50, 3 lbs. LC4.

Large Fire Extinguisher (TL9): A heavy backpack model with a handheld projector connected to the pack. Three-yard range, 30-second discharge. $200, 10 lbs. LC4.

Multiply the duration of the discharge by 1.5 (TL10), 2 (TL11), or 3 (TL12).

Any fire extinguisher can also be used as a weapon. Use Liquid Projector (Sprayer) skill, using the jet rules: that is, it's treated as a melee weapon. Treat a hit to the face as an Affliction with the Contact Agent modifier. On a failed HT-3 resistance roll, the victim is stunned, and suffers the Blindness disadvantage for seconds equal to the margin of failure.

Tractor-Pressor Beam (TL11^)

A tractor-pressor beam can move things directly toward or away from it. It manifests as an invisible force that acts under the operator's conscious direction at a distant point.

The operator can move objects as if pushing or pulling them with two hands that have a specified ST. Objects can only be moved if the beam has strength enough to lift it at a Move equal to the beam's ST, modified as usual for encumbrance level.

A tractor beam requires constant concentration to use. In combat, this means the operator must take a Concentrate maneuver on his turn. No rolls are necessary

for ordinary lifting and movement. For more complex actions, the GM might require the user to make an Electronics Operation (Tractor Beam) skill roll.

It takes a Ready maneuver to move an unresisting object, or an Attack maneuver to affect an active opponent. A tractor beam cannot strike blows, manipulate objects, hold an enemy in place, or prevent him from attacking.

To affect a foe, roll against Gunner (Beams) to hit. The foe cannot grab hold of the force, but he can try to break free as usual. The turn after you grapple a foe, use a Move maneuver to pick him up off the ground, provided it has ST to lift his weight, and begin moving him. Someone in this position can't run, retreat, or do anything that relies on ground contact, but can perform any other action that is possible while grappled.

"Tractor" setting causes objects to move until they're in contact with the generator, whereupon they're held there until the ability is turned off.

"Pressor" shoves objects away from the generator until they reach its maximum range.

It takes a Ready maneuver to switch between tractor or pressor modes.

In either case, objects in the beam can only move or be moved in the opposite direction if the mover wins a Quick Contest of his ST against that of the beam.

Heavy Tractor-Pressor Beam (TL11^): Projects a ST 400 beam with a 10,000-yard range. It can snatch aircraft out of the sky, or grapple shuttlecraft and pull them in. $10,000,000, 20,000 lbs. Vehicle power. LC3.

Light Tractor-Pressor Beam (TL11^): Projects a ST 100 beam with a 100-yard range. Used as a crane. $200,000, 220 lbs. E/15 min. LC3.

Utility Tractor-Pressor Beam (TL11^): Projects a ST 50 beam with a 10-yard range. Used as a forklift. $20,000, 25 lbs. D/15 min. LC3.

TL12 beams have twice the ST and 10 times the range. Gravitic manipulators (p. 85) are a related technology. They have much greater manual dexterity, but less strength.

Pressor Beam (TL11^)

These only *repel* objects; they have no tractor setting. They are half as expensive as tractor-pressor beams, but are otherwise identical.

Tractor Beam (TL11^)

These only *attract* objects; they have no pressor setting. They are half as expensive as tractor-pressor beams, but are otherwise identical.

Demolitions

Explosives have many uses, from civilian mining and construction sites to safe-cracking, sabotage, booby-traps, and terrorism.

Explosives (TL9-11)

Ultra-tech demolitions and explosive capabilities benefit from advances in chemistry and high-energy physics. Explosives are rated for their relative explosive force (REF) compared to TNT; see p. B415. Some common types are described below:

Antimatter (TL9): A microgram of antimatter (see *Antimatter Trap*, pp. 80-81) is $25,000 (at TL9), $2,500 (TL10), $25 (TL11), or $5 (TL12). LC0.

Plastex B (TL9): This is a powerful moldable high explosive. It is very stable and can only be detonated with an explosive detonator. It is roughly four times as powerful as TNT (REF 4). $20 per pound. LC2.

High-Energy Explosive (TL10): An exotic explosive that stores energy in metallic hydrogen. It is approximately six times as powerful as TNT (REF 6). $40 per pound. LC2.

Plasma Explosive (TL11): These are rapid-discharge power cells, or power cartridges with the safety features removed. Plasma explosives have REF 10 at TL11, and REF 20 at TL12. Their damage also has the surge damage modifier (p. B105), so additional safety precautions are necessary when using them near electronics. $100 per pound; includes a built-in detonator. LC2.

For more exotic types, see also *Warheads and Ammunition* (pp. 152-159).

Detonators for explosives can use communicators or timers. They are $20, neg. weight, LC3.

Taggants (TL9)

Commercial and military explosives may be embedded with taggants: inert materials that will not be destroyed in the explosion, and which can be analyzed later to determine the type of explosive, manufacturer, and lot number. Taggants add +TL/2 to Research or Forensics rolls to find the origin of the explosive.

Not all explosives have taggants – companies may resist including them to avoid liability, and military or black ops teams may not want them (unless they want to blame someone else for the blast). A chemistry lab can be used to test a sample; decontamination swarms (p. 87) can be used to remove taggants! There is no extra cost for taggant-equipped explosives. However, if taggant use is required by law, any explosives *without* taggants will be one lower LC.

Manufacturing

Ultra-tech manufacturing equipment can be very portable. An expedition, spacecraft, or military unit may be able to make many supplies itself, rather than waiting for resupply. This could be carried into the consumer sector as well, with shops or homes having their own manufacturing facilities. This is most likely in societies with dispersed populations, such as colonial worlds. In highly-populated centers with an excellent transport infrastructure, it will be cheaper to centralize manufacture and distribution.

Many of these systems use the cost of goods as a rough indicator of how long it takes to manufacture things. This is an abstraction intended to apply to ordinary products; factor out cost changes from artistic or collector value, non-intrinsic value (e.g., paper currency), age, and source (black market, second-hand, etc.).

Industrial Equipment

These may be used to equip corporate facilities, colonies, or large ships.

Factory Production Line (TL9)

This is a production line for assembling a *specific* product from existing components. Each can assemble one copy of a device every (retail price/100) hours. Computer chips and other small gadgets take longer: multiply time required by 5 if the item's weight is under 0.1 lbs., by 20 if under 0.01 lbs., by 100 if under 0.001 lbs., etc.

The per-item production cost is 20-30% of the retail cost for parts. (The production line requires a supply of component parts.) The cost of the production line is $20 times the retail cost times the small gadget multiplier above. Each station in the production line requires one worker and weighs 1 lb. per $100 the production line costs (minimum 20 times item weight). It uses external power. LC is the same as the item. Big factories may have several lines with multiple stations up to a maximum of cost/100 stations; divide the time per item by number of stations in the line.

Example: A factory makes a $200 computer chip that weighs 0.005 lbs. A single production line makes one chip every $200 / 100 = 2 hours × 20 = 40 hours, or about 18 chips/month. The production line costs $200 × 20 × 20 = $80,000 and weighs $80,000/100 = 800 lbs. However, 18 chips/month isn't many. A proper "computer chip fabricator" complex might have 2,000 stations among several lines costing a total of $160 million, and weighing 1,600,000 lbs.

Future Economies

TL11 and TL12 offer the potential of vast increases in wealth, thanks to molecular nanotechnology, inexpensive artificial intelligences, and total conversion of matter. However, ***GURPS*** prescribes conservative levels of starting wealth at these TLs. What's going on?

The assumption is that GMs and players will be more comfortable with a setting in which the PCs have a familiar level of wealth. If everyone is unimaginably wealthy, what are their motivations? But if a "reasonable" justification for more modest wealth is required, it's available.

In space operas, a higher power, such as the galactic emperor and his bureaucracy, or the benevolent space patrol, or the military, usually has control of the majority of this wealth. It is squandered on building vast planet destroyers, mobile star-traveling planets, enormous battle fleets, ringworlds, or massive terraforming and resettlement projects. The average standard of living doesn't improve that much, it's just that the very rich have more levels of Multimillionaire.

In transhumanist settings, the vast increase in wealth may result in the dominant race in a society (which may or may not be humans) all being Filthy Rich or better. However, the working proletariat – in this case, usually vast numbers of low-sapient computers – controls Average (or less) wealth.

In more socialist settings, the wealth is spread evenly among everyone, regardless of race . . . but thanks to the ability of digital intelligences to rapidly replicate, the ability to create wealth with nanotechnology and transmutation is matched or exceeded by the ability of free beings to reproduce themselves. While such beings also do work and create wealth (and require little in the way of living space), the net result is a modest improvement in average wealth, even as populations skyrocket.

Robotic Production Line (TL9)

A production line can be designed that is capable of producing devices without any direct human involvement at all. Necessary raw materials must still be delivered. It requires its own mainframe (or fast microframe) computer of the appropriate TL to supervise. A robotic production line is 10 times the cost and double the weight of a production line, but goods are manufactured without the need for human operators (except possibly for maintenance and programming).

Fabricator (TL9)

This is a programmable factory capable of making, repairing, or modifying most manufactured goods, assuming parts such as sheet metal, circuit boards, and chemicals are available.

Fabricators incorporate multi-axis lathes, grinders, laser welders, and mills. They create custom parts and assemble pre-built components into a final product inside their manufacturing chamber. They also incorporate rapid-prototyping 3-D printer systems that spray down layers of liquid plastics, epoxies, and metal powders to manufacture solid objects. At TL10+, these can build most solid objects by painting materials, layer by layer, until the object takes form. With appropriate blueprints, a fabricator can build just about anything that fits inside it.

TL9 fabricators are incapable of assembling microtech items. At TL10+, fabricators can assemble devices one molecular layer at a time. Multiply the time required to fabricate microtech gadgets by 5 if item weight is under 0.1 lb., by 20 for under 0.01 lbs., by 100 for under 0.001 lbs., etc.

Fabricators require databases with the appropriate blueprints. Construction data for controlled devices such as military lasers will be very hard to come by, though a good programmer who is also a technician could write one himself, given enough time.

Fabricators are not as efficient as production lines; they're designed to produce a wide variety of high-tech items in small quantities. Military units, ships, and small space stations often have "minifacs" to make spare parts and miscellaneous gadgets. Start-up colonies may purchase a few fabricators, and neighborhoods may have them instead of hardware stores.

The GM may judge how long any one item takes to build. Most items can be built in one hour per $50 of value, if the fabricator has access to new, packaged parts for everything it needs. If it is working from scrap, printer cartridges, or salvaged materials, one day per $500 would be more appropriate. Fabricators are not capable of atomic-level assembly of items, and a critical shortage of an element can stop production. A fabricator can start an adventure just by flashing a red light and announcing that it can't finish the current project until you give it three ounces of selenium and a quarter-carat gem-quality ruby.

The cost of an item would be about 60% of base price if working from specialized parts – or 50% if using generic scrap or printer cartridges. Since a full-size production line produces items for 50% of cost, and merchants buy in bulk at a discount, owning a fabricator does not mean you can get rich quick.

Memory Materials

Many items in this book are made of *memory plastic* (including "bioplastic" or "bioplas") or *memory metal*. These materials "remember" their shape, giving them remarkable durability. They first appear at TL8, but at higher TLs – TL9 for plastic, TL10 for metal, and TL11 for complex machines and electronics – they can flex or even change shape *on command*.

Fabricators also serve as basic equipment for the Machinist skill; larger systems provide a bonus to skill due to their utility in making spare parts.

Industrial Fabricator (TL9): A full-size factory; it adds +TL/2 (quality) to Machinist skill. For every $500 or 5 lbs. of goods it can fabricate per hour, it is $500,000, 1,000 lbs., industrial power. LC3.

Minifac (TL9): A workshop-sized unit. It can fabricate $50 or 1 lb. of product per hour. It adds +3 (quality) to Machinist skill. $50,000, 100 lbs., external power. LC4.

Suitcase Minifac (TL10): A portable system that fits in a carrying case, or a large backpack. It adds +1 (quality) to Machinist skill and can fabricate $10 or 0.1 lbs. of product per hour. $5,000, 10 lbs., C/8 hrs. LC2.

Fabrication speed doubles each TL after introduction.

Robofac (TL10)

All ultra-tech factories incorporate a wide variety of automated, programmable machine tools. However, these are a step up: fabricators that can operate with no human involvement, with all operations and maintenance directed and performed by machines.

Robofacs can reconfigure themselves to manufacture almost any product. The largest robofacs may cover several city blocks, and cost billions – but they make the difference between a civilized planet and a colony world. An unmanned colony expedition carrying genetic material, exo-wombs, and a robofac can develop a world in an astoundingly short time, producing both living things and industry.

Universal robofacs function exactly like universal fabricators, but they are also capable of fully autonomous control with their own Machinist skill.

Industrial Robofac (TL10): A full-size factory; it has Machinist-14. For every $1,000 or 10 lbs. of goods it can fabricate per hour, it is $1,000,000, 1,000 lbs., industrial power. LC3.

Robotic Minifac (TL10): A workshop-sized unit. It can fabricate $100 or 1 lb. of product per hour. It has Machinist-13. $100,000, 100 lbs., external power. LC4.

Portable Robofac (TL11): Fits in a carrying case, or a large backpack. It has Machinist-12, and can fabricate $10 or 0.1 lbs. of product per hour. $10,000, 10 lbs., C/8 hrs. LC2.

Fabrication speed doubles each TL after introduction.

Blueprints (TL9-12)

The instructions to build a gadget. For many commercial goods, blueprints are licensed rather than sold outright. The licensing agreements require royalty payments based on the quantity of goods produced – typically 10%-50% of the base cost of the item. This royalty may exceed 90% on goods whose main cost is their artistic value, information content, or trademark (e.g., designer clothes). LC is equal to that of the item.

3D Blueprints (TL9): These are used with fabricators (p. 90) and robofacs (above). They are Complexity 2 for devices costing up to $100, Complexity 3 for devices up to $1,000, etc.

Molecular Blueprints (TL11): These are usable with nanofacs (below). They are Complexity 3 for devices costing up to $100, Complexity 4 for devices up to $1,000, etc.

Wet Nanofabrication Systems (TL10)

Early industrial nanofactories require highly controlled environments. They use a mix of protein-based nanobots and top-down manufacturing techniques, which is sometimes referred to as "wet" nanotechnology.

Vatfac (TL10)

This is a large biofactory unit that can grow food, pulp, industrial bacteria, or similar products. It can feed up to 20 people, or half as many if creating a variety of imitation flesh, and other foods. $100,000, 200 tons, external power.

Nanofacs (TL11-12)

Nanofactories ("nanofacs") are molecular manufacturing systems that utilize programmable general-purpose assemblers – cell-sized robots reprogrammed to build molecular components in an orderly fashion "from the bottom up."

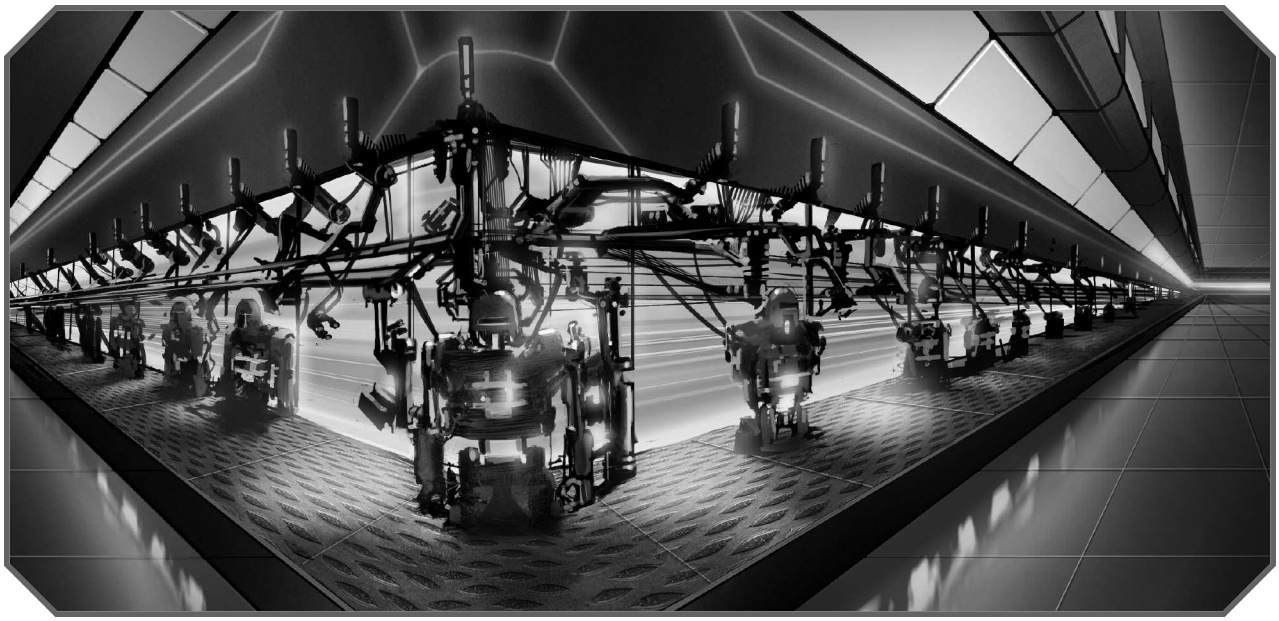
At the core of a nanofac is a set of manufacturing chambers, surrounded by a cooling system (the process generates prodigious amounts of heat) and feed lines connected to material storage tanks. The storage tanks house assemblers and a feedstock of prefabricated parts and industrial chemicals. The assemblers are cell-sized robots equipped with their own computer brains, jointed arms, plugs, and sockets. Prefab parts are molecular structural fibers, motors, brackets, fasteners, and molecular computers.

The nanofac's operator selects a design program for the assemblers to follow. A fluid mixture of prefab parts, assemblers and chemicals is pumped into the manufacturing chambers. The assemblers begin work, seizing the prefab parts and snapping them together or bonding them chemically. The molecular-scale parts undergo sorting and assembly in stages, gradually forming complicated structures. Countless microscopic nanobots swirl into the tank, and begin building the object from the inside out. The desired object quickly takes shape within the manufacturing chamber. When it is completed, it is totally seamless, with no tool marks, rivets or other evidence to show it was manufactured. It seems to have been grown, not built.

The fabrication nanobots themselves have limited onboard computing power, simplifying their design and limiting the possibility of "rogue" nanomachinery escaping the factory. Most fabrication nano is delicate: the construction process relies on a carefully controlled environment within the manufacturing chambers and even minor deviations can result in flawed subassemblies.

Nanofacs build complex objects using convergent assembly. Large objects are constructed out of subassemblies created in their own small manufacturing chambers. The subassemblies are built from sub-subassemblies, which are built in still smaller chambers, etc. In this way objects can be created quickly and efficiently, in sizes limited only by the number and volume of chambers and the supply of feedstock.

Nanofacs cannot change the atomic structure of objects. If an object includes rare elements, for example, they must be provided. Similarly, a nanofac can not make antimatter, though it can build a particle accelerator that does.



Von Neumann Machines

A defining characteristic of biological organisms is the ability to replicate. What if machines also had that capability?

A well-equipped robotic factory (p. 90), nanofac (pp. 91-93), or replicator (pp. 93-94) can gather resources, fashion parts, and build additional copies of itself at other locations, which can in turn copy themselves, and so on. This "universal constructor" technology can be used in extraterrestrial colonization for manufacture of parts that are too expensive to import.

Self-replicating machines are necessary for megaprojects. Operating at maximum theoretical efficiency, it would take 40 to 60 years to perform any planetary-scale project, such as converting a moon or a gas giant into machinery or another structure. In practice, the actual times would likely be far longer due to engineering complications, such as the difficulty of operating in harsh environments like a planetary core. Multiply construction times by 100 at TL10, by 10 at TL11, or by 2 at TL12.

Because they must devote time to mining or gathering resources, or building tools to make the tools, self-replicating factories are less efficient than ordinary factories that can import parts. Practical systems are often designed with a secondary purpose: after building a certain number of copies, they redesign themselves into a cooperative network of specialized machines and factories, which then begin building some other product.

The possibility of self-replicating robot weapons (or construction systems run amok) may lead to tight regulations. Such systems might be required to have human overrides and supervision.

Self-Replicating Swarms (TL12)

Nanobot swarms (p. 35) are an alternative to large, complex robot factories. Swarms may be simple enough that they can "live off the land."

A self-replicating swarm is a devourer, pesticide, or defoliator swarm that is designed to consume appropriate matter and make copies of itself. It can double its size every hour or so as long as it has something to eat. It requires a gastrobot or organovore power supply.

The simplest self-replicating swarm will eat anything carbon-based that is not a replicator swarm. This is sometimes referred to as "gray goo," since it can transform an entire planetary ecosystem into a barren wasteland. Even before consuming a planet down to the bedrock, gray goo can cause ecological catastrophe due to the direct damage it inflicts and the waste heat produced by the conversion process.

Swarms can be programmed to eat only certain targets (including enemy replicator swarms!), but this will limit their ability to reproduce if they're short of food.

A self-replicating swarm costs 10 times as much as an ordinary devourer, pesticide, or defoliator swarm. LC0.

Nanofacs do make some previously valuable materials inexpensive, such as synthetic diamond made out of carbon.

Nanofacs can build biological material such as food by assembling proteins and sugars, but they are unsuited for creating liquids or gases. Complex living things cannot be manufactured by a standard nanofac, but specialized systems can be designed to build almost anything within the above constraints.

A big gadget built piecemeal from smaller modules usually takes an additional hour of work (and an appropriate Armoury, Electronics Repair, or Mechanic skill roll) to put together per $1,000 it cost, multiplied by the number of modules used. Some parts such as armor plate and weapon barrels only retain full structural integrity if produced as single units. It is up to the GM whether any large device can be effectively assembled from modules or not.

Nanofacs come in a variety of sizes, rated for the greatest mass of object they can manufacture. The time required to manufacture a product in hours is expressed by both cost and weight, since more complicated structures take longer. However, the cost is also based on the cost of acquiring an object at that TL. High-quality diamonds that are very expensive at lower TLs might cost less than $500 per pound at TL11.

The major cost for manufacture is likely to be licensing fees for the design programs used, which may cost anywhere from 1% to 80% of the cost of the item.

Operating a nanofac requires Machinist skill. Repairs also require Mechanic (Nanomachines) skill. Fabrication time is based on both the cost and the material weight; use whichever takes longer.

Industrial Nanofac (TL11): A full-size factory. For every $10,000 or 20 lbs. of goods it can assemble per hour, it is $2,000,000, 1,000 lbs., industrial power. It must be connected to a suitable feedstock source. LC1.

Nanofac Workbench (TL11): A table-sized nanofac, roughly 6 feet × 3 feet × 3 feet. It can assemble $500 or 1 lb. of product per hour. $200,000, 100 lbs., external power. It must be connected to a suitable feedstock source. LC2.

Suitcase Nanofac (TL11): A portable system that fits in a suitcase or backpack – very useful for a black ops team! It can assemble $50 or 0.1 lbs. of product per hour. It must be connected to a suitable feedstock source. A suitcase nanofac and feedstock supply can be implanted *inside* a human-sized robot or cyborg. $20,000, 10 lbs., D/4 hrs. LC2.

Double the fabrication rate (in dollars only) at TL12.

Feedstock Pipes (TL11)

Societies that have integrated nanofacs into daily life may develop "public utility" services that allow houses or businesses to draw feedstock material from a central source. Users could open a tap and cause prefab molecular parts and assemblers, or raw chemicals, to flow into the nanofac. The supplier may be the state or a corporation. The price might be metered by weight or composition and treated as a utility bill.

Feedstock must equal the weight of gadgets. Replacement tanks of assemblers, raw materials cost about $1-10 per pound of goods; exotic or volatile materials are more expensive. Nanofac maintenance costs are very low – there are few moving parts, and the assemblers are very efficient with their feedstock.

Replicators (TL12^)

Replicators represent the ultimate alchemy: the ability to swiftly transform one object into another. The item is placed within the machine, analyzed by a molecular scanner, and then removed, after which the replicator can make any number of copies.

Replicators require incredible amounts of energy ($E=mc^2$); or a stock of elemental hydrogen, and not so much energy; or a stock of the required elements, and less energy still; or (for organic objects) a little bit of energy and a stock of water, amino acids, and trace elements. Replicators can synthesize elements and molecules if they have to, but it's cheaper if they don't. They generally reduce material into plasma, then reorganize it into solid, liquid, or gas. They usually do not *create* matter, and require an amount of matter equal to the mass of whatever object is being replicated.

Universal replicators can transform (almost) anything into anything, including making repairs or healing people or things. The "almost" is up to the GM – exotic superscience materials may exist that cannot be replicated.

In theory, universal replicators can also be used to resurrect or upload people. However, the GM may decide that the fidelity of the recording is limited. There may be tiny deviations at the atomic or quantum levels, enough that the replicator cannot duplicate a person's memories exactly. See *Uploading*, pp. 219-220.

Industrial Universal Replicator (TL12^): Building-sized. It can replicate objects up to 500 lbs. in 10 seconds. No feedstock is required. $100,000,000, 10,000 lbs., 10F*/150 sec., per 500 lbs. capacity. LC1.

Suitcase Universal Replicator (TL12^): A portable system. It can create objects up to 0.25 lbs. in 10 seconds. $200,000, 2 lbs., C*/300 sec. LC1.

Workbench Universal Replicator (TL12^): A table-sized device, capable of creating up to five lbs. in 10 seconds. $2,000,000, 100 lbs., D*/150 sec. (but usually runs on building power). LC1.

* Requires cosmic power cells (pp. 19-20) rather than ordinary cells. If this technology is unavailable, replicator technology is unlikely to be cost-effective.

Replicator Software and Templates

These are the atomic-level "blueprints" of an object. In societies where replicators are common, people may sell replication templates and licenses rather than the objects themselves.

Replicator Templates (TL12^): Usable with replicators (p. 93). Most designs typically require at least one terabyte of storage space. They cost up to 10 times as much as a device (assume $50,000 for a template that can be used for replicating a particular person). Complexity 8+.

Psi Amplifiers

If psionic powers are scientifically understood, it may be possible to use technology to amplify them. Such devices are called psi amplifiers ("psi amps").

"Psi amps" boost a psi's Talent level in a particular power, such as Psychokinesis. This boost can increase the psi's Talent beyond the usual four-level limit. Optionally, each +1 bonus may instead add +1 level to any leveled psionic ability (e.g., Telekinesis or Innate Attack). The user can always choose to use less than the maximum boost, which reduces the danger should psychotronic feedback (below) occur.

A psi amp should be attuned to the user, and can only be attuned to one person at a time. This requires a successful roll against Electronic Operations (Psychotronics) skill. Failure wastes an hour; critical failure damages the device. It is possible to use a psi amplifier that is not properly attuned, or is attuned to someone else, but any roll of 15+ when using the device is treated as a critical failure.

The power surge a psi experiences when using an amplifier can be dangerous. If the user ever suffers a critical failure while using an amplified ability, he suffers psychotronic feedback. This burns out the machine, which requires minor repairs. The user must also make a HT+3 roll, at a penalty equal to the boost. Failure means he suffers a seizure (p. B429) for seconds equal to the margin of failure (along with the usual 1d FP loss afterward); failure by 5+ results in psionic feedback that leaves the user unconscious, suffering the Coma mortal condition (p. B429).

Amplifier Throne (TL9^)

This is a throne-like chair, with a helmet, biofeedback monitors, and a computer. The user sits in the chair, and power floods through him to be channeled into psionic energy. Unless the user is very powerful, machines amplifying teleportation will move the user, but not the machine! The device adds up to (TL-5) to the user's Talent in a particular power. $200,000, 1,000 lbs., external power. Machines that can amplify more than one power at once are available – add $100,000, 500 lbs. per extra power. LC3.

Backpack Psi Amplifier (TL9^)

These devices work in the same fashion as standard psionic amplifiers, but use a backpack-sized power pack connected to a helmet, and run off a D cell. Portable amplifiers can increase the user's Talent by up to (TL-7) in a particular power. $40,000, 20 lbs., D/1 week. Add $20,000 and 10 lbs. per extra power it can amplify. LC3.

Psi-Amplifier Helmet (TL10^)

This is low-powered psionic amplifier. It adds a maximum of (TL-9) levels of Talent to a particular power. $25,000, 4 lbs., C/1 week. Add $10,000 and +2 lbs. per extra power it can affect. LC3.

Psi-Amplifier Headband or Belt (TL11^)

This adds a maximum of (TL-10) levels of Talent to a psi power. $6,000, 1 lbs., B/1 day. Add $3,000 and +0.25 lbs. per extra power it can boost. LC3.

Chapter Five
Covert Ops and Security

Operations, this is Security Control. Motion sensors show unauthorized entry in the tunnel outside the antimatter storage bay. The laser fence at checkpoint 4 was triggered, no idea if they hit anything. Any of your techs or the client's guys down there?"

"That's a negative, Control. Another rat?"

"Maybe. If it was a rat, it should have shown up on infrared. Flood the area with nerve gas, then send in a security robot – one with the new sensor suite."

– Syndicate security log (23:09)

My cammo suit was good against radar, infrared, ladar, and the human eye. I was ready for all the ultra-tech toys they'd brought in. I didn't realize they'd installed local sonic sensors as well. Low tech – but if it weren't for the ablative armor, I'd have been toast when that laser grid opened up.

Sniff. What's that? Nerve gas. Well, at least they still think I'm human.

– Special Agent Gabrielle, Imperial Secret Service

This chapter covers gadgets intended for law enforcement, secret agents, criminals, and special ops teams . . . although as technology advances, many of these gadgets may also be used by ordinary citizens to maintain their own security.

Deception and Intrusion

Sometimes the most important items in an adventurer's toolkit are the ones that allow him to get into places where he shouldn't, find out things that he isn't supposed to, and get away undetected. At times like that, technology may be the only ally that he can trust! This section presents devices that are useful to commandos, spies, and thieves – anyone who has to tangle with a security system or elude detection.

Burglary, Infiltration, and Sabotage

These gadgets are useful for cracking security measures, or entering hard-to-reach places.

Items listed elsewhere that are helpful for burglars include explosives (pp. 88-89), laser torches (pp. 80, 85), plasma torches (p. 80), sonic probes (p. 84), and tool kits (p. 82).

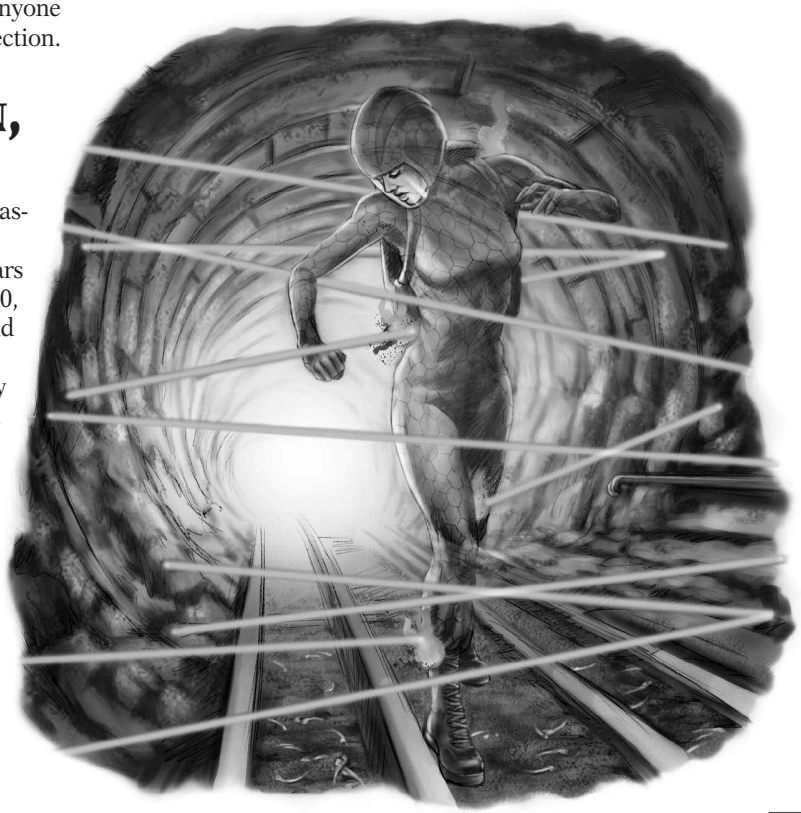
Gadgets mentioned elsewhere that are especially useful for infiltration include diver propulsion (p. 228), flight packs (p. 230), and stealth drop capsules (p. 232). Demolitions (pp. 88-89) and gremlins (p. 169) are useful for sabotage operations. Portable fabricators (p. 90), nanofacs (p. 91) and replicators (pp. 93-94) are extremely useful for any black ops team!

Electronic Lockpick (TL9)

This sensor/decoder gives a +3 to Lockpicking and Electronics Operation (Security) skill on attempts to pick any electronic or combination lock. $1,500, 0.2 lbs., A/2 hr., LC2.

Biometric Cracker Tools (TL9)

This sensor/decoder gives a +3 to Lockpicking and Electronics Operation (Security) skill on attempts to defeat any biometric scanner. $4,000, 10 lbs., A/2 hr., LC2.



Electronic Thumb (TL9)

An electronic thumb counters retina and fingerprint scanners. The pocket-sized gadget has the size and shape of an eyeball, and lights from within to display a retina pattern. The other end has the shape of a thumb and warms to body temperature. Its memory plastic pad can be reconfigured to match any thumbprint in the device's memory. New thumb and retina prints can be downloaded into it by connecting it via cable to an appropriate database. Getting a thumb or retina print for the database may not be easy – high-quality photos of the target's eye and an actual thumb impression are needed. $5,000, 0.25, A/100 hr. LC3.

Electromagnetic Autograpnel (TL10)

This uses an electromagnetic coil gun to silently fire a grappling hook up to 30 yards. Make a Climbing or Guns (Grenade Launcher) roll to hit, at -2 if unfamiliar with this gadget (see p. B169). An electromagnetic winch on the gun lifts up to 800 pounds at up to five yards per second. The reel contains 30 yards of 1/8"-diameter rope (p. 81). Ascent and descent speed improves at higher TLs: seven yards/second (TL11) or 10 yards/second (TL12). $500, 5 lbs., C/15 min. LC4.

Gecko Gear (TL10)

These gloves and footwear let the user cling to walls and ceilings and move at half his Basic Move; no use of Climbing skill is necessary. Gecko gear designed for humanoids can support only 50 lbs. per limb in contact with the surface, including the user's body weight. An adult human won't be able to carry much gear with him. If the user's weight requires three or four limbs in contact, he will be limited to crawling. Each pad is $500 and 0.1 lbs. weight. They can be built into armor or other suits. LC3.

Sonic Screen (TL10)

Worn strapped onto a belt, this forms a portable privacy field (p. 106) which moves with the wearer. The field is three yards in diameter. Sounds from outside the field cannot be perceived by someone inside the field (-10 to detection), and vice versa. The field also provides DR 10 against sonic attacks. Assassins and thieves use sonic screens to make the victims' cries inaudible. $5,000, 2.5 lbs., C/1 hr. LC3.

Variable Lockpick (TL10)

A memory-metal lockpick with a small imaging radar, an ultrasound imager, and its own contact mike. It reconfigures its shape into one of several hundred alternative forms after performing a sensor analysis of the lock. It includes a fiber-optic scope. Gives +4 to Lockpicking skill to open mechanical locks. It fits in a wallet., $50, neg., A/12 hr. LC2.

Exophase Field Generator (TL12^)

Everything in an exophase field enters an insubstantial state – one that has only limited interactions with ordinary matter and energy. Exophase fields are sometimes explained as moving the user into a parallel universe, altering his subatomic structure, or turning him into an odd form of "dark matter."

The user is still affected normally by gravity and by gravitic beam weapons. Other physical and energy attacks cannot harm him (nor can he harm others), although he's still vulnerable to psionic and nonmaterial magical attacks.

The user can pass through solids, but must still breathe. When moving through a solid object, treat this as if swimming underwater for purposes of suffocation.

The user cannot re-materialize inside a solid object; attempting to do so will simply prevent materialization. If he runs out of power while inside a solid object, he is destroyed.

Someone using an exophase field is blind, deaf, and cannot be detected by any active sensors or any sonic sensors. The field's outline *is* visible as a sort of ghost-image across the electromagnetic spectrum – this is a side effect of whatever keeps it anchored in reality. Most users turn the field off to check their position, or use an inertial navigation system.

The user can interact normally with someone else in an exophase field. Whether he can affect (or be affected) by someone who has the Insubstantiality advantage depends on the form of Insubstantiality. An exophase cannot pass through a force shield that can stop solid objects, or a reality stabilizer. The GM may rule that certain other materials, energy barriers, or magic spells are impenetrable to exophasing.

Only objects within the exophase can be carried. Objects released from it materialize.

A human-sized exophase field generator that surrounds the user and anything he is carrying (up to light encumbrance) is $500,000, 10 lbs., D/15 min. Adjust this for SM (see p. 16); users may also wish to add weapons or other gear. LC1.

Stasis Key (TL12^)

This reality stabilizer (pp. 194-195) creates an energy pulse which will cause any active stasis web to collapse. The stasis web generator is unharmed.

Stasis Disruptor (TL12^): 10-yard range. $5,000,000, 540 lbs., 2E/15 min. LC2.

Stasis Key (TL12^): Contact range. $5,000, 1 lb., 2B/15 min. LC3.

Forgery and Counterfeiting

Most ultra-tech forgery involves the gaining of passwords, personal information, or biometric data through computer hacking, the breaking of encryption, corruption, theft, coercion, or simple carelessness. However, some special tools are also available.

Document Fabricator (TL9-10)

This is a dedicated terahertz scanner and specialized 3-D printer that is used to copy and manufacture the special

dyes, fibers, films, foils, inks, papers, and plastics used in TL8+ identity documents or currency. Higher-TL document fabricators incorporate better scanners and molecular nanotech. With a sample to analyze, they can forge documents from any prior TL.

Desktop Doc-Fab (TL9): Table-sized. Provides a +2 (quality) bonus for Forgery and Counterfeiting skills at its own TL, increasing to +TL/2 for any *lower-TL* documents. Most documents take an hour per attempt to scan plus a minute per copy to print. $20,000, 50 lbs., 4D/10 hr. LC2.

Suitcase Doc-Fab (TL10): Suitcase-sized. Provides a +1 (quality) bonus for Forgery and Counterfeiting skills at its own TL, increasing to +TL/2 for any *lower-TL* documents. Somewhat slower than the desktop version: most documents take about two hours per attempt to scan, plus five minutes per copy to print. $4,000, 10 lbs., 4C/10 hr. LC2.

Programmable Wallet (TL11)

This wallet contains a miniature dedicated nanofac (pp. 91-93). Using pre-fab "blanks" of smart material, it can change their molecular composition to become identity cards with an integral Counterfeiting and Forgery-15 skill; this takes only a minute. It's often used when visiting lower-TL cultures lacking molecular nanotech. It has a -5 (quality) modifier to Forgery or Counterfeiting at its own TL, but counts as basic equipment for lower-TL documents. $500, 0.2 lb., 2B/15 min. LC1. A pack of 100 blanks of various sizes (for passports, paper money, ID cards, etc.) is $100, 0.1 lb. LC2.

HoloPaper (TL11^)

This device can instantly morph to create a realistic falsified document at Forgery-15, suitable only for fooling a visual search. It will not defeat examination at its own TL or higher, but is quite realistic for lower TLs. $100, 0.1 lb. LC2.

Disguises and Smuggling

This section covers innovations in personal concealment and the smuggling of people or items. Distortion chips (p. 99) are another useful technology.

Disguise Kit (TL9)

An elaborate set of prosthetic devices, skin-tinting chemicals, and hormone sprays for disguising one person's appearance. Many components incorporate microelectromechanical systems that can mimic muscle twitches, realistic limps, and other key characteristics.

Suitcase Disguise Kit (TL9): Provides a +1 (quality) bonus to Disguise skill. $200, 10 lbs. LC3.

Disguise Fabricator (TL9): Designed specifically for intelligence agents. Provides a +2 (quality) bonus for the Disguise skill. $800, 50 lbs. LC2.

Shape-Memory Disguises (TL9)

Memory-plastic and memory-metal technology can disguise weapons and other suspicious items as innocuous devices of the same general shape and size. Another possibility is to break the contraband down into several parts, each of which appears to an unrelated piece of equipment.

Single-Function: While disguised, the gadget doesn't function (except as much as its basic shape allows). It costs five times as much as a normal version of the original gadget.

Multi-Function: Both the disguise and the disguised gadget are fully functional. Cost is 20 times the sum of the cost of *both* the gadgets. Both gadgets must be of similar (+/-10%) weight.

Shape-memory devices usually incorporate a power cell (an AA cell for devices up to 0.1 lb. weight, A cell for up to 1 lb., B cell for up to 10 lbs. etc.) to provide an electrical impulse that triggers the change. The cell powers 60 changes, and can be removed and inserted later if power cells would be suspicious. A simple gadget may also use a piezoelectric material that changes if shaken vigorously for 10 seconds.

A gadget with a shape-memory disguise has *half* its normal LC (rounded up). An LC3 pistol would be LC2 as a shape-memory gadget, but an LC1 gadget is still LC1.

Stealth Luggage and Cargo (TL9)

Perfect for the professional courier or smuggler, these items use the latest in electronic countermeasures and stealth materials to spoof scanners and sniffers. A hidden liner compartment provides safety for small packages, while a biometric lock (p. 104) provides security. The liner compartment holds one-tenth the luggage's capacity and provides a +2 (quality) bonus to Smuggling skill. It is sealed to defeat chemical sniffers and dogs.

Attaché Case (TL9): Holds up to 20 lbs. (or two cubic feet). $400, 2 lbs. LC3.

Travel Bag (TL9): Holds 100 lbs. (or five cubic feet). $1,200, 10 lbs. LC3.

Trunk (TL9): Holds 400 lbs. $4,000, 40 lbs. LC3.

Shipping Container (TL9): Holds 10,000 lbs. Up to four people can hide in the liner compartment, but they'll need breathing gear. $10,000, 1,000 lbs. LC3.

These items may have a programmable camouflage (p. 99) surface at an extra 50% to cost. Distortion chips or fields (p. 99) can also be added.

Voice Mask (TL9)

This wearable mike obscures the speaker's voice. He can set it to sound human, but different than his normal voice, or to change his apparent age, race, or sex. It will also alter the speaker's voiceprint. $200, 0.1 lb., B/20 hr. LC3.

Active Flesh Mask (TL10)

A full-face mask of a *specific* person, complete with micromotors that move the face in realistic fashion. This is a custom design, and detailed measurements of both the user and the subject's face (which can be taken by medical examination, or remotely by T-ray scanner, X-rays, or ultra-scan) are needed. It takes 10 seconds to put on, two seconds to remove.

The mask adds +3 to Disguise skill, cumulative with quality modifiers. When impersonating somebody, the GM may treat this as a perfect disguise, but Acting skill will still be required to convince someone who knows the individual being mimicked. The mask's legality class reflects legal uses in media productions and as a prosthetic for people with extensive facial injuries. It includes a voice mask (p. 98). $10,000, 1 lb., B/24 hr. LC3.

Dynamic Holotech (TL10^)

This holographic projector casts a preset three-dimensional image. It will not fool sensors that do not use visible light, such as infrared or hyperspectral imaging. A disk inappropriate to a given planet is more likely to draw attention to the user than it is to conceal him. Because it projects light, it glows in the dark.

Holobelt (TL10^): Casts an image around the wearer, roughly man-sized, for concealment. The image must be bigger than the person concealed! Standard hologram disks let the user choose between a native-looking rock, tree, mailbox, bush, animal, etc., or plug in a disk taken from a 3-D camera. All attacks on the user are at -1 to hit, and aimed shots to specific body areas are not possible unless the image closely resembles the user's body. $2,000, 2.5 lb., C/10 hr. LC3. Prerecorded holodisks are usually about $50.

Holofield (TL10^): A larger model of the holobelt, used to disguise buildings, camps, and vehicles. The field will cover a radius of up to 10 yards. New images can be captured via a 3-D camera or synthesized with a computer. $50,000, 25 lbs., D/10 hr. LC3.

Cannibal Nanokit (TL11)

Want to be prepared, but don't want to carry a ton of hardware? Need to sneak past low-tech customs with a concealed firearm? No problem. Just buy a few tubes of cannibal nano. It's a tube, can, or canister of white gooey paste, with countless nanomachines programmed to cannibalize *other* objects to build a single, specific gadget.

To use it, the paste is applied to a suitable object that has raw materials similar to whatever is to be built. Mechanical devices such as guns and engines require objects made of metal. Plastics are often broken down to make gasses, propellants, etc. Electronic devices or energy weapons require other electronic systems to cannibalize. Within these restrictions, a cannibal nanokit is flexible. It can turn a toaster into a gyroc pistol, or a motorcycle into a suit of powered armor.

It takes the nanokit one minute to build the object per pound of finished weight; the nanokit will usually eat all objects in close proximity. Whether the result works or not depends on whether the nanokit has enough suitable material. In doubtful cases, the GM can roll 3d vs. the kit's TL+1, with modifiers for availability.

Whatever is cannibalized is, of course, destroyed (or rather, transformed). The process also produces residual heat, so it's best to start it on a nonflammable surface such as a counter top or concrete garage floor, and to turn off smoke detectors.

Cannibal nanokits are specific to one gadget or weapon. A single kit may build several closely related gadgets as long as they can all be fused into one object, such as a gun with laser sight, or a helmet with built-in infrared goggles.

A tube of cannibal nano costs 300% of the intended gadget's cost, and is limited to constructing gadgets or weapons that appear at least a TL before the nano's own TL. Its weight and volume are 1% of the gadget's normal weight and volume. The LC of cannibal nano is generally the same as the equipment it builds. The exceptions are any weapons or armor, which have half their normal LC (round down).

It's easy to disguise a small container of cannibal nano. It only takes 0.01 lbs of nano to build a one-pound laser pistol. That could be disguised as lip gloss, or domestic nanocleanser. A cannibal nanokit designed to build a cybersuit (pp. 184-185) would weigh less than a pound, and could be disguised as a bottle of shampoo. And since TL11 lip gloss or shampoo may well use nanomachines, a cursory scan or inspection would turn up nothing unusual!

ECM and Stealth

These electronic countermeasures are used to jam or deceive surveillance sensors.

Chameleon Surface (TL9-12)

A suit can be equipped with sensor-controlled active camouflage that changes color and pattern to match the local background environment, in both the visual and infrared spectra. This provides a bonus to the user's Stealth skill when attempting to avoid visual and infrared detection.

At TL9, a chameleon surface's bonus is halved against hyperspectral or ultraviolet vision. It is fully effective at TL10+.

The system can also be manually controlled, allowing the user to "paint" the surface with whatever color scheme or markings are desired (as *Programmable Camouflage*, p. 99), or to give a mirrored skin equivalent to reflec armor (p. 173).

Thermo-Optic Chameleon Surface (TL9)

This may be added to an outfit covering the entire body, or to a vehicle surface. It gives +4 to Stealth skill against ordinary and infrared vision, +2 against hyperspectral or ultraviolet vision, and +1 against extended high- or

low-band hyperspectral vision. This bonus is halved (round down) if moving. $4,000, 4 lbs. (adjust for SM). LC3.

Multispectral Chameleon Surface (TL10)

This version gives +8 to Stealth skill against ordinary and infrared vision, +4 against hyperspectral or ultraviolet vision, and +2 against extended high- or low-band hyperspectral vision. This bonus is halved if moving. $6,000, 4 lbs. (adjust for SM). LC3.

Dynamic Multispectral Chameleon Surface (TL11)

This version is identical to the multispectral chameleon surface, except that it is not affected by movement. $8,000, 4 lbs. (adjust for SM). LC3.

Ultimate Chameleon Surface (TL12)

This version gives +4 to Stealth skill against extended high- or low-band hyperspectral vision, and +8 to Stealth skill against other hyperspectral, ultraviolet, infrared, and normal vision. $10,000, 4 lbs. (adjust for SM). LC3.

Chameleon Cloak (TL9-12)

A large cloak that can be wrapped around a person or object to conceal it. It works the same way as a chameleon surface, but the bonus is halved again, cumulative with other modifiers (round down!) when moving! It can also be used just like any other large cloak. It is half the cost and weight of an equivalent chameleon surface. LC3.

Chameleon Net (TL9-12)

This camouflage net works much like a large chameleon cloak, and can hide vehicles, heavy equipment, or campsites. It covers 25 square yards, and is 10 times the cost and weight of an equivalent chameleon surface. LC3.

Deception ECM (TL9-10)

These devices detect and mimic incoming active sensor pulses to give a distorted or false reading of the user. Most models can jam radar and imaging radar *or* sonar. Superscience versions use a "distortion field" that is effective against all active scans!

They can also be set to spoof rather than just jam. If so, there is no penalty to detection, but the sensor operator must succeed by an amount *greater* than half the detection penalty (e.g., 2 for deceptive radar), or he is fooled into detecting something *else*.

Deceptive Radar Jammer (TL9): This jams all types of radar signals: -4 to radar, -2 to imaging radar. Spoofing is only possible for non-imaging radar; successfully doing so can change the user's apparent size and course by up to +/-6 SM or 60°. $2,000, 2.5 lbs., C/10 hr. LC2.

Deceptive Sonar Jammer (TL9): This emits deceptive sonar signals: it gives a -4 to sonar detection. Successfully spoofing sonar can change the user's apparent size and (if desired) course by up to +/-6 SM or 60°. $2,000, 2.5 lbs., C/10 hr. LC2.

Distortion Field Belt (TL10^): -6 to *all* active sensors. Successful spoofing can provide a pre-set, seemingly accurate, but completely false image (within the limits of the spoofed sensor) and/or change the apparent size and course by up to +/-6 SM or 60°. $10,000, 2.5 lbs., C/10 hr. LC2.

*Holo-Distort Belt (*TL10^): Combines a distortion field belt with a holobelt (p. 98). $12,000, 3 lbs., 2C/10 hr. LC3.

Distortion Chip (TL10^): A small distortion field that protects a one-foot radius around it. It is usually hidden in clothing or luggage, or attached to a weapon or other device to evade or spoof Search rolls that use active sensors. $500, 0.05 lbs., A/4 hr. LC2.

Increase the penalty by -2 per TL after introduction. Except for the distortion chip, these jammers protect a roughly human-size area. Larger objects like vehicles need bigger jammers: multiply cost, weight, and number of C-cells by the square of the vehicle's *longest* dimension in yards. (Substitute a D cell for 10 C cells, an E cell for 100 C cells, etc.)

Infrared Cloaking (TL9)

This system reduces an object's heat signature to defeat infrared and thermal imaging detection. It subtracts -4 (at TL9), -6 (at TL10), -8 (at TL11), or -10 (at TL12) from rolls to detect it via infrared vision or similar sensors. $1,500, 3 lbs. (adjust by SM). LC3.

Programmable Camouflage (TL9)

This electronic-camouflage system allows the wearer to choose a color scheme from any of eight different patterns – desert, snow/arctic, jungle, forest, underwater, urban, black, or high-visibility orange, useful for rescue and underwater operations. The time required to reset the suit depends on TL: four seconds (TL9), three seconds (TL10), two seconds (TL11), or one second (TL12). A suitable camouflage pattern gives a +2 to Camouflage rolls, but a -1 to Camouflage rolls in non-matching terrain, and a -2 in highly-contrasting terrain (i.e., wearing an arctic pattern in the jungle).

Programmable camouflage systems are a significantly cheaper alternative to sensor-controlled systems, and are commonly used by civilians hunters, survey scouts or lightly-equipped military forces. This can be added to any outfit that covers most of the wearer: $1,000, 2 lbs. (adjust for SM). LC4.

Radar Stealth (TL9)

Many suits of personal armor incorporate radar-absorbent material as part of their structure. This subtracts -4 at TL9, -6 at TL10, -8 at TL11 or -10 at TL12 from detection by radar, imaging radar, or terahertz (T-ray) radar. Integral radar stealth systems are incorporated with many armor suits. They may also be added to any sealed suit: $1,500, 3 lbs. (adjust for SM). LC3.

Scent Masking (TL9)

This works like a sealed chemical protection suit in reverse – instead of preventing chemicals from entering the clothing, it prevents chemicals from leaving. It provides +4 to Tracking when trying to cover your scent trail. Available for any sealed suit. $200, 1 lb. LC4.

Invisibility Surface (TL10-12)

This active optical camouflage system renders the user nearly invisible. Its fabric incorporates thousands of embedded nanocameras and projectors (or a quantum dot array) to create a seamless "projection stealth" system. Controlled by a fast dedicated computer, this captures images of the user's surroundings, then displays photorealistic imagery that can fool observers from multiple angles and perspectives.

The user is invisible. He gets +9 to Stealth rolls in most circumstances. The invisibility is effective against living things and machines, and will fool cameras. The user casts a visible shadow. He also appears as a shadow when silhouetted *directly* against the sun or any other extremely bright light source (such as a searchlight); reduce the Stealth bonus to +3 under these conditions. When he moves, there's a faint shimmering that others can spot with a Vision-6 roll, and target in combat at -6 to hit.

The suit can also function as a video display terminal. The user can "paint" the suit with any desired color or pattern; this reduces the power drain by a factor of 10.

At TL10, an invisibility surface is only effective against visual and infrared (or thermal) imaging.

At TL11, it is also effective against ultraviolet and hyperspectral imaging, unless that has either the extended high- or low-band options.

At TL12, it is effective against extended high- and low-band hyperspectral imaging.

Invisibility Surface (TL10-12)

Any suit that covers most or all of the wearer may have an invisibility surface. The cost and weight includes coverage for gloves, boots, and a helmet or hooded mask. $20,000, 4 lbs., 2C/30 min. LC2.

Invisibility Cloak (TL10-12)

This optical camouflage cloak can be wrapped around a person or object to conceal it. This works like an invisibility surface, but provides only a +3 bonus when moving. $10,000, 4 lbs., C/15 min. LC2.

Invisibility Net (TL10-12)

This invisibility cloak is large enough to hide vehicles, heavy equipment, or a base camp. It covers 25 square yards. $200,000, 50 lbs., 2D/8 hr. LC2.

Computer Intrusion

These hardware devices retrieve data from computers or their interfaces. For online intrusion, use software tools (p. 25) for Computer Hacking or Computer Programming. For hacking encryption, see *Quantum Computers* (pp. 23, 47).

Computer Monitoring Gear (TL9)

Computer equipment emits radio signals when in use. This gadget picks these up. It can detect whatever data is being typed or displayed on an interface screen at a distance, allowing someone to eavesdrop on computer activity. It cannot read what is stored inside the computer. It can scan through walls, provided they are not shielded.

Using the device requires an Aim maneuver for the duration of the surveillance; roll against Electronics Operation (Surveillance) to get clear data. Optionally, all TL9+ interfaces may be *automatically* shielded against these emissions (due to different design principles). However, the system remains useful when infiltrating lower-TL worlds!

Mini Scanner (TL9): 100-yard range; -1 to skill per 10 yards range. $500, 0.1 lb., A/10 hr. LC2.

Long-Range Scanner (TL9): 1,000-yard range; -1 to skill per 100 yards of range. $5,000, 5 lbs., C/10 hr. LC2.

Keyboard Bug (TL9)

This pinhead-sized adhesive bug can be stuck to the bottom of a terminal's keyboard. It uses induction to read the keystrokes, recording everything that gets typed in its memory. It can record a gigabyte at TL9; multiply by 1,000 per TL afterward. The bug can be retrieved manually, or it can be programmed to send out the data as a coded burst transmission using its microcommunicator (p. 43). It runs for a year. $200, weight is negligible. LC3.

SQUID (TL9/11)

A superconducting quantum interference device is used to interrogate a computer brain to retrieve data, *even if that system is offline*.

Contact SQUID (TL9): This SQUID must be physically attached to the target computer; it can then assist in reading the data stored within. $20,000, 5 lbs., 2C/10 hr. LC3.

Ranged SQUID (TL11): This can probe a computer even at a distance. It is usable at 10 yards at TL11, or 100 yards at TL12. Hardened computers cannot be probed at a distance, but can still be scanned through direct contact. $200,000, 50 lbs., 2D/10 hr. LC2.

Memory Scan (TL10^): Any ultra-scan (p. 104) active sensor with this modification can scan a computer that it has detected. +200% to the ultra-scan sensor's cost. LC2.

Future Crime

Technology can lead to new vices, such as pleasure robots, sensie addiction, or direct neural stimulation, any or all which may be legally regulated. It can also lead to variations on existing crimes, such as hijacking robots, illegally copying a mind, or transforming a person into a cyborg against his will. Some societies may declare certain technologies criminally dangerous – for example, volitional AI, nanofactories, uploading minds, or time travel – and prosecute anyone who employs them.

Advancing technology can also impact the way existing crimes are perceived. Future societies could have very different attitudes to the ownership of data or the protection of personal privacy, depending on the ways that different technologies are used. If ultra-tech medicine (see Chapter 7) can make injury or death into an inconvenience, assault and even murder may be taken less seriously, as long as the victim is easy to restore. Similarly, the existence of nanofacs (pp. 91-93) or replicators (pp. 93-94) may turn the theft of physical goods into a trivial misdemeanor.

Security and Surveillance

Even as technology gives thieves and spies the ability to bypass old security systems, it creates new ones to replace them. In addition, as the average criminal becomes more sophisticated, so does the cop who has to track him down. This chapter covers security systems that protect against both physical and electronic intrusion, as well as advanced law-enforcement tools that allow police and security forces to track, identify and detain criminals more effectively – or simply suppress a riot.

It might be possible to build an impregnable security system – but the more layers of security that are added, the harder it is get anything else done. If an executive has to go through six different scans every time she enters or leaves her office for a cup of coffee, or a computer requires 20 minutes of identity verification before it will let anyone use it, personal convenience and efficiency will be sacrificed.

Most systems compromise between security and ease of use. A system that is too complex or too sensitive can easily be degraded, overloading its monitors with input. The simplest method of fooling an electronic security system is to convince the human component of the security system that the electronic element is malfunctioning. After receiving several false alarms, a human operator or self-programming computer may ignore input from a sensor or just turn it off, leaving a hole in the defenses.

Barriers, Mines, and Traps

Many dangerous traps have low LC. Even low-CR societies frequently ban lethal traps, on the principle that property is not as important as life.

In addition to the systems described here, construction foam (p. 83), force screens (pp. 190-192), stasis webs (pp. 193-194), and wards (p. 193) make useful barriers.

Armored Doors (TL9-12)

Still the most basic way to keep somebody out. A heavy door made of an inch of composite armor will be HP 50 with DR 100 (TL9), 150 (TL10), 200 (TL11), or 300 (TL12). It is $1,000, 200 lbs. per 10 square feet. Typical materials include ceramic composites at TL9, metal-matrix composites at TL10, diamond-carbon composites at TL11, and hyperdense alloys at TL12.

The lock is usually in the adjacent wall rather than the door.

Laser Fences (TL9-12)

These project a continuous beam between two emitters, which may be built into fence posts, doorways, or corridors. Each emitter weighs 10 pounds and may be no more than 10 yards apart.

Open: The standard "cinematic" beam fence, this produces a fixed or moving pattern that can be avoided with an Acrobatics-3 or Escape-3 roll.

Tight: A tight grid of beams, or a thick, continuous energy field. It can't be avoided; anyone passing through takes damage. (It does, however, require more power to generate.) A computer-controlled system could start with an open pattern, then switch to a tight pattern if an intruder avoids the beams.

Laser Fence (TL9): This inflicts up to 6d(2) tight-beam burn damage. $5,000 per post for an open fence, double cost for a tight fence. LC3.

Electrolaser Fence (TL9): An electrical fence using energy beams instead of wires. It delivers a HT-6 (2) affliction attack plus linked 1d-3 burn damage; use the rules for military electrolasers (p. 119). The fence can be set to "stun" or "kill." $5,000 per post for an open fence, double cost for a tight fence. LC3.

Rainbow Laser Fence (TL10): This inflicts up to 6d(3) tight-beam burn damage. $3,000 per post for an open fence, double cost for a tight fence. LC2.

X-ray Laser Fence (TL11): This inflicts up to 6d(5) tight-beam burn damage with the radiation and surge damage modifiers. $4,000 per post for an open fence, double cost for a tight fence. LC2.

Graser Fence (TL12): This inflicts up to 6d(10) tight-beam burn damage with the radiation and surge damage modifiers. $6,000 per post for an open fence, double cost for a tight fence. LC2.

All of these fences use external power.

Electronic Locks (TL9)

An electronic lock may be mounted on doors, consoles, briefcases, and anything else that needs to keep people out. It uses a numeric keypad, or a small electronic key card. Picking it requires Electronic Repair tools (p. 82) or an electronic lockpick (p. 95).

Simple Lock (TL9): Typical of homes, hotel or shipboard staterooms, etc. No modifier to Lockpicking rolls. Uses building power. $25. LC4.

Complex Lock (TL9): Typical of secure installations. -4 to skill. $200. LC4.

Electronic locks may also incorporate a scanlock (p. 104) for additional security.

Remote-Controlled Weapons (TL9)

These are usually connected to sensors with a cable and controlled by a computer, either manually or via an AI. Roll vs. Traps-9 to spot them first.

Defense Globe (TL9): A remote-control weapon mounted in a small turret, usually disguised as an ordinary light fixture or smoke detector. Install any ranged weapon up to 4 lbs. weight, such as a blaster pistol or a sonic stun pistol. It is SM-6, HP 8, and can't use active defenses. Beam weapons use building power. $100/lb. of weapon, plus the cost of a weapon and a smart sight (p. 149).

Spray Canisters (TL9): These do not require sophisticated mounting systems; they're normally disguised as building fire extinguishers, or placed in air ducts. They can be built by adding optical cable or a communicator (pp. 43-46) to a spray tank (p. 134). Numerous types of gas and nano can be deployed – see *Gases and Clouds* (pp. 159-160). $100 for installation.

Safes and Vaults (TL9)

These delay or deter thieves. Safes use electronic locks (above) and biometric scanners (p. 104) to limit access to valuables; add normal cost and weight to the safe.

A particularly nasty trick is to station defensive robots or swarmbots *inside* a safe.

Wall Safe (TL9): A typical home or business safe; one cubic foot, DR 100, HP 25. $100, 50 lbs. LC4.

Small Safe (TL9). A high-security safe; five cubic feet, DR 300, 80 HP. $500, 0.5 ton. LC4.

Armored Vault (TL9). A small walk-in vault. 50 cubic feet, DR 800, 100 HP. $30,000, 2 tons. LC4.

MT Vault (TL10^): An MT booth (p. 233) may be placed inside a room in a hidden location. Even its users may not know where it is! LC3.

Safe DR is multiplied by 1.5 at TL10, doubled at TL11, and tripled at TL12; HP are unchanged.

Sonic Barrier (TL9)

This generates a curtain of high-intensity sound, inaudible until someone tries to cross it. It can be turned on or off remotely. There may be a faint ripple in the air (make a Vision roll to notice) from the sonic field. It inflicts a HT-6 affliction attack on anyone trying to cross, with the effect of a sonic nauseator (p. 125) beam weapon. $3,000, 10 lbs. per 10 square yards of field, external power. LC4.

Wire Fences (TL9-11)

The fencing materials described here are designed to be easily stored and quickly deployed. A typical "unit" of fencing stretches up to 15 yards when uncoiled or unfolded, and stands four feet tall. All fencing is free-standing, and flexible enough to form a curved enclosure or surround an odd-shaped area. Stakes and other fixtures can make the fencing more permanent. Multiple layers of fencing can be "stacked" for extra protection.

It takes one man-minute per yard to deploy fencing. If protective gloves, wirecutters, and fasteners are not available, the time required is tripled.

Cutting Wire (TL9)

Cutting wire comes coiled into tight rolls. The wire is wound with triangular segments of memory metal that extend when the wire is subjected to an electric pulse, forming thousands of small jagged cutting edges. Once "popped, " the wire cannot be returned to its original form. The inner core of the wire is flexible and shear-resistant, making it difficult to cut. Passing through an area of cutting wire requires a roll at DX-5 each yard. Failure deals 1d-1 cutting damage, and may require a Will roll to avoid yelping or cursing as the barbs tear clothing and skin. The easiest way to cross cutting wire is to lay something on top of it – a log, a sheet of metal or thick plastic, a body – and climb over. A 15-yard coil of cutting wire is $100, 15 lbs. LC4.

Fragwire (TL9)

This looks like ordinary wire, but the core is tightly coiled memory-metal. When cut, the wire explodes outward with a loud *ping*! The burst of sharp fragments does 1d-1 cutting damage over a two-yard radius. Fragwire is often wound around cutting or sensor wire to dissuade infiltrators. While fragwire does little harm to armored troops, it is an effective deterrent against civilian trespassers. A 15-yard coil of fragwire is $200, 30 lbs. LC2.

Sensor Wire (TL9)

This wire includes an optical-fiber core. Each end of a strand terminates in a short wire plug that can be connected to another strand of wire or a hidden transmitter. If the wire is cut or snapped, the signal running between the two emitters is interrupted and the communicator sends an alert. Each coil has a unique identification code, allowing security monitors to determine exactly where the wire was breached. A 15-yard coil of sensor wire costs $150 and weighs 15 lbs. LC4.

Monowire (TL9^)

Deadly and nearly invisible, monowire (p. 82) can cut an intruder to pieces without warning. People who prefer less lethal defenses use fragwire or sensor wire, or mix an outer perimeter of ordinary wire with an inner perimeter of monowire.

Any roll to see monowire requires a Vision or Traps roll at -4 (-1 if a searcher is specifically looking for it). Anyone walking through a monowire "spiderweb" will take 2d(10) cutting damage per strand. This damage is reduced to 1d(10) if moving very slowly, and increased to 3d(10) if running. Care must be taken to avoid injury when stringing monowire, since it is hard to see and cuts almost anything. On a critical failure when using it, the user takes 1d(10) cutting damage to one hand. LC3.

Neural Disruptor Field (TL10^)

This device is built into furniture or flooring. It produces an area effect identical to a neural disruptor (p. 121). The grid can be left on, activated by sensors, or activated by remote control. Anyone moving through or ending his turn in an activated field must roll against HT-1 or suffer the effects of the neural disruptor. Add +1 to HT to resist for every DR 2 of sealed armor worn.

The effect lasts for as long as the power remains on and the victim remains on the grid, and for minutes equal to the margin of failure afterward. Neural disruptor fields producing a specific effect such as agony or paralysis are $10,000 to install, plus $1,000 per square yard. (Tunable fields are double cost.) Neural disruptor fields run on building or ship power. LC3.

Gravity Web (TL10^)

This is a set of gravity plates (p. 78) mounted in a room or corridor as a remote-controlled security system. They can increase the gravity to slow, disorient, or immobilize intruders. See *Crossing a Gravity Gradient* (p. 79) for the effect of suddenly entering an area of different gravity.

Dream Net (TL11^)

This technology is an *invasive* neural induction device combined with a sensory interface transmitter. A dream net grid can be concealed in an area of floor or ceiling, a doorway, or furniture such as a console, chair, or bed. The induction field extends one foot from the field generator.

Someone moving into an activated dream net must make a Will-4 roll each second or be trapped. The field will not affect someone with the Sealed or Digital Mind traits, or who is wearing a sealed suit. Failure means the person's body becomes paralyzed while his mind plunges into a computer-controlled sensory recording or dreamgame. Someone passing through a dream net feels a sense of dislocation even if he makes the Will roll to resist; if he *wants* to interface, he can remain in the net until he fails the roll.

Dream nets used for security often employ nightmarish simulations – or a virtual-reality prison with a live or computerized interrogator. On the other hand, a dream net may simply send the user to someone's private virtual-reality coffeehouse to have a nice chat with the owner. A dream net may be set to cycle continuously, or to release the user after a period of time. A benign dream net may allow the user to voluntarily log out by saying something like "program off."

Physically removing a user from the dream net before the program has run its course will end the interface, but doing so without shutting off the simulation may cause shock and disorientation. The subject must make a Will roll. On a failure, he is stunned for seconds equal to the margin of failure; on a critical failure, he will be unconscious for 1d hours.

Some dream nets may be placed just inside doors or other portals. If a dream net uses a skillfully-constructed dreamgame or neural virtual reality, the subject may not even realize he was trapped! For example, someone who steps through a door into a hallway may find himself in a dreamgame simulation of the same hallway and building. The GM can allow an IQ-4 roll to notice any sense of dislocation under such circumstances. People intending to engage in mind games or brainwashing often use these techniques. $70,000, 50 lbs. per square yard, external power. LC3.

Disintegrator Field (TL12^)

This projects a matter-disrupting field that can disintegrate anyone passing through. The fence is designed to be turned on or off remotely. It inflicts 8d×10 corrosion damage that bypasses all DR. Bullets, missiles, etc. are also disintegrated: treat it as DR 280 vs. projectiles. It may be based on either disintegrator (p. 130) or reality disintegrator (p. 131) technology; refer to either for defenses that stop it. Two emitter posts are used, up to five yards apart. It projects a two-dimensional vertical barrier. $20,000, 10 lbs. per 10 square yards of field, external power. LC1.

MT Interceptor (TL12^)

This device detects and diverts matter transmissions. When operating, any matter transmission into or out of the maximum range will be detected, and can be diverted to the interceptor. This may be performed selectively, affecting only unauthorized transmissions. The area of effect may also be adjusted, out to the maximum radius.

The device detects the origin, destination, and mass of the transmission, but nothing else. Successful diversion requires a Quick Contest of Electronics Operation (Matter Transmission) Skill. If rolling against a system that does not normally require an operator, such as a booth-to-booth matter transmitter, roll against the TL of the system.

An MT interceptor is rated for the maximum mass it can divert, and for its area of effect. Objects of greater mass are unaffected. The system is usually built around a cargo platform, which may be sealed off for safety and security reasons. MT interceptors use external power.

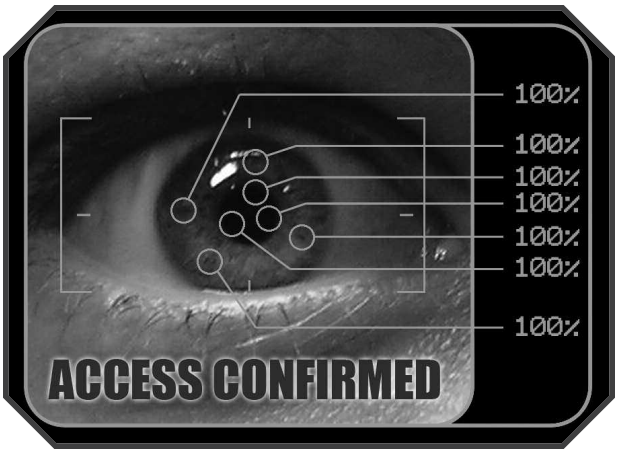
If different types of matter transmission technology exist, a single device is normally effective only against one type. The GM decides whether it can intercept people using the similar Warp advantage (roll vs. their Will) or magical Teleport spells (roll vs. skill.)

Local MT Interceptor (TL12^): Maximum range is a 200-yard radius, enough to cover most vehicles or buildings. It can receive up to 2,000 lbs. $1,000,000, 2,000 lbs. LC3.

Regional MT Interceptor (TL12^): Maximum range is a 10-mile radius. It can also receive up to 2,000 lbs. $100,000,000, 200,000 lbs. LC3.

Security Scanners

Security scanners are fixed sensor installations designed to identify intruders.



Biometric Scanner (TL9)

This is a multipurpose identity scanner. It can identify a fingerprint, a retina print, a voiceprint, or a DNA print, if this data is in a database accessible to it. Fingerprints and retina prints must be taken from a one-yard range, while DNA prints require a hair or blood sample. At TL9, it takes 10 seconds to scan a fingerprint, retina print, or DNA print; voiceprints can be scanned in one second. At TL10+, all scans take one second.

Handheld Biometric Scanner (TL9): A handheld device used by security personnel to check identities. $1,000, 1 lb., A/1 day.

Biometric Scanlock (TL9): Integrated into a lock on a door, case, or other device. Cost, weight, and power are the same as the handheld scanner.

Surveillance Sensors (TL9)

Security sensors are designed to detect an intruder and then take action, whether sounding an alarm, activating gas, or closing doors. They run indefinitely using vehicle or building power; most have backup power cells. Make a Traps-2 roll to spot them. Electro-optical cameras (p. 60), infrared cameras (p. 61), hyperspectral cameras (p. 61), short-range terahertz radars (p. 65), and imaging radars (p. 65) are among the most common types. Add $100/lb. to cover the mount and installation costs.

Portal Scanners (TL9-10)

These are short-range, ultra-high resolution sensors that scan whatever passes between them. The device usually consists of transmitter and receiver with a one- to three-yard range. They can be concealed in doorways or luggage conveyer belts, and may be set to trigger automatic doors, weapons, or force fields if they detect anything. They are remotely controlled, with information displayed on a video screen or other interface. They work automatically, but their results must be interpreted by the Search skill roll of a person or AI.

X-ray Scanner (TL9): This device uses X-rays to see inside objects, and is much lighter than lower-TL systems. It comes with a microcommunicator, a data port, and X-ray analysis software. Add +4 to Explosives (EOD) skill when using it to defuse a bomb, and to Search skill when examining the contents of a package. $2,000, 5 lbs. (2.5 lbs. per module), C/4 hr. LC3.

T-Ray Portal Scanner (TL9): This illuminates its target with tunable terahertz radiation. The absorption spectra of the resulting image is analyzed and cross-referenced with a database to check for chemicals of interest. This is good for locating drugs or other chemicals, explosives, and weapons. Gives +4 to Search skill for identifying non-living objects. $10,000, 10 lbs., C/4 hr. LC3.

Explosives Scanner (TL9): A nuclear quadrupole resonance (NQR) scanner excites a specific material (typically nitrogen) into a higher quantum mechanical energy state using a radiofrequency beam. When the material "relaxes" it gives off a distinct signal. The scan provides an unambiguous yes/no answer to the presence of all chemical explosives, but does not detect energy-based explosives. It provides +4 to Search skill to detect chemical explosives. $4,000, 10 lbs. C/4 hr. LC3.

Ultrascan Portal (TL10^): This uses para-radar to perform an fast atomic-level scan of the target's body, including a detailed bio-scan. It gives a +TL/2 (quality) bonus to Search rolls to find *anything*, and can match a person by their genetic code against a database. It can be fooled by distortion fields (p. 99). $10,000, 10 lbs., D/100 hr. LC3.

Security Swarm (TL10)

A swarm of data-gathering microbots with short-range infrared, tactile, visual, and chemical sensors. They search anyone they contact with Search-12 and Diagnosis-8, crawling over the subject's body and noting what is carried

where. They are limited to performing either a skin search (+3 to Search skill) or a body cavity search (+5 to Search skill); see *Search,* p. B219. They also record the subject's physical dimensions (height and build), species, gender, and can note if he's running a fever.

Since a swarm can't store data from more than one sweep, it should be uploaded to a computer and reviewed. It can also be accessed in real time as it is used. In addition to performing their own search, security swarms can be teleoperated to remotely perform skin or body cavity searches; as such, they provide a +1 (quality) bonus to Search skill. $1,000/square yard. LC3.

Surveillance and Tracking Devices

Passive sensors (pp. 59-63) and audio-visual recorders (p. 51) are the basic tools of surveillance. Active sensors (pp. 63-66) are useful if the subject lacks appropriate detection gear, or if letting him know he's being watched isn't a problem.

The devices that follow are useful for covertly obtaining information, or for following people or objects.

Com Tap (TL9)

This device can tap into an optical or electrical cable line. It is a 100-yard, hair-thin optical cable ending in a clip head, connected to a pocket-sized unit which includes both a monitor and a recorder that uses standard computer storage media. An Electronics Operation (Surveillance) roll is needed to succeed without damaging the line being tapped into; tapping an optical cable is at -3 to skill. $500, 0.1 lb., A/100 hr. LC3.

Homing Beacon (TL9)

This tiny tracer (SM -11) can be set to activate when it receives a coded signal (sleeper mode), or to broadcast continuously. Its signal can be picked up by radio emissions scanners up to 10 miles away. $40, neg., AA/100 hrs. (1 year in "sleeper" mode). LC4.

At higher TLs, its range is ×5 at TL10, ×20 at TL11, ×100 at TL12.

Nanobug (TL9)

A pinhead-sized sensor/recorder unit (SM -18) with an adhesive backing, which is usually placed somewhere where it can scan an entire room. Its camera and microphone can record constantly, listen for a specific voice before recording, scan at specific times of day, or scan when its sensors detect light or motion in the room. It includes a microcommunicator (p. 43) that can transmit recorded data in a short "burst" upon receiving a coded radio command. It can also be set to transmit after a specific time has passed. Once it transmits, it may be programmed to erase everything it has stored and begin recording again, or to self-destruct. It will also self-destruct if tampered with (roll vs. Explosives (EOD)-3 or Traps-3 to defuse). $100, AA (1 year).

Emissions Nanobug (TL9): As above, but instead of audiovisual sensors, it has field-emission sensors that can read data being sent to or from an electronic device that the bug is in direct contact with. It cannot read stored data that is not being accessed.

Microbot Nanobug (TL10): A single, tiny microbot spy (SM -16). As a regular nanobug, above, but add any microbot swarm chassis (pp. 35-36) at 1% the usual cost. Mobility is as per a cyberswarm. One hit destroys it.

Laser Microphone (TL9)

This device turns any window or faceplate into a bug by reflecting an invisible laser beam off the glass and picking up vibrations caused by speech within the room. The user may roll Electronics Operation (Surveillance) to hear whatever is behind the window as if he were present on the other side of it. Extraneous noise such as loud music or running faucets is easily filtered out. Very heavy curtains, anti-laser coating, or triple-glazing may defeat this method; bug stompers and privacy field white-noise generators (pp. 62, 188) never do. Laser sensors (p. 106) can sense a laser mike.

Laser Microphone (TL9). Range 3,000 yards. $200, 2.5 lbs., C/10 hr. LC3.

Pocket Laser Mike (TL9). Range 300 yards. $40, 0.1 lb., A/1 hr. LC3.

Range is doubled at TL10, multiplied by five at TL11, and multiplied by 10 at TL12.

Surveillance Worm (TL9)

A flexible robotic snake only 0.1" wide and 2" long. These devices replace lower-TL endoscopes for examinations of body cavities or small cracks. Its light source illuminates a two-yard cone, and TL10+ worms also have Infravision. The user can see whatever the worm is looking at, but has No Depth Perception (p. B145).

The worm uses myoelectric muscles to flex and bend. It can be controlled via fiber-optic cable (to avoid emitting any signals), or it can operate using its built-in microcommunicator. A series of surveillance worms can also relay signals to each other.

Surveillance worms provide +3 on Search attempts. A Vision-5 roll is required to spot the worm. $4,500, 2 lbs.

Computer Pill (TL10)

Designed to be disguised as a piece of candy, a raisin, a pill, or a seed, this is a disposable organic computer that activates once swallowed. It attaches itself to the user's stomach, remaining in the body. It has its own microcommunicator, which only has a range of a few feet inside a body. That's enough to contact any radio communicator implanted in or carried by the person who consumed the pill.

The computer is complexity 3, stores 1 TB, and costs $50. Its integral power supply operates it for one week. Increase Complexity by +1 and data storage by a factor of 1,000 per TL after introduction.

Messenger Pill: A computer pill that incorporates a genetic scanner that can determine if it's been swallowed by the right person (or family, or species, or whatever). If the scan comes up with a match, the pill will try to call the communicator of its host. If not, it self-destructs, and is dissolved by the body's own digestive system.

Messenger pills are double normal cost.

Surveillance Swarm ("Surveillance Dust") (TL10)

This microbot swarm (p. 35) mounts tiny video cameras and audio sensors, collectively equivalent to a nanobug (see p. 105). The swarm is programmed to remain in a particular place, observe for a period of time, and then return; it can also transmit information or be ordered to go to a different location. Base cost is $500/square yard; modify this for *Swarm Chassis* (pp. 35-36). LC3.

Counter-Surveillance and ECM

These devices are used to warn of or defeat surveillance attempts.

Bug Detectors (TL9)

RF Bug Detector (TL9): Detects and locates radio transmitters and microphones. This requires a Quick Contest between the operator's Electronics Operation (Surveillance) skill and the Electronics Operation (Surveillance) skill of whoever hid the bug. Locating a bug involves sweeping the room with the device (range 1 yard). The detector has a range of one yard, and takes 10 seconds to scan 100 square feet. $200, 0.1 lb., A/10 hr. LC4.

Multispectral Bug Sweeper (TL9): A countersurveillance radio frequency detector integrated with IR sensors and sensitive microphones. Adds +2 (quality) to Electronics Operation (Surveillance) skills when used to sweep for transmitters (infrared, sonic, and radio), comm taps, microphones, recorders, sound detectors, and other bugs. It can scan automatically with its own skill of (TL+5). It can check or monitor comm lines, or everything within a 10-yard radius. It folds up into a small briefcase. $10,000, 5 lbs., C/10 hr. LC3.

GUT Bug Sweeper (TL11^): An advanced system that can also detect transmitters using gravity-ripple or neutrino comms. $20,000, 5 lbs., C/10 hr. LC3.

Bug Stomper (TL9)

This is a pocket-sized "pink noise" generator, which prevents audio surveillance device from picking up anything but static within three yards of the device. It will jam the listening ability of a programmable bug, but not its visual sensors. It has no effect on laser mikes, and a bug of a higher TL can filter out the noise. $600, 0.25 lbs., B/24 hr. LC3.

Bughunter Swarm (TL10)

This microbot swarm (p. 35) is equipped with emissions sensors. Each square yard of bughunters can sweep one square yard per minute to locate nanobugs, comm taps, surveillance swarms, or other surveillance devices. They have Electronics Operation (Surveillance) at TL+2 for this function only, or give a +2 (quality) to a director's skill. $4,000/square yard. LC3.

Privacy Field (TL10)

This sonic generator creates a spherical interference pattern that blocks all normal sound waves. No one inside the field's boundaries can hear any sound originating outside the field, and no sounds within the field are audible to anyone outside it. The generator can only be used in an atmosphere, with the diameter of the field increasing with atmospheric density. In a standard atmosphere, the bubble has a four-yard radius. A privacy bubble will block audio bugs, but not laser listening devices. It also gives DR 15 against sonic weapons fired across its boundaries. $5,000, 4 lbs., C/8 hr.

Enforcement and Coercion

This equipment is used to enforce laws, control populations, and compel obedience. It can also easily be used for sinister purposes, such as torture and mind control.

Forensics and Lie Detection

Forensic equipment is used to analyze clues, usually at crime scenes. In addition to this specialized gear, investigators use chemsniffers (p. 61), portable labs (pp. 66-67), medscanners (p. 200), ultra-scan (p. 66), or even time-scanners (p. 67).

Lie detectors help determine whether the subject believes he is telling the truth. It's up to the investigator to decide if that subject is correct, or if he has a faulty memory, is delusional, or was brainwashed. Within these limits, ultra-tech gear using advanced neurotech is much more reliable than the polygraphs used at lower TLs.

Verifier Software (TL9)

This computer program monitors a person's facial expression, especially facial movements near the eye muscles; different programs are needed for nonhumans. Creating software for other races requires knowledge of the

race's biology and psychology. The software uses passive visual sensors (p. 60), and has Detect Lies-12. Complexity 4. LC3.

Neural Veridicator (TL10)

A *veridicator program* provides highly accurate lie detection by monitoring brain waves transmitted through a braintap neural interface (p. 215). It gives a human or computer a bonus of +TL/2 to Detect Lies skill.

Neural veridicator helmets are *completely* reliable, providing an automatic success on a Detect Lies roll. However, people can forget, delude themselves, be fooled, or have their memories altered by brainwashing technology. A veridicator does not provide absolute truth; it just tells if someone believes they are telling the truth.

Veridicator Helmet (TL10): This incorporates a dedicated neural interface and veridicator software. The user wears the helmet; a light goes on or a buzzer sounds if he's lying. $12,000, 2 lbs., B/24 hr. LC3.

Veridicator Program (TL10): Complexity 6. LC3.

Forensic Swarm (TL10)

These swarms can provide detailed information on the room's occupants and visitors for the past several years by analyzing the buildup of organic and inorganic detritus: skin flakes, blood, clothing fibers, food residue, presence of other nano, etc. When gathering forensic evidence, each square yard of swarm can sweep one square yard per hour. The data collected from people or animals will reveal their sex, race, blood type, genetic pattern and approximate age. It can form the basis of a computer simulation of what they might look like, but will not identify someone unless he is listed in a database available to the investigator. Forensic swarms can also perform pathological analysis without an autopsy.

A forensic swarm gives a +3 (quality) bonus to Forensics skill for gathering evidence. Analyzing the data requires Forensics (or Biology) skill or an appropriate expert-system program. $4,000/square yard. LC2.

Restraint and Riot Control Devices

This equipment is used by security forces to restrain individuals, or to control and disperse crowds of demonstrators or rioters. Other useful equipment includes:

Barricades: Construction foam (p. 83), construction swarms (pp. 86-87), slipspray (p. 83), and wards (p. 193) allow quick erection of barricades to channel crowds and block streets. Holoprojectors (p. 52) may create illusionary barriers to divert an unwary mob.

Dispersion: Techniques useful for scattering crowds without leaving a field of stunned, injured, or dead bodies are microwave pain beams (MAD, p. 120) and sonic nauseators (p. 125). Launchers or sprays may deliver riot gas (p. 159), sonic nauseators (p. 125), warbler warheads (p. 157). Shock clubs (p. 164) and neurolashes (p. 165) let an officer defend himself, and can be a painful but nonlethal deterrent.

Shields: Riot shields (p. 188), or force shields (pp. 192-193) can be used not only as defenses, but also to push or slam rioters.

Cufftape (TL9)

This looks like duct tape, but the sticky side is a memory polymer that tightens if the prisoner struggles. A two-foot-long strip has ST 20, and is sufficient to restrain arms or legs. Each failure to escape does one point of damage to the taped area. Cufftape has DR 1; six points of cutting, corrosion, or burning damage severs it. $10, 0.5 lb. per 100-foot spool. LC3.

Razortape (TL9)

This cufftape has a thin strand of sharp wire embedded in it. On a successful attempt to break free using brute force (a Quick Contest of ST), the wire does thrust cutting damage using the escapee's own ST. $40, 0.5 lb. per 100-foot spool. LC2.

Monowire Razortape (TL9^): As razortape, but it costs twice as much and does +1d damage. The damage has an armor divisor of (10).

Electronic Cuffs (TL9)

This is a rigid pair of handcuffs or leg irons, padded to avoid abrasions and used for restraining people or animals. It is controlled by an embedded remote-controlled microcommunicator, and incorporates a homing beacon (p. 105) for tracking the prisoner.

To break free of the restraints, win a Quick Contest of ST or make an Escape roll at -6 (-8 if both arms and legs are cuffed). The first try takes one second; further attempts require 10 minutes of struggle. Also available with collar and 10' leash (same weight) for animals, slaves, etc. It may incorporate neuronic restraints or a neural pacifier (p. 108).

Electronic Cuffs (TL9): This has ST 20 and DR 10. $40, 0.25 lbs., A/1 wk. LC4.

Heavy-Duty Electronic Cuffs (TL9): ST 40 and DR 15. Uncomfortable to wear. $100, 0.5 lbs., A/1 wk. LC3.

At higher TLs: Add +5 to DR and ST per TL over TL9.

Explosive Collar (TL9)

This locked, plastic-alloy collar attaches around a prisoner's neck. It contains an inertial compass, secure radio, and a tiny computer (p. 22) – none of them usable by the wearer – along with explosives equivalent to a 15mm HE warhead (p. 154). The radio and computer constantly broadcast the prisoner's exact coordinates.

A coded signal can detonate the explosive liner, decapitating the wearer. The collar can also be broken (it has DR 10 and 2 HP), but any attempt to damage it that fails to immediately remove it results in detonation next to the subject's neck. Disarming the explosives requires appropriate tools and a Traps-4 roll; failure means the collar explodes. $200, 0.25 lbs., B/100 hr. LC2.

Power Damper (TL9^)

A neural-feedback device that is designed to restrain people with psionic powers, or possibly another type of biologically-based super power; each origin may require a different device. It prevents the subject consciously using an advantage associated with that power origin.

The subject can attempt to overcome the device by deliberately pushing himself: each time he tries to use an advantage that would be impeded by the device, he must win a Quick Contest of Will against the device's Will. He may add his relevant Talent, if any. If he succeeds, he overloads the device, which burns out. If he fails, he cannot try again for *hours* equal to the margin of failure.

A power damper may be combined with neuronic restraints (below), triggering a "punishment circuit." This activates the neurolash after any attempt to overcome the damper.

Power-Damper Band (TL9^): A small headband. The damper can also be built into electronic cuffs, a collar, or a sensory restraint. It has an effective Will 18. $2,000, 0.1 lb., B/100 hr. LC3.

Power-Damping Field (TL9^): This covers a 2-yard radius; it is usually built into a cell, giant test tube, or similar small prison. Effective Will 20. $20,000, 70 lbs., E/100 hr. LC3.

Add +2 to the device's effective Will for every TL after TL9^.

Sensory Control Restraints (TL9)

A single-piece device containing a video visor (p. 60) and ear muffs designed to control the reality perceived by the wearer. It can also see and hear what the prisoner does (and if desired, record it). The visor can blank out the prisoner's vision or hearing, restore it, or let the controller overlay false sounds and images. It can be controlled by any external interface with the proper codes. It includes a tiny computer, and at high TLs could even have its own AI. It has DR 6.

Smart Blindfold (TL9): Locks onto the head, covering eyes and ears. Gives a +1 (quality) bonus to Interrogation skill against the wearer. $100, 1.5 lbs. C/100 hr. LC2.

Restraint Mask (TL9): A flexible helmet that covers the entire head and locks into place; it takes six seconds to attach or remove. It blocks the senses of smell and taste, and also includes a removable gag/feeding tube and respirator tube. Gives a +2 (quality) bonus to Interrogation rolls against the wearer. $500, 2 lbs. 2C/100 hr. LC2.

Sensory Deprivation Tank (TL9): *Completely* removes all sensation except that permitted by the operator by suspending the subject in a sense-deadening liquid medium (or a contragravity field, at TL10^). Treat as a restraint mask, but the bonus to Interrogation rolls increases to +3 after the subject has been in the tank for an hour. Long stays may require Fright Checks: use the *Size and Speed/Range Table*, reading "yards" as "hours" and rolling every time an interval passes at the listed penalty. The tank includes a restraint mask, a respirator, and feeding tubes. $10,000, 200 lbs., D/100 hr. LC3.

At higher TLs, a combination of neural interfaces (p. 48) and either sensie (p. 57) or total virtual reality (p. 54) technology are used for sensory control.

Neuronic Restraints (TL10)

An add-on for electronic cuffs or collars, these use a tailored electrical impulse to deliver a neurolash effect (pp. 165-166) if tampered with, or if triggered by communicator.

They are available in all standard neurolash settings, although the seizure, pain, paralysis, and ecstasy effects are the most common (the latter is sometimes also purchased for recreational purposes). The effect is identical to a neurolash strike (roll vs. HT-5 to resist). However, since the victim is restrained and the effect can be continued each turn, neuronic restraints are very effective!

This option can also be built into sensory restraints (above). A neurolash delivering pain or pleasure in a sensory deprivation tank is especially effective; add an extra -1 to the roll to resist. $200, 0.25 lbs., B/100 sec. LC2. Tunable versions are +50% per setting.

Neural Pacifier (TL10)

Used legally by police, prison guards and hospitals, this restraint band projects a soothing hypnagogic field into the wearer's brain, keeping him sedated and compliant without risking drugs or injury.

The neural pacifier has two settings: sleep and control. On "sleep," it places the wearer into a deep slumber. He cannot be awakened until the device is removed or turned off. On "control," the headband projects frequencies that allow the user to retain consciousness while suppressing aggressive tendencies, making the subject easily led. It effectively gives him the Slave Mentality disadvantage.

The device can be resisted. After it is activated, the wearer gets a roll against the *higher* of HT-3 or Will-3 each second to avoid succumbing to the effects. Once a roll is failed, the effects persist for as long as the device remains on. $500, 0.25 lbs., B/100 hr. LC3. This option can also be built into sensory restraints (above).

Stasis Chamber (TL12^)

If correction is not important, stasis technology can provide the ultimate prison! See pp. 193-194.

Interrogation, Brainwashing, and Animal Control

Unlike passive lie detection gear, these systems are used to actively retrieve information, as well as to alter, erase, or enslave the minds of people or animals. See also *Drugs and Nano*, pp. 204-205.

Beamed Audio Sound System (TL9)

A sonic projector (p. 52) has numerous deception applications. One obvious use is to distract or lure away sentries by beaming recorded voices or other suspicious noises that

appear to come from one direction, then approaching from a different direction.

Beamed audio can also be used to psychologically manipulate victims by beaming whispers to them from hundreds of feet away. This is merely annoying to anyone who knows what is going on, but targets unaware of this technology may believe they are going mad, talking to divine or supernatural entities, or, if the voice was engineered to sound like their own, talking to some part of themselves. Beamed audio may even be used to hypnotize someone over a distance; the normal rules and limits for Hypnotism skill apply to any such attempt.

Biopresence Software (TL9)

This software allows the user to teleoperate another living entity's body (the host). The host must have a puppet implant (p. 218), and the user must be in telecommunication with the host, or physically jacked into him. The user must be using a direct neural interface (p. 48) connected to the computer running this software, or be a digital mind.

Control can be achieved automatically if the user has the appropriate passwords for full access to the puppet's mind; gaining these may require Computer Hacking skill.

The user remotely teleoperates the host's body, completely suppressing the host's personality. His own body is in a trance; he may choose to return at any time, and must do so if the host falls unconscious or dies or if the communications link is interrupted. Sleep does not break the link, but if it is ever jammed or out of range, the operator loses control.

The user gains the host's ST, DX, HT, and secondary characteristics calculated from these scores, as well as the host's physical advantages and disadvantages. The user keeps his own IQ, Perception, Will, and mental traits. Social traits may or may not apply. The user's IQ-, Perception-, and Will-based skills are unchanged. Other skills remain at the same relative skill level. For instance, if the user has Guns at DX+3, then he would have Guns-12 in a DX 9 body and Guns-14 in a DX 11 body.

The user has no access to the subject's memories.

If someone has biopresence software and appropriate equipment implanted in his body, the GM may require him to take the Puppet advantage (p. B78) for each Ally or Dependent (or group of them) whose mind he has access codes for.

The software is Complexity 7, double standard cost. LC3. Note that this is similar to the Possession (p. B76) advantage with the Telecontrol enhancement, and the Mindlink Required and No Memory Access limitations.

Brainwipe Machine (TL9-10)

This technology is much less subtle than neural programming. It involves using focused energy fields or nanomachines to alter brain structure and destroy memories.

Brainwipe is used to punish criminals or dissidents, and to erase sensitive information from the minds of those who know too much. Brainwipe causes classic amnesia, erasing all memories of the subject's personal life. It leaves personality and abilities intact. After brainwipe, a victim's skills and mental disadvantages remain unchanged. He can function in society, but can't remember his name, or anything from his past, even when confronted with the evidence. It can only be used to give the subject the Amnesia disadvantage.

Clinical Brainwipe Machine (TL9): This is a room-sized device incorporating a specialized diagnostic bed (p. 197). At TL9, it's the only system available; at higher TLs, it gives a +1 (quality) bonus to operator skill. $100,000, 100 lbs., D/10 days. LC2.

Portable Brainwipe Machine (TL10): A helmet-sized device, plus an attached briefcase-sized control unit. $10,000, 5 lbs., C/24 hr. LC2.

Message Bomb (TL9)

A smart grenade (pp. 146-147) may be equipped with a tiny speaker and player. This lets it be programmed to deliver an audio message. This is usually set to play when the grenade is used with a time-delay fuse, typically for the purpose of warning civilians ("You have 20 seconds to leave the area. 19, 18 . . .") or delivering some pronouncement ("Free Antares! Death to the Terran Empire!") before detonation. The maximum duration of the message is 10 minutes, doubled per TL after TL9. Add $10 per weapon. LC3.

Neural Programmer (TL9)

This technique uses a neural interface to "get inside" the subject's head, then alter his perceptions through subtle and overt applications of total virtual reality (p. 54).

The subject must be fitted with a neural interface (pp. 48-49) and connected to a computer system running neural programmer software. He is then put through multiple scenarios, some realistic, some bizarre or even hellish. The operator does not require a neural interface. Neural programming may add or remove a permanent self-imposed mental disadvantage (p. B121). It may give the subject a set of false memories or beliefs, which take the form of Delusions (p. B130). It can also induce a Phobia (p. B149).

The process is handled as a regular contest of Brainwashing skill vs. the subject's Will; add the equipment bonuses given below, and apply a penalty of -1 to skill for every -5 points or fraction the disadvantage is worth. Base time is one day, but more or less time can be taken – see *Time Spent* (p. B346).

The process cannot actually *erase* memories (see *Brainwipe Machine*, p. 109) but it can give the subject the Delusion that a brainwashing, kidnapping, or other traumatic event was actually a dream or a false memory.

Neural programmer software is Complexity 7. Good-quality software (+1 quality bonus) is Complexity 9; fine-quality software (+2 quality bonus) is Complexity 11. LC1.

Mechanical Mind Probe (TL10-11)

This device, also called an extractor, probes a subject's mind and retrieves memories. As the operator questions the subject, the extractor stimulates the brain to recall specific memories. It then uses electrochemical means to read those memories as they are formed.

Use of the device takes a specified time (varying by TL) per attempt, and requires a successful Electronics Operation (Medical) skill. Critical success retrieves the exact memory the questioner wishes to evoke. Success retrieves some of the desired memories, mixed up with exaggerations, errors, or unrelated associations. Failure retrieves fragmentary memories of no interest to the interrogator, or obviously false memories. Critical failure results in the subject's brain constructing false memories that seem realistic.

All memories are in the form of a raw sensie feed. Its length depends on the duration of the probe. This information must be accessed via neural interface before the user knows whether the attempt succeeded or failed; see *Sensies* (p. 57-58).

A mind probe may be used as a fast or slow probe. A slow probe is safe, but takes eight hours per attempt. A fast probe takes only an hour per attempt, but is dangerous to the subject: whether the probe succeeds or fails, he must roll vs. the *lower* of his HT or the operator's skill. Failure means brain damage (-1 to IQ); critical failure means he suffers the Coma mortal condition, and cannot be further interrogated until he recovers. Repeated fast mind probes can reduce a subject to a drooling idiot.

Clinical Mind Probe (TL10): This is a room-sized scanning device incorporating a specialized diagnostic bed (p. 197). At TL10, it's the only system available; at higher TLs, it gives a +1 (quality) bonus to operator skill. $200,000, 200 lbs., D/10 days. LC2.

Portable Mind Probe (TL11): A helmet-sized device, plus an attached briefcase-sized control unit. $20,000, 10 lbs., C/24 hr. LC2.

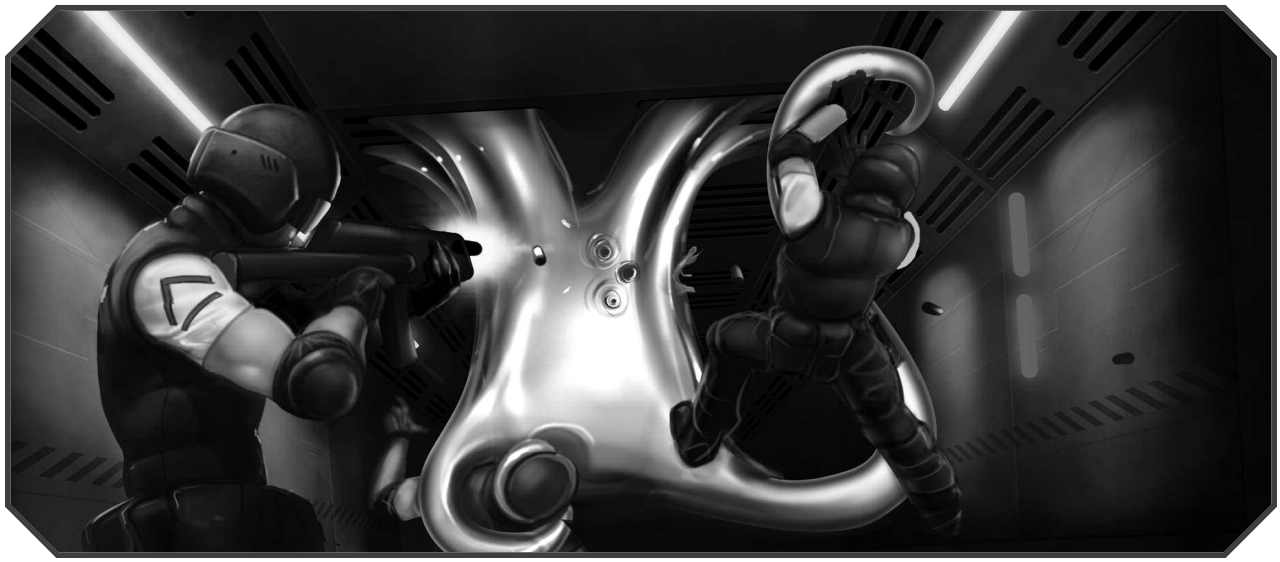
A mechanical mind probe can also incorporate a brainwipe setting, equivalent to a similar-sized brainwipe machine (p. 109), for +50% to cost and no extra weight.

The time required for fast and slow scans is halved at TL11, and again at TL12.

Black Ops Robots

Robots are perfect for many security and intelligence missions. They don't fall asleep during boring patrols or on surveillance missions, they can be relied on to sacrifice themselves or act without remorse as necessary, and they may willingly self-destruct or wipe their memories to avoid capture.

In addition to the types covered below, bush robots (p. 86), combat androids (p. 167), scoutbots (p. 80), and warbots (pp. 167-168) are often used for these jobs. Nursebots (p. 202) or medical bushbots (p. 203) also make effective interrogators.



Robobug (TL9)

-32 points

This is a single robot the size of a large insect. It is bigger than most microbots, but still small enough to easily escape notice. It is designed for surveillance, forensics, scouting, or assassination. It may also patrol power conduits or air ducts, performing security or maintenance tasks. Its weapon mount can hold a weapon up to 0.01 lbs. weight, such as a micro-laser or a drug injector.

Attribute Modifiers: ST-9 [-90].
Secondary Characteristic Modifiers: SM-9; Basic Move -3 [-15].
Advantages: Absolute Direction (Requires signal, -20%) [4]; Clinging [20]; Doesn't Breathe [20]; DR 1 (Can't Wear Armor, -40%) [3]; Extra Arm (Weapon Mount, -80%) [2]; Machine [25]; Peripheral Vision [15]; Protected Vision [5]; Radio (Burst, +30%; Reduced Range 1/10, -30%; Secure, +20%; Video, +40%) [16]; Sealed [15]; Sharp Teeth [1].
Perks: Accessories (Flashlight, tiny computer) [2].
Disadvantages: Bad Sight (Nearsighted) [-25]; Electrical [-20]; Restricted Diet (Very Common, power cells) [-10].

Lenses

Choose a TL lens (see below), configuration lens (see below), machine intelligence lens (p. 27) and biomorphic lens (p. 28). Consider the optional upgrade lenses.

TL9 Model (-80 points): Add Increased Consumption 3 [-30], Maintenance (one person, weekly) [-5], Mute [-25], and Numb [-20]. $100, 0.01 lbs., 2A/1 hr. LC4.
TL10 Model (+5 points): Add Discriminatory Smell [15], Infravision [10], Disturbing Voice [-10], and Increased Consumption 1 [-10]; $50, 0.01 lbs., 2A/4 hr. LC4.
TL11 Model (+27 points): Add Discriminatory Smell [15], Infravision [10], and Reduced Consumption 1 [2]. $20, 0.01 lbs. 2AA/12 hr. LC4.
TL12 Model (+44 points): Add, Discriminatory Smell [15], Hyperspectral Vision [25], and Reduced Consumption 2 [4]. $10, 0.01 lbs., AA/1 day. LC4.

Robobugs come in various shapes, not all of them bug-like.

Crawler (+16 points): A spider-bot that crawls along the ground. Add Extra Legs (6 legs) [10] and Super Climbing 2 [6].
Flier (+41 points): A dragonfly-like ornithopter. Add Extra Legs (4 legs) [5] and Flight (Small Wings, -10%) [36].
Rodent (-35 points): A mouse-sized robot. Add the Quadruped [-35] meta-trait.
Toy Soldier (-15 points): A humanoid robot, like a miniature figure. Delete Peripheral Vision [15].
Worm (-35 points): A serpentine robot slim enough to squirm through a keyhole-sized opening, along a drain pipe, or even down a throat to explore someone's stomach. Add the Vermiform [-35] meta-trait.
Vehicle (-80 points): A tiny robot all-terrain vehicle, like a toy car. Add Enhanced Move 1 (Ground) [20] and Ground Vehicle [-100], with wheels or tracks. Half cost.
Contragrav (TL11^) (+38 points): A small flying sphere with a pair of arms. Add Flight (Planetary, -5%) [38] and Aerial [0]. +20% cost.

Optional Upgrade Lenses

Chameleon (TL10) (+21 points): Add Chameleon 3 (Extended, Infravision, and Ultravision +40%) [21]. +$100. LC3.
Nuclear (TL11) (+10 points): Add Doesn't Eat or Drink [10]. +$100. LC3.
Water Jets (+10 points): Add Amphibious [10]. +50% cost.

Nanomorph (TL11-12)

568 points

This is a shapeshifting nanotech robot. Its intelligence is distributed through its body, and its smart matter structure is capable of rapid self-repair. In addition to assuming whole new shapes, it can also extrude spikes or talons at will. Unlike most robots, nanomorphs have bioconvertor power systems that consume food, although they aren't very fussy about what they eat – they devour most organic substances, including plastics!

Attribute Modifiers: ST+5 [50]; DX+2 [40]; HT+4 [40].
Secondary Characteristic Modifiers: HP+5 [10]; Basic Speed+0.50 [10]; Basic Move+3 [15].
Advantages: Absolute Direction [5]; Appearance (Handsome) [12]; Doesn't Breathe [20]; Enhanced Move 1/2 (Ground) [10]; Hyperspectral Vision [25]; Injury Tolerance (Homogenous) [40]; Long Talons [11]; Machine (Not Unhealing) [55]; Protected Senses (Hearing, Vision) [10]; Radio (Burst, +30%; Secure, +20%) [15]; Recovery [10]; Regeneration (Very Fast) [100]; Regrowth [40]; Sealed [15]; Sensitive Touch [10]; Slippery 2 [4]; Striking ST +5 [25]; Super Jump 1 [10]; Universal Digestion [5].
Perks: Accessory (Fast personal computer) [1].
Disadvantages: Electrical [-20].

Lenses

Choose a TL lens and machine intelligence lens (pp. 27-28); cyborg is unavailable.

Consider these options:

TL11 Model (Bioplastic) (+140 points): Nanomorphs can be made of plastic rather than living metal. Add DR 15 (Flexible, -20%) [60] and Morph (Mass Conservation, -20%) [80]. $50,000, 100 lbs. LC3.
TL12 Model (Living Metal) (+255 points): Living metal nanomorphs can transform into just about anything, and are stronger and tougher than bioplastic versions. Add ST+5 [50], DR 15 [75], and Morph (Unlimited, +50%; Mass Conservation, -20%) [130]. $150,000, 150 lbs. LC3.

Optional Lenses

Budding (+21 points/copy): Some nanomorphs can bud off copies of themselves, just like bush robots. Add Duplication (Shared Resources, -40%) [21]. +50% cost per bud.
Contragrav (+38 points) (TL11^): Add Flight (Planetary, -5%) [38].

Chapter Six
Weaponry

"Cerberus Unit Three, this is Control. Proceed to checkpoint 4 antimatter bay to investigate possible intruder."

"Cerberus Three to Control. I confirm unauthorized human life form in area. Am closing . . . Have achieved visual identification: life form is humanoid, unarmored, in damaged ablative suit, standing beside open access panel with large container. Target is holding small hand weapon. Running weapon library scan. Weapon identified as small switchblade or knife. Threat level minimal."

"Cerberus Three, this is Security Control. You are authorized to subdue the intruder."

"Affirmative. Sonic stunner firing. Hit achieved. No effect on target. Intruder closing fast. Intruder is . . ."

"Cerberus Three, report. Your telemetry is breaking up."

"Am in close combat with intruder and sustaining damage. Warning! Initial scan in error. Intruder reclassified as armored combat android with monowire switchblade. Upgrading threat level to maximum."

"Cerberus Three, you are authorized to use lethal force."

"Firing – negative capability. Left weapon mount holding plasma gun is no longer attached to this unit. Am sustaining heavy damage. Warning! Total systems failure is imminent. Total sys . . ."

"Security Control to all Cerberus units, proceed to antimatter bay! Red alert!"

– Syndicate security log (23:11)

To adventurers, police, and soldiers, perhaps the most important tools of all are weapons – a grim commentary on the nature of sapient life in the universe.

Weapon Tables

Weapon Tables in this chapter follow the format described on pp. B268-271 – refer to this section for an explanation of all table entries.

Most beam weapons use standardized power cells instead of magazines; as such, the type and number of power cells (e.g., 2C) is listed instead of an ammunition weight. Normally, the power cell's weight is included in the weapon's loaded weight; however, if the notation "p" is added, it means the power cell is worn as a separate belt or backpack, and that its weight is *not* included.

The notation (∞), found in some superscience weaponry entries, means the weapon has an infinite "cosmic" armor divisor. Only special forms of DR, noted in the weapon type description, apply vs. direct hits.

See pp. B104-105 for the meaning of special damage notations such as double knockback (dkb), incendiary (inc), and surge (sur).

Beam Weapons

These are directed energy weapons. They include lasers, blasters, and other "death rays," as well as stunners and other nonlethal energy weapons.

Lasers

Lasers are among the most versatile of beam weapons, with a wide range of offensive and defensive applications.

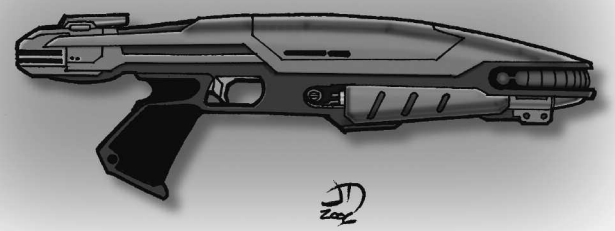
Laser weapons can be broadly classified by the effect on their target:

Dazzle lasers cause temporary blindness.

Blinding lasers cause permanent damage to eyesight or optics.

High-energy lasers blind, and inflict physical burn damage.

Chemical lasers are obsolete at TL10 – it is assumed that all lasers are solid-state, using a solid crystalline material as the lasing medium. They require no hazardous chemicals and are compact, light, and easy to use. Another option is the free electron laser, usually found on vehicle systems – see pp. 117-118.



Laser Dazzler

A laser dazzler is a low-energy laser that fires a wide beam of coherent light. Dazzlers temporarily blind eyes and optical sensors, and are designed for personal defense and riot control. They also have a more sinister use: if the beam blinds someone performing a dangerous activity such as operating a vehicle or climbing, the target could suffer an accident. If the accident is fatal, there will be no evidence of the assault . . . unless the victim had laser sensors and recorded the attack.

A laser dazzler delivers a Vision-based affliction attack against anyone struck. To be affected, the target must be looking at the laser. The victim gets a HT roll to resist, at the penalty noted on the weapon table; add +3 to HT if he is beyond 1/2D range. DR has no effect, but Protected Vision adds +5 to resist. A Nictitating Membrane adds +1 per level. Failure to resist inflicts Blindness (p. B125) for minutes equal to the margin of failure.

Laser dazzlers deliver cone attacks – see *Area and Spreading Attacks* (p. B413).

Weapons

Dazzler Carbine (TL9): A long-range dazzler weapon, most often used for police or covert operations (disrupting crowds, blinding suspects, causing vehicle accidents).

Penlights, Flashlights, and Searchlights (TL9): Ultra-tech flashlights have a "laser dazzle" setting; see *Flashlights* (p. 74) for descriptions. The combat statistics are presented below.

Dazzle Mode

Any high-energy laser (see pp. 114-116) may be designed with a dazzle mode. Switching to or from this mode takes a Ready maneuver. When in dazzle mode, the laser fires a low-power laser beam that is identical to the effect of a dazzle laser, except that it does not have a cone effect – it must strike the target's face or eyes. A HT-5 roll is needed to resist the affliction. Dazzle mode uses up negligible power. The setting adds +10% to laser cost.

Blinding Lasers (TL9)

These weapons emit a medium-power laser beam that can cause permanent blindness, or fry optics, without burning flesh. The beam is wide enough that it need only be aimed at the target, not the eyes.

Dedicated blinding lasers are rare at TL9+, since more effective high-energy lasers are also available. However, military active sensors, targeting systems, and electronic warfare systems that utilize lasers often incorporate a "high-power optical countermeasures" mode that is designed to blind sensors, including eyes.

A blinding laser delivers a Vision-based affliction attack. Anyone hit who is looking toward the laser can be affected. The victim gets a HT-10 roll to resist (HT-7 past 1/2D range). Protected Vision adds +5 to resist; a Nictitating Membrane adds +1 per level.

Failure to resist inflicts crippling Blindness (p. B125).

Dazzle Laser Weapons Tables

BEAM WEAPONS (PROJECTOR) (DX-4, or other Beam Weapons-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*	*Notes*
9	Dazzler Carbine	HT-5 aff (3 yd)	6	1,500/4,500	5/C	1	9,000(3)	6†	-2	1	$500	3	[1]
9	Laser Penlight	HT-4 aff (1 yd)	6	100/300	0.1/A	1	900(3)	1	-1	1	$3	4	[1]
9	Mini Laser Flashlight	HT-5 aff (1 yd)	6	170/500	0.25/B	1	3,600(3)	1	-1	1	$10	4	[1]
9	Heavy Laser Flashlight	HT-5 aff (1 yd)	6	330/1,000	1/2B	1	3,600(3)	1	-2	1	$20	4	[1]
9	Laser Searchlight	HT-5 aff (2 yd)	12	7,000/20,000	10/C	1	1,800(3)	1	-5	1	$500	4	[1]

[1] Projects a cone with the specified width at maximum range.

Weapons

Blinding Mode: A high-energy laser (below) may be designed with a Blinding Mode, enabling it to fire a medium-power laser beam. Modify the laser's statistics as shown on the table below when using this mode. Changing to or from this mode requires a Ready maneuver. This mode adds +10% to cost.

Military Ladar: These are military sensor arrays that can focus laser energy into a beam powerful enough to function as a weapon. The weapon statistics of these arrays are given here; the sensor statistics are covered in Chapter 3.

High-Energy Laser (TL9)

The generic laser weapon is assumed to be a high-energy laser. It emits near-infrared or visible coherent light in a narrow, tightly-focused beam that can burn through armor or explode flesh into steam. The beam usually has a duration of only a few microseconds; lasers cycle multiple times per second.

Lasers inflict lower damage than equivalent-sized projectile weapons, particle beams, or plasma guns, but they're far more accurate and completely recoilless.

High-energy lasers are available in different sub-types depending on the frequency of light used: infrared (below), blue-green (below), ultraviolet (p. 115), X-ray (p. 117), and gamma-ray (p. 118). All inflict tight-beam burning damage, but with various armor divisors and damage modifiers.

Laser eye injuries are especially dangerous. If an eye takes enough laser damage to cripple it, the result is *always* permanent crippling (giving the victim the One Eye disadvantage, or if he only has one eye, Blindness).

High-energy laser beams are silent and invisible, but in dusty air, there will be a slight glow from incinerated dust particles.

Rain, fog, smoke, snow, and similar weather or atmospheric conditions interfere with all high-energy lasers, adding extra DR to the target equal to the vision penalty (per yard). Thus, if a yard of smoke would be -10 to vision, then each yard gives DR 10; if every 100 yards of haze gives -1 to vision, then 1,000 yards provides DR 10.

A high-energy laser beam can pass through material transparent to its particular frequency of light, which includes most glass, plastic canopies, etc. Increase the laser's armor divisor to (10) when it strikes glasses, visors, windows, etc. unless the material was specifically designed to be laser-resistant. Assume that TL9+ transparent armor *is* laser-resistant.

Chemical Infrared Lasers (TL9)

A few early TL9 high-energy lasers are chemical lasers, as noted in their descriptions. They are continuous-beam weapons powered by highly reactive, energetic and corrosive chemicals – usually hydrogen-fluorine or oxygen-iodine. Chemical lasers should be issued to robots or troops in sealed suits, as fumes from the exhaust inflict 1 HP of toxic damage per second to anyone within a yard of the weapon. Carrying a man-portable chem-laser poses similar risks to a flamethrower – if the chemical tank is damaged, the spill can injure the wielder.

Mirrored surfaces are not effective against a high-energy laser: any laser powerful enough to inflict damage destroys the mirror, ruining its reflectivity. In cinematic games, however, a shield-sized mirror will provide its Defense Bonus vs. a visible-light laser.

High-energy lasers inflict tight-beam burning damage with a (2) armor divisor.

Infrared Lasers (TL9)

IR lasers emit a coherent beam of near-infrared frequency light. They are the most common high-energy laser at TL9, as they are more efficient to generate than other frequencies and propagate well in both air and space.

IR lasers inflict tight-beam burning damage with a (2) armor divisor. They can't penetrate more than a few inches of water, which reduces their underwater Range to 0/1.

Option: Blue-Green (TL9)

The standard laser light frequency for high-energy laser weapons shown on the weapon table is red or near-infrared light, but there are other alternatives. One of the most popular is the shorter blue-green wavelengths. Blue-green lasers require more power to generate, but permit greater ranges, and can also propagate underwater.

Any high-energy laser except a chemical laser can be designed to use a blue-green wavelength. Blue-green lasers inflict the usual tight-beam burn damage with the (2) armor divisor. Double the Range, but halve the RoF; treat each shot as consuming two shots for purpose of power drain. Blue-green lasers can fire underwater.

Blinding Laser Table

BEAM WEAPONS (PROJECTOR) (DX-4, or other Beam Weapons-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*	*Notes*
9	Blinding Mode	HT-10 aff	var.	var.	var.	var.	10×	var.	var.	1	var.	var.	[1]
9	Military Ladar	HT-10 aff	24	×0.1/0.3	–	1	–	–	–	1	–	–	[2]

[1] Use the high-energy laser's statistics for everything noted as var., with the exception that each shot in blinding mode counts as one-tenth of a normal shot (i.e., it has 10 times as many shots).

[2] Multiply range shown by the sensor system's detection range, e.g., a ladar with a 100-mile range has a blinding laser range of 10/30 miles.

High-Energy Laser Table

BEAM WEAPONS (PISTOL) (DX-4, other Beam Weapons-4, or Guns (Pistol)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
10	Heavy Laser Pistol	4d(2) burn	6	300/900	3.3/2C	10	56(3)	6	-2	1	$2,400	3
10	Holdout Laser	2d(2) burn	3	100/300	0.35/B	10	22(3)	3	-1	1	$300	3
10	Laser Pistol	3d(2) burn	6	200/600	1.5/C	10	66(3)	4	-2	1	$1,100	3
11	Laser Crystal	1d-1(2) burn	3	15/45	–	1	1	0	0	1	$100	2

A blue-green laser's underwater range depends on the water's clarity. The maximum Range can never exceed 150 yards in crystal-clear water, 60 yards in average water, or 15 yards in murky water. It is possible to fire into or out of water (out to normal ranges) as long as the maximum range *through* the water is not exceeded.

Option: Ultraviolet (TL9)

Some high-energy lasers fire a beam in the near-ultraviolet wavelength. An ultraviolet laser has superior range (in vacuum) compared to infrared or blue-green lasers, but its beam is rapidly absorbed by atmosphere. The beam is invisible, but it ionizes air molecules when fired in atmosphere of greater than trace density, producing a visible green glow along its path.

An ultraviolet laser has triple the usual Range, but due to its lower efficiency, its Damage is halved. Treat half-dice as a +2 modifier, e.g., 5d(2) becomes 2d+2(2). UV lasers are mainly used for space combat and on airless worlds. In atmosphere, the Range cannot exceed 500 yards divided by atmospheric pressure.

Mounted Lasers

Area Defense Laser (TL9): This is built to engage lightly armored targets, such as TL9 spacecraft and ballistic missiles, at a range of a few hundred miles.

Point Defense Laser (TL9): This is a vehicle-mounted system. It is designed to destroy soft targets like missiles, aircraft, and personnel at a range of several miles, with minimal collateral damage.

Semi-Portable Laser (TL9): This continuous-beam chemical-powered weapon is the size of a heavy machine gun. Its chemical tank is separate, and has SM-2, DR 10, HP 12. If disabled, the chemical splash inflicts 2d corrosion damage over a 2-yard radius.

Laser Cannon (TL10): A large vehicle-mounted weapon. It is a standard spacecraft and air defense system.

Strike Laser (TL9-10): A smaller version of the laser cannon, often used by fighter aircraft, and as a defensive weapon for armored vehicles or spacecraft.

Gatling Laser (TL10): A rapid-fire laser weapon. Infantry use these on a tripod; they're also often vehicle mounted or used as "small arms" by powered troopers.

Laser Pistols

Heavy Laser Pistol (TL10): A bulky but rapid-firing military-style laser sidearm, often used as an alternative to a machine pistol.

Holdout Laser (TL10): A favorite of spies and assassins, this is a tiny weapon disguised as an innocuous object, such as a wrist communicator or pen. Its mechanism uses nonmetallic ceramics and exotic composites, so with the power cell removed, an ordinary scanner cannot distinguish it from a civilian electronic device.

Laser Pistol (TL10): The basic laser sidearm. On some worlds, it may be as ubiquitous as six-guns in the Old West.

Laser Crystal (TL11)

An 1/8-inch-diameter solid-state laser projector with an integral one-shot power cell. It is surgically inserted just under the skin; this takes only a minute in an automed (p. 196). Firing is triggered by a specific nerve impulse – if implanted in a finger, it might be fired by clenching the fist while pointing at the target. When fired, it burns through the skin (a thin enough layer that no damage is taken). It's possible to equip multiple fingers and fire them simultaneously; treat this as a single attack with a RoF equal to the number of laser crystals.

Laser Rifles

Assault Laser (TL9): This is an early-TL9 chemical-pumped laser. It is most often used for microgravity combat. If its chemical power pack is attacked, it has SM-4, DR 10, HP 7; if disabled, it inflicts 1d corrosion damage in a 1-yard radius.

Laser Sniper Rifle (TL9): A bulky but accurate chemical laser rifle, used as a battlefield sniping weapon. Its backpack chemical tank has the same vulnerability as the chemical laser carbine.

Dinosaur Laser (TL10): A big laser sniper rifle, capable of stopping a battlesuit or a dinosaur (hence its nickname). Also called a "heavy laser." These are mostly military weapons, but are sometimes used as an "elephant guns" for big game.

Laser Carbine (TL10): A compact "assault" version of the laser rifle, favored by vehicle crews and special ops teams. Its low bulk makes up for its lack of range.

Laser Rifle (TL10): The standard infantry combat laser, capable of full automatic fire. In some settings, it may be as ubiquitous as the flintlock rifle was in its day.

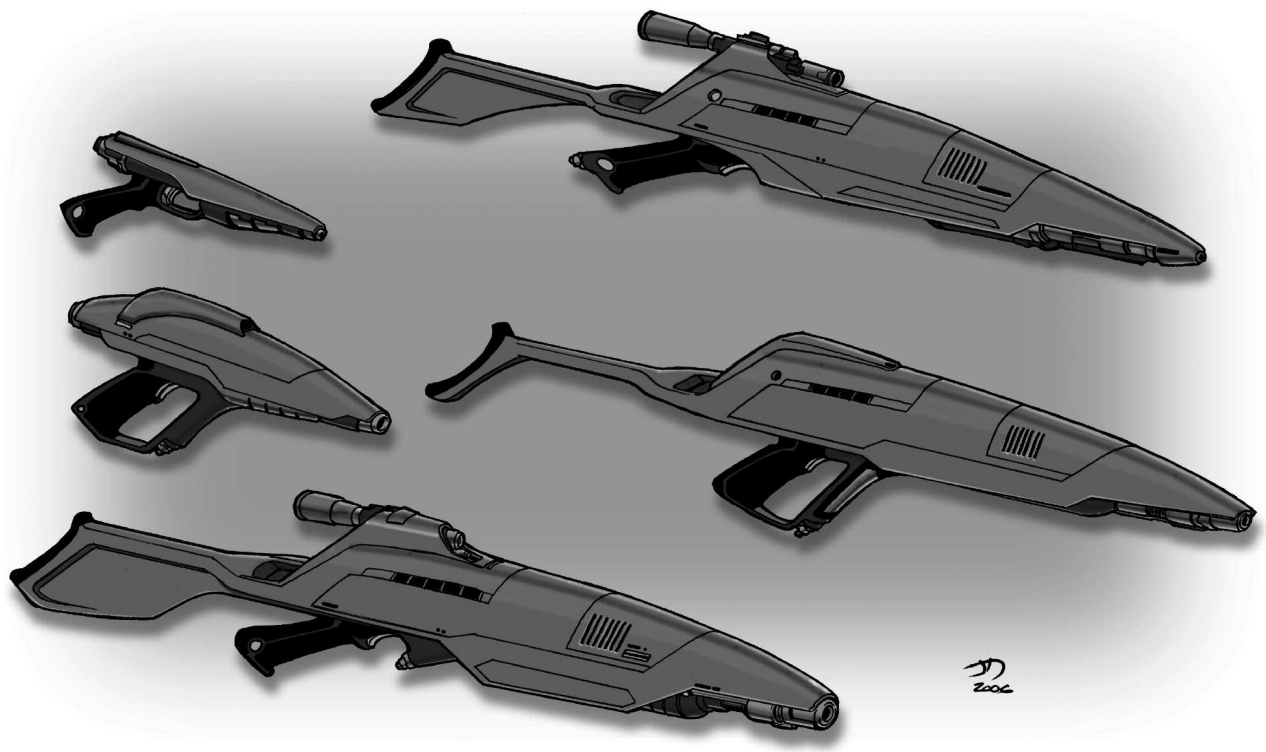
Survival Laser (TL10): A carbine version of the heavy laser pistol. Survival lasers are designed to be broken down into four pocket-sized components, which take one minute to assemble or disassemble. Although the survival laser is not very powerful, it is a good choice as a survival weapon due to its excellent accuracy (useful when shooting small game) and the modest drain it imposes on power cells. It is also a favorite weapon of assassins.

BEAM WEAPONS (RIFLE) (DX-4, other Beam Weapons-4, or Guns (Rifle)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9	Assault Laser	4d(2) burn	12+1	700/2,100	10/4p	1	40(5)	7†	-5	1	$10,000	2
9	Laser Sniper Rifle	5d(2) burn	12+2	1,100/3,300	20/4p	1	20(5)	10†	-8	1	$20,000	1
10	Dinosaur Laser	8d(2) burn	12	1,300/3,900	19/Dp	1	35(5)	10†	-5	1	$19,000	1
10	Laser Carbine	5d(2) burn	12	500/1,500	5.6/2C	10	28(3)	5†	-3	1	$4,600	2
10	Laser Rifle	6d(2) burn	12	700/2,100	8/Dp	10	83(5)	7†	-4	1	$8,000	2
10	Survival Laser	4d(2) burn	12	300/900	3.3/2C	6	56(3)	6†	-3	1	$2,400	3

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9	Area Defense Laser	6d×5(2) burn	18	36,000/110,000	8,000/10Fp	1	83(5)	200M	-10	1	$2,000,000	1
9	Point Defense Laser	3d×5(2) burn	18	9,000/27,000	1,000/Fp	1	66(5)	70M	-10	1	$250,000	1
9	Semi-Portable Laser	6d(2) burn	18	1,400/4,300	70/Ep	10	100(5)	18M	-8	1	$32,000	1
10	Gatling Laser	6d×2(2) burn	18	2,900/8,700	70/Ep	4	100(5)	18M	-8	1	$70,000	1
10	Laser Cannon	6d×10(2) burn	18	72,000/220,000	8,000/10Fp	1	83(5)	200M	-10	1	$4,000,000	1
10	Strike Laser	6d×5(2) burn	18	18,000/54,000	1,000/Fp	1	66(5)	70M	-10	1	$500,000	1



Rainbow Lasers (TL11)

These weapons fire powerful nanosecond pulses of laser light. The light's interaction with the atmosphere does most of the work of focusing the beam, so that laser needs only a small lens. A rainbow laser beam is *polychromatic*, appearing as a needle-thin line of blue-white light.

A rainbow laser inflicts burning damage with a (3) armor divisor. It is effective in atmospheres with a density ranging from very thin through superdense. In vacuum or trace atmospheres, the laser defocuses. Its range is divided by 10, and its damage loses its armor divisor. Rainbow lasers have an underwater range of only two yards.

Weapons

Rainbow lasers come in similar varieties to visible light lasers. At TL11, rainbow lasers may be used in conjunction with blasters as standard military weapons – they have less penetration, but superior accuracy, range, and RoF.

Rainbow Laser Table

BEAM WEAPONS (PISTOL) (DX-4, other Beam Weapons-4, or Guns (Pistol)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
11	Heavy Rainbow Laser Pistol	4d(3) burn	6	900/2,700	3.3/2C	10	56(3)	6	-2	1	$2,400	3
11	Holdout Rainbow Laser	2d(3) burn	3	300/900	0.35/B	10	22(3)	3	-1	1	$300	3
11	Rainbow Laser Pistol	3d(3) burn	6	600/1,800	1.5/C	10	66(3)	4	-2	1	$1,100	3
12	Rainbow Laser Crystal	1d-1(3) burn	3	50/150	–	1	1	0	0	1	$100	2

BEAM WEAPONS (RIFLE) (DX-4, other Beam Weapons-4, or Guns (Rifle)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
11	Dinosaur Rainbow Laser	8d(3) burn	12	4,000/12,000	9/Dp	1	35(5)	7†	-5	1	$9,000	1
11	Rainbow Laser Rifle	6d(3) burn	12	2,000/6,000	8/Dp	10	83(5)	7†	-4	1	$8,000	2
11	Rainbow Laser Carbine	5d(3) burn	12	1,500/4,500	5.6/2C	10	28(3)	5†	-3	1	$4,600	2
11	Rainbow Survival Laser	4d(3) burn	12	900/2,700	3.3/2C	6	56(3)	6†	-3	1	$2,400	3

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
11	Rainbow Gatling Laser	12d(3) burn	18	8,000/24,000	70/Ep	4	100(5)	16M	-8	1	$70,000	1
11	Rainbow Laser Cannon	6d×10(3) burn	18	200,000/600,000	4,000/10Fp	1	83(5)	45M	-10	1	$2,000,000	1
11	Rainbow Strike Laser	6d×5(3) burn	18	50,000/150,000	500/Fp	1	66(5)	27M	-10	1	$250,000	1

X-Ray Lasers (TL11)

These free-electron laser weapons use a particle accelerator to generate a beam of coherent, deep-penetrating X-rays. They inflict tight-beam burning damage with a (5) armor divisor and the surge damage modifier.

If an X-ray laser had the same diameter lens as an ordinary laser, its range would be *thousands* of times greater! But it's difficult to build large X-ray lenses, so practical weapons have tiny focal arrays. The range is still great . . . in vacuum. X-rays are quickly absorbed by atmosphere; Range drops to 7/20 yards in a standard atmosphere. (For thinner or thicker atmospheres, divide this range by the relative air pressure.) X-ray lasers have no range underwater.

This minimal atmospheric range means X-ray lasers are best used as space combat weapons, or for boarding actions and close-range assassinations. To mitigate this, superscience X-ray lasers are often field-jacketed (p. 133). A field-jacketed X-ray laser is a terrifying weapon, with tremendous range and penetration in all environments.

X-Ray Laser Weapons

These weapons are available in the same models as TL10 high-energy lasers (p. 114), but they appear one TL later.

X-Ray Laser Table

BEAM WEAPONS (PISTOL) (DX-4, other Beam Weapons-4, or Guns (Pistol)-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST
11	Heavy X-Ray Laser Pistol	4d(5) burn sur	6	17/50 mi.	3.3/2C	10	56(3)	6
11	Holdout X-Ray Laser	2d(5) burn sur	3	1/3 mi.	0.35/B	10	22(3)	3
11	X-Ray Laser Pistol	3d(5) burn sur	6	5.5/17 mi.	1.5/C	10	66(3)	4

BEAM WEAPONS (RIFLE) (DX-4, other Beam Weapons-4, or Guns (Rifle)-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST
11	X-Ray Dino Laser	8d(5) burn sur	12	72/220 mi.	19/Dp	1	35(5)	10†
11	X-Ray Laser Carbine	5d(5) burn sur	12	27/83 mi.	5.6/2C	10	28(3)	5†
11	X-Ray Laser Rifle	6d(5) burn sur	12	40/120 mi.	8/Dp	10	83(5)	7†

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST
11	Semi-Portable X-Ray Laser	12d(5) burn sur	18	160/480 mi.	70/Ep	10	100(5)	18M
11	X-Ray Laser Cannon	6d×10(5) burn sur	18	4,000/12,000 mi.	8,000/10Fp	1	83(5)	200M
11	X-Ray Strike Laser	6d×5(5) burn sur	18	1,000/3,000 mi.	1,000/Fp	1	66(5)	70M

[1] Range cannot exceed 20 yards in a standard atmosphere unless field-jacketed (p. 133).

Gamma-Ray Lasers (Grasers) (TL12)

The gamma-ray laser is the ultimate high-energy laser. Its effect is similar to an X-ray laser, but with superior penetration and even greater range. A graser inflicts burning damage with a (10) armor divisor and the surge damage modifier.

Graser beams are rapidly absorbed by air, but have better propagation than an X-ray laser. The maximum range in air cannot exceed 70/200 yards in a standard atmosphere (for thinner or thicker atmospheres, divide this range by the relative air pressure). They have no range underwater. As with X-ray lasers, superscience weapons can be field-jacketed (p. 133).

Grasers replace X-ray and visible-light lasers for space combat, or in all roles if field-jacketed. Even if not field-jacketed, they may be useful as close-assault weapons.

Graser Weapons

These come in the same models as high-energy lasers (p. 114), but two TLs later.

Pulse Lasers (TL9-12)

The standard high-energy laser is a beam laser. An alternative is the pulse laser, which fires a wider pulse of higher-energy coherent light with an extremely short duration. A hit causes a surface explosion, concussion and blunt trauma – sometimes enough to knock a person down. Its range is superior to a beam laser, but it has less penetration.

Pulse lasers aren't listed on the weapon tables; rather, they're available as an option that may be taken for all lasers except chemical and rainbow lasers. Change the damage from burning to crushing, add the explosive

Gamma-Ray Laser Table

BEAM WEAPONS (PISTOL) (DX-4, other Beam Weapons-4, or Guns (Pistol)-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST
12	Graser Pistol	3d(10) burn sur	6	10/30 mi.	1.5/C	10	66(3)	4
12	Heavy Graser Pistol	4d(10) burn sur	6	50/150 mi.	3.3/2C	10	56(3)	6
12	Holdout Graser	2d(10) burn sur	3	17/50 mi.	0.35/B	10	22(3)	3

BEAM WEAPONS (RIFLE) (DX-4, other Beam Weapons-4, or Guns (Rifle)-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST
12	Dinosaur Graser	8d(10) burn sur	12	200/600 mi.	19/Dp	1	35(5)	10†
12	Graser Carbine	5d(10) burn sur	12	80/240 mi.	5.6/2C	10	28(3)	5†
12	Graser Rifle	6d(10) burn sur	12	120/360 mi.	8/Dp	10	83(5)	7†

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST
12	Graser Cannon	6d×10(10) burn sur	18	12,000/36,000 mi.	8,000/10Fp	1	83(5)	200M
12	Semi-Portable Graser	12d(10) burn sur	18	480/1,400 mi.	70/Ep	10	100(5)	18M
12	Strike Graser	6d×5(10) burn sur	18	3,000/9,000 mi.	1,000/Fp	1	66(5)	70M

[1] Range cannot exceed 200 yards in a standard atmosphere, unless field-jacketed (p. 133).

Bulk	Rcl	Cost	LC	Notes
-2	1	$4,800	3	[1]
-1	1	$600	3	[1]
-2	1	$2,200	3	[1]

Bulk	Rcl	Cost	LC	Notes
-5	1	$38,000	1	[1]
-3	1	$9,000	2	[1]
-4	1	$16,000	2	[1]

Bulk	Rcl	Cost	LC	Notes
-8	1	$130,000	1	[1]
-10	1	$8,000,000	1	[1]
-10	1	$1,000,000	1	[1]

damage modifier, and reduce the armor divisor one step, e.g., (10) to (5) for grasers, (5) to (3) for X-ray lasers, or delete it entirely for ultraviolet, infrared, and visible-light lasers. Double the range. The other statistics remain the same.

It's also possible to design a laser that can function as both a beam and a pulse weapon. A pulse-beam laser is +100% to cost; switching modes takes a Ready maneuver.

Electrolasers

Electrolasers use a pair of low-power far-ultraviolet laser beams to create an ionized path through the air, then transmit an electrical discharge that follows this to the target. In effect, they're an electric stun gun that uses a laser beam instead of a wire. They're also called "zap guns" or "stat guns."

Low-Power Electrolasers (TL9)

These are non-lethal weapons. They deliver both an electrical shock and a minor laser burn.

Bulk	Rcl	Cost	LC	Notes
-2	1	$3,300	3	[1]
-2	1	$7,200	3	[1]
-1	1	$900	3	[1]

Bulk	Rcl	Cost	LC	Notes
-5	1	$28,000	1	[1]
-3	1	$13,000	2	[1]
-4	1	$24,000	2	[1]

Bulk	Rcl	Cost	LC	Notes
-10	1	$12,000,000	1	[1]
-8	1	$190,000	1	[1]
-10	1	$1,500,000	1	[1]

The laser beam inflicts 1d-3 burn damage. It needn't penetrate to carry the charge. Smoke, fog, rain, or clouds give extra DR equal to the visibility penalty. For example, if rain gives a penalty of -1 per 100 yards, a target 200 yards away gets an extra DR 2.

An electrolaser's shock is a HT-based affliction attack with a (2) armor divisor (each 2 DR on the location struck provides +1 to HT). Add +3 past 1/2D range. If the victim fails to resist, the shock stuns him. He may roll against HT every turn at the same penalty (but *without* the DR bonus) to recover. Electrolasers also affect machines that are Electrical.

Electrolaser weapons produce a "zap" sound, no louder than a silenced pistol, and the beam is visible. They are most effective in dry climates. In humid conditions they are less accurate; the electrical bolt jumps off the laser path to paths of lower resistance. This gives a -2 to hit in moist, humid environments, and a -6 to hit in rain, drizzle, or heavy fog. In a vacuum or trace atmosphere, there is no air to ionize; the electrolaser only inflicts 1d-3 burn damage from the laser, with no additional linked effect.

Police and civilians often use electrolasers; they're also popular for prisoner control, kidnappings and covert operations, and even subduing animals. Electrolasers are available in holdout, pistol, carbine, and rifle configurations at TL9.

Electrolaser Weapons

Electrolaser Carbine (TL9): This compact rifle is one of the most common ultra-tech stun weapons. At TL9-10, police on patrol may carry one of these in their vehicle, for use in long-range suspect takedowns.

Electrolaser Pistol (TL9): A wireless successor to dart-firing electric stun guns. It is popular as a police and prison guard weapon.

Heavy Electrolaser (TL9): A heavy-duty electrolaser used against armored foes or large animals. Its ultraviolet carrier beam causes a more severe burn than lower-powered weapons, so it's best used on targets that have some protection (heavy clothes, fur, etc.).

Holdout Electrolaser (TL9): A palm-sized zap gun popular for covert ops, kidnappings, and self-defense. Its electroshock capabilities also endear it to slavers and torturers.

Underbarrel Electrolaser (TL9): This electrolaser is designed to be attached under the barrel of any weapon with Bulk -3 or more, providing a backup stun capability. Use the Bulk, ST, and sighting bonuses of the weapon it is installed in.

Semi-Portable Electrolaser (TL9): Also called a "tripod zapper," this powerful long-range electrolaser is usually mounted on a vehicle or tripod. Like the heavy electrolaser, its carrier beam can inflict nasty burns.

Lethal Electrolasers (TL9)

Any electrolaser may have an optional "kill" setting that uses up two shots instead of one. It takes a Ready maneuver to change settings.

On "kill" the weapon transmits a higher-amperage current. Any HT roll that fails by 5 or more triggers the Heart Attack mortal condition (p. B428). For electrical machines, a "heart attack" results in the target's electrical systems burning out until repaired.

These are popular assassination weapons. Lethal electrolasers are all LC2.

Electrolaser Table

BEAM WEAPONS (PISTOL) (DX-4, other Beam Weapons-4, or Guns (Pistol)-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	Electrolaser Pistol *linked*	HT-4(2) aff 1d-3 burn	4	40/80	2.2/C	3	36(3)	4	-2	1	$1,800	4
9	Holdout Electrolaser *linked*	HT-2(2) aff 1d-3 burn	2	10/20	0.3/B	1	22(3)	3	-1	1	$250	4

BEAM WEAPONS (RIFLE) (DX-4, other Beam Weapons-4, or Guns (Rifle)-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	Electrolaser Carbine *linked*	HT-4(2) aff 1d-3 burn	8	160/470	3.7/2C	3	72(3)	4†	-4	1	$3,900	3
9	Heavy Electrolaser *linked*	HT-6(2) aff 1d-2 burn	8	400/1,100	20/Dp	1	83(3)	10†	-5	1	$20,000	3
9	Underbarrel Electrolaser *linked*	HT-3(2) aff 1d-3 burn	4	90/270	1.8/C	1	66(3)	4	–	1	$1,300	4

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	Semi-Portable Electrolaser *linked*	HT-8(2) aff 1d-1 burn	12	600/1,900	70/Dp	10	100(5)	18M	-8	1	$70,000	1

Microwave Weapons

Microwave weapons project electromagnetic beams with wavelengths longer than infrared light, but shorter than radio waves. Vehicle-mounted microwave beams first appear at TL8, followed by personal weapons at TL9+. Microwave beam weaponry is usually used to stun people or machines, depending on the frequency used.

Microwave Area Denial (MAD) (TL9)

These "pain beam" weapons use microwaves to heat the surface of the target's skin to about 130°F, activating pain receptors without causing actual burning. The sensation is similar to touching a hot light bulb all over the surface of the body. MAD weapons are often used for riot control: they can disperse a crowd without leaving piles of unconscious bodies or messy clouds of gas.

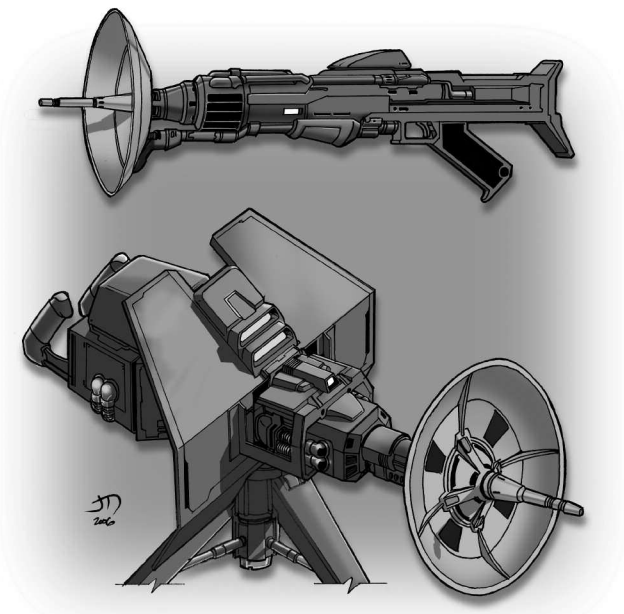
MAD beams deliver a HT-based affliction attack (modifier varying by weapon) with no armor divisor; add the target's DR to HT to resist. If he fails to resist, he suffers from the Agony affliction (p. B428) for as long as he is in the beam, and for one second afterward.

MAD beams are ranged cone attacks – see *Area and Spreading Attacks* (p. B413).

MAD Weapons

Portable MAD (TL9): A weapon the size of a light machine gun, used as a portable anti-riot device. It's sometimes built into vehicles as a secondary weapon.

Tactical MAD (TL9): A large semi-portable projector capable of breaking up a crowd at a thousand yards. It's usually tripod-mounted or built into a vehicle.



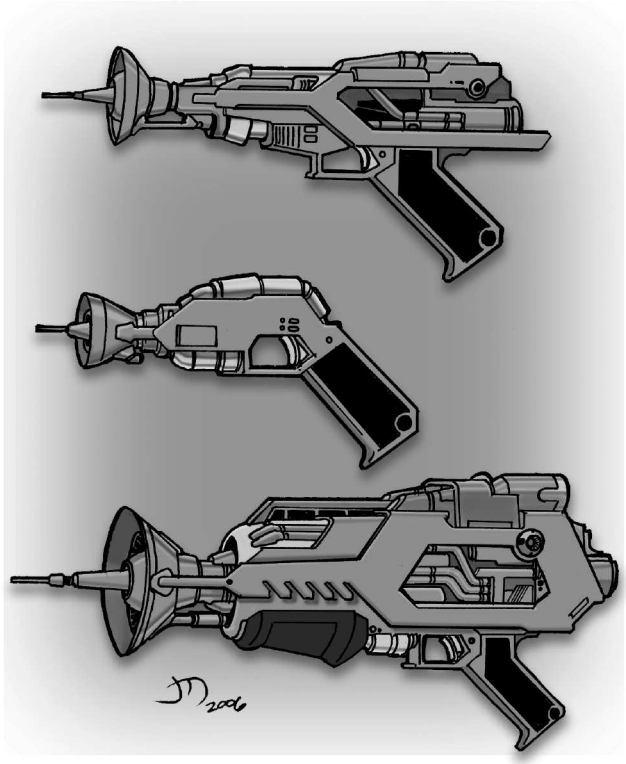
MAD Weapons Table

BEAM WEAPONS (PROJECTOR) (DX-4, other Beam Weapons-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	Portable MAD	HT-3 aff (1 yd)	12	400/800	20/Dp	1	300(5)	10†	-5	1	$10,000	3

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	Tactical MAD	HT-4 aff (3 yd)	18	600/1,200	70/Dp	1	100(5)	18M	-8	1	$70,000	3



Microwave Disruptor (TL9)

These are refinements of the single-shot explosively-pumped high-power microwave pulse weapons of TL8. They generate a directional pulse that can scramble and overload electronics and electrical systems. Criminals use them to hijack robots for later resale, while saboteurs and terrorists use them to attack vital circuitry.

Microwave disruptors project ranged cone attacks – see *Area and Spreading Attacks* (p. B413). Any target in the cone is struck by an affliction attack. This only afflicts electrical systems and those with the Electrical disadvantage. Make a HT roll or be shut down (or unconscious) for minutes equal to the margin of failure. Add +3 to resist beyond 1/2D range. The target's SM adds to the HT roll to resist.

Microwave disruptors are contact agents that ignore DR unless the target is sealed. Disruption can propagate along radar or communications antennas, power lines and communication cables. Treat a target with unshielded electronic access as unsealed.

Microwave disruptors come in holdout-sized "scramblers" for sabotaging computers or other electronics, and heavier carbines and semi-portable weapons for disabling robots and vehicular targets. Very large microwave disruptors are rare, since most large vehicles are sealed; EMP warheads (p. 157) are more effective.

Microwave Disruptor Weaponry (TL9-10)

Most microwave disruptors are personal weapons requiring Beam Weapons (Projector) skill to use.

EMP Gun (TL9): The basic portable microwave weapon, capable of stopping a robot or vehicle, or frying a room full of electronics.

Pulse Carbine (TL9): A more compact version of the EMP Gun, primarily used as an anti-robot weapon.

Scrambler (TL9): A pocket holdout microwave pulse weapon, useful for disabling a small security robot or performing sabotage on computers or other electronics.

Tactical Disruptor (TL9): A semi-portable microwave cannon, usually tripod-mounted or installed in a vehicle or robot. It requires Gunner (Beams) skill to use.

Neural Weapons

These weapons use precisely-focused pulsed electrical or radio-frequency beams to affect the brain or nervous system at a distance. They are superscience weapons, but may be explained as improvements on electrolasers and microwave MAD beams. They only work on beings with a functional nervous system. Someone with Injury Tolerance (Diffuse, No Brain, Homogenous, or Unliving) or the Machine meta-trait is immune. A neural weapon won't affect giant blobs, plant-creatures, silicon-based entities, and so on.

A neural weapon designed to affect terrestrial life may have an unpredictable effect on aliens, and vice versa. Depending on how alien they are, they might receive a HT bonus (e.g., +3 to resist), be unaffected, or may be affected *differently*. For example, a pain beam may cause the effect of an ecstasy beam.

Neural beams are silent and invisible. There are two categories: neural disruptors and mind rippers.

Neural Disruptors ("Nerve Guns") (TL11^)

This family of weapons stimulates the nervous system, causing pain, pleasure, seizures, or other effects. They are popular for covert operations, as self-defense or dueling weapons, or as coercive weapons for slavers, prison guards, and security forces.

High-Power Microwave Weapon Table

BEAM WEAPONS (PROJECTOR) (DX-4, other Beam Weapons-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9	EMP Gun	HT-3 aff (1 yd)	6	90/270	1.8/C	1	33(3)	4	-2	1	$650	2
9	Pulse Carbine	HT-4 aff (1 yd)	12	160/480	5/2C	1	28(3)	5†	-3	1	$2,000	2
9	Scrambler	HT-2 aff (1 yd)	3	40/120	0.3/B	1	11(3)	3	-1	1	$120	2

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9	Tactical Disruptor	HT-8 aff (3 yd)	18	600/1,200	70/Dp	1	50(5)	18M	-8	1	$32,000	1

Neural disruptors project ranged cone attacks – see *Area and Spreading Attacks* (p. B413). The beams are ranged contact agents – ignore DR unless the target is sealed, in which case there is no effect. They deliver an affliction attack. The victim gets a HT roll to resist, at a penalty dependent on the weapon. Add +3 to resist beyond 1/2D range. Failure means the victim suffers a particular affliction for minutes equal to the margin of failure. The affliction suffered depends on the type of beam fired:

Agony: The victim suffers the Agony incapacitating condition* (p. B428). After recovery, he suffers Moderate Pain (p. B428) for an equal length of time.

Ecstasy: As above, but the victim suffers Ecstasy* followed by Euphoria (p. B428).

Neural Stun: The victim suffers the Unconsciousness condition (p. B429).

Paralysis: The victim suffers the Paralysis incapacitating condition (p. B429).

Seizure: The victim suffers the Seizure incapacitating condition (p. B429).

* If struck by an Agony or Ecstasy attack, a failure by 5+ causes a Heart Attack mortal condition (p. B429).

Tunable Weapons: Each extra setting after the first adds +50% to cost. Changing settings is a Ready maneuver.

Personal Neural Disruptor Weapons

Most neural disruptors are personal weapons that require Beam Weapons (Projector) skill to use.

Holdout Neural Disruptor (TL11^): An easily-concealed pocket-sized nerve gun with no handgrip. Depending on the weapon setting, it may be popular as an interrogation device or recreational toy.

Nerve Pistol (TL11^): The most popular neural weapon. In some cultures, these may be the standard weapons of police and security forces, supplanting sonic stunners. Also called a neural disruptor pistol.

Nerve Rifle (TL11^): A powerful neural disruptor sometimes used as a police sniper weapon.

Tactical Nerve Disruptor (TL11^): A large semi-portable weapon, usually vehicle- or tripod-mounted. It is often deployed in prison guard towers or police vehicles. It requires Gunner (Beams) skill to use.

Death Beam Setting (TL12^)

At this setting, any failed resistance roll causes the Heart Attack mortal condition (p. B429). Add +1 to the TL of neural disruptors with death beam settings.

Tunable: A death beam may have nonlethal neural disruptor settings such as agony or paralysis. Add +50% to cost for each setting.

Mindrippers (TL12^)

These weapons are closely related to neural disruptor and ultrascanner technology. They perform a high-energy neurological scan of a single target that may simultaneously record and fry the target's brain. They're useful because they simultaneously destroy and capture an opponent.

A mindripper functions exactly like a mind disruptor (p. 132), except that failure to resist causes the Coma mortal condition (p. B429). Failure by 5+ results in a permanent Total Amnesia disadvantage even *after* the subject recovers.

A mindripper also *uploads* the subject, storing a copy in its internal database. This copy is enough to make a low-res "fragment" mind emulation (p. 220) if the subject failed by 1-4, or high-res if he failed by 5+.

Less invasive ways of making a mind emulation exist, but they require special medical equipment and can't be performed over a distance!

Weapons

Long-Range Mindripper (TL12^): A semi-portable weapon, sometimes built into vehicles or robots, or tripod-mounted.

Short-Range Mindripper (TL12^): A bulky pistol-type weapon.

Particle Accelerators

These are deadly versions of the particle accelerators used in physics research. An electric field (or in some superscience versions, gravitic field) accelerates stored particles to near-lightspeed velocities and focus them into a tight beam.

As the particles strike the target, they disrupt its atomic structure, causing it to heat up rapidly to very high

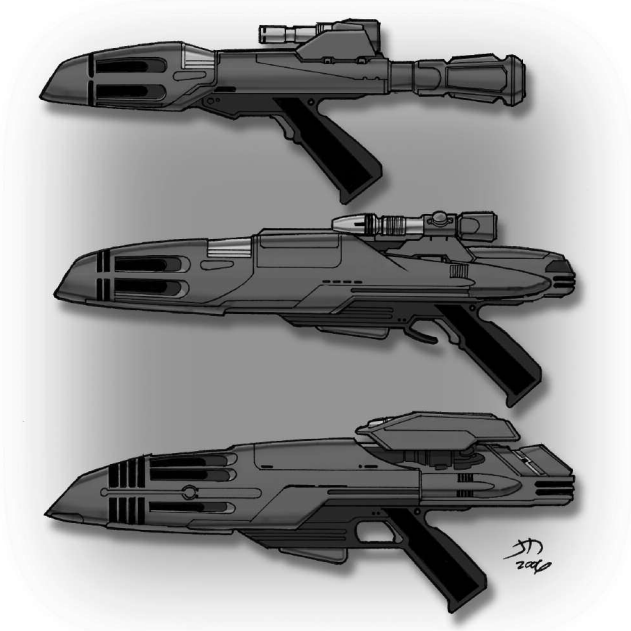
Neural Weapon Table

BEAM WEAPONS (PROJECTOR) (DX-4, other Beam Weapons-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
11^	Holdout Nerve Disruptor	HT-2 aff (1 yd)	3	10/30	0.3/B	1	22(3)	3	-1	1	$500	4
11^	Nerve Pistol	HT-3 aff (1 yd)	6	23/70	1.8/C	1	66(3)	4	-2	1	$2,600	4
11^	Nerve Rifle	HT-4 aff (1 yd)	12	40/120	5/2C	1	56(3)	5†	-3	1	$8,000	4
12^	Short-Range Mindripper	HT-2 aff (1 yd)	6	4/12	5/2C	1	56(3)	7	-3	1	$40,000	1

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
11^	Tactical Neural Disruptor	HT-8 aff (3 yd)	18	160/480	70/Dp	10	100(5)	18M	-8	1	$130,000	1
12^	Long-Range Mindripper	HT-4 aff (1 yd)	18	70/200	70/Dp	10	100(5)	18M	-8	1	$700,000	1



temperatures. They have greater penetrating power than most laser beams, and can damage deep internal components. They can even cause a target to explode from the massive amount of energy being transferred. A particle beam strike will also damage electrical systems with a shower of secondary radiation.

Charged Particle Beams ("Blasters") (TL10-11)

These particle beam weapons accelerate ionized particles – usually electrons – to near-light velocities. They work best in an atmosphere – the beam collides with air molecules, creating enough ions of the opposite charge so that the beam is self-neutralized and remains coherent. The beam resembles a linear lightning bolt. In a vacuum, range is reduced, since the particles repel one another, but the beam is invisible.

Blasters inflict burn damage with a (5) armor divisor and the surge damage modifier. In a vacuum or trace atmosphere, the beam's Acc is halved (round up) and the beam's Range is divided by 5.

These weapons compete with Gauss guns (p. 141), plasma guns (p. 127), rainbow lasers (p. 116), and field-jacketed X-ray lasers (p. 117) as standard TL11 lethal weapons.

Personal Weapons

These require Beam Weapons (Pistol or Rifle) skill to use.

Blaster Carbine (TL11): Compact assault weapons with the same power as a blaster rifle, but reduced range. Popular with vehicle crews and special ops teams.

Blaster Pistol (TL11): A long-barreled particle beam pistol. It is sometimes known as an "electron pistol." It is most often used as a military sidearm by combat-armored troops – especially if fighting robots, where its surge effects are useful.

Blaster Rifle (TL11): A standard military weapon of TL11 troops. It's also called an electron rifle.

Heavy Blaster (TL11): An oversized blaster rifle with a backpack power supply, often used by powered troopers or as a squad support weapon.

Heavy Blaster Pistol (TL11): A large and powerful "magnum" blaster pistol, this is a favorite sidearm for Space Patrol officers, swaggering space pirates, and powered armor troopers. Its bulk makes it hard to conceal, but it will (barely) fit into a standard holster.

Holdout Blaster (TL11): A palm-sized blaster similar to the holdout laser (p. 115).

Mounted Weapons

These are usually vehicle- or tripod-mounted; they require Gunner skill to use.

Blaster Cannon (TL10-11): A multi-ton weapon installed in the turret or hull of a spacecraft or tank.

Semi-Portable Blaster (TL11): This infantry support weapon can fire a bolt capable of burning through three inches of steel. It is usually carried by heavy powered troopers, or installed on a vehicle or tripod mount.

Particle Beam Table

BEAM WEAPONS (PISTOL) (DX-4, other Beam Weapons-4, or Guns (Pistol)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
11	Blaster Pistol	3d(5) burn sur	5	300/900	1.6/C	3	40(3)	4	-2	1	$2,200	3
11	Heavy Blaster Pistol	4d(5) burn sur	5	500/1,500	3.3/2C	3	33(3)	6	-3	1	$5,600	3
11	Holdout Blaster	2d(5) burn sur	3	130/500	0.35/B	3	13(3)	3	-1	1	$600	3

BEAM WEAPONS (RIFLE) (DX-4, other Beam Weapons-4, or Guns (Rifle)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
11	Blaster Carbine	5d(5) burn sur	10+1	500/1,500	5.6/2C	3	17(3)	5†	-3	1	$9,200	2
11	Blaster Rifle	6d(5) burn sur	10+2	700/2,100	10/2C	3	10(3)	7†	-4	1	$18,000	2
11	Heavy Blaster	8d(5) burn sur	10+4	1,200/3,600	20/Dp	3	20(5)	10†	-6	1	$40,000	1

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
10	Blaster Cannon	5d×10(5) burn sur	15	30,000/90,000	4,000/10Fp	1	20(5)	160M	-10	1	$2,000,000	1
11	Blaster Cannon	5d×20(5) burn sur	15	120,000/360,000	4,000/10Fp	1	20(5)	160M	-10	1	$2,000,000	1
11	Semi-Portable Blaster	6d×2(5) burn sur	15	2,800/8,400	70/Ep	3	62(5)	18M	-8	1	$140,000	1

Antiparticle Beams ("Pulsars") (TL11-12^)

These weapons accelerate a beam of antimatter particles, usually positrons or anti-hydrogen atoms. Their interaction with normal matter results in an explosion when they strike the target. They require a trapped store of antiparticles as "ammunition," but the amount is negligible and is included in the weapon's cost.

Antiparticle beams inflict crushing damage with a (3) armor divisor and the explosive, radiation, and surge damage modifiers. Their armor penetration is slightly less than a charged particle beam, but the overall energy delivered is greater.

Antiparticle beam range in atmosphere cannot exceed 1,000 yards divided by atmospheric pressure unless the beam is field-jacketed (p. 133).

Antiparticle Weapons

Pulsars are available in the same styles as blasters (p. 123). Due to their explosive and radiation effects, they're less likely to be used as civilian weapons, hence their lower LC.

Antiparticle Beam Table

BEAM WEAPONS (PISTOL) (DX-4, other Beam Weapons-4, or Guns (Pistol)-4)

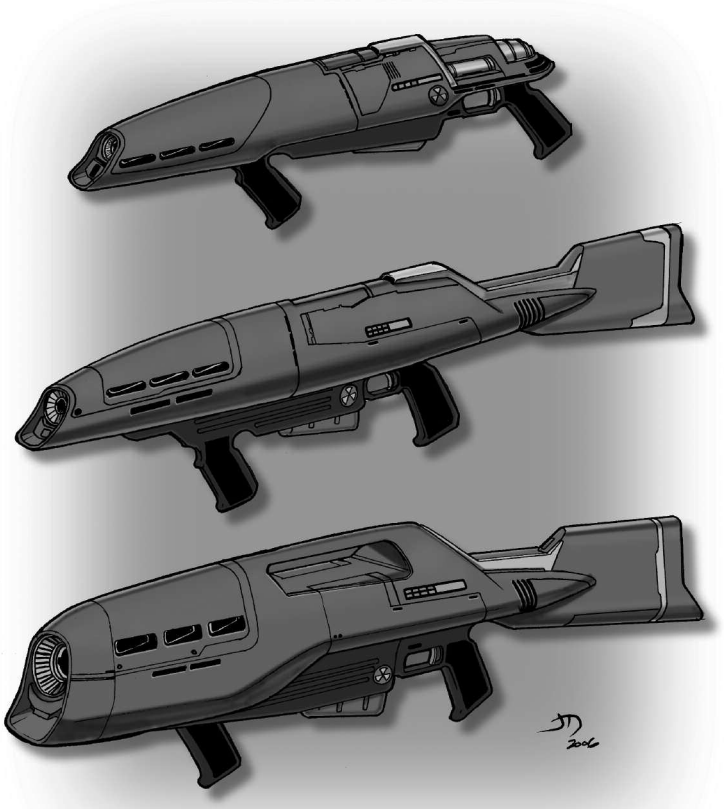
TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
12	Heavy Pulsar Pistol	8d(3) cr ex	5	400/1,200	3.3/2C	3	33(3)	6	-3	1	$5,600	2
12	Holdout Pulsar	4d(3) cr ex	3	130/500	0.35/B	3	13(3)	3	-1	1	$900	2
12	Pulsar Pistol	6d(3) cr ex	5	300/900	1.6/C	3	40(3)	4	-2	1	$3,300	2

BEAM WEAPONS (RIFLE) (DX-4, other Beam Weapons-4, or Guns (Rifle)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
12	Heavy Pulsar	8d×2(3) cr ex	10+4	1,200/3,600	20/Dp	3	20(5)	10†	-6	1	$60,000	1
12	Pulsar Carbine	10d(3) cr ex	10+1	500/1,500	5.6/2C	3	17(3)	5†	-3	1	$14,000	1
12	Pulsar Rifle	6d×2(3) cr ex	10+2	700/2,100	10/2C	3	10(3)	7†	-4	1	$27,000	1

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
11	Antiparticle Cannon	8d×10(3) cr ex	15	40,000/120,000	5,000/Fp	1	20(5)	160M	-10	1	$3,000,000	0
12	Antiparticle Cannon	8d×20(3) cr ex	15	120,000/360,000	5,000/Fp	1	20(5)	160M	-10	1	$3,000,000	0
12	Semi-Portable Pulsar	6d×4(3) cr ex	15	2,800/8,400	70/Ep	3	60(5)	18M	-8	1	$100,000	1



Omni-Blasters

At +100% to cost, a blaster may incorporate a stun setting, firing a non-lethal energy bolt similar in nature to an electrolaser beam. A stun setting usually feels like a powerful electrical shock. Unlike an electrolaser, a blaster's stun bolt works in any environment. It takes one turn to "switch to stun."

When set to stun, the victim takes no damage, but must make a HT roll to resist suffering an unconsciousness affliction. The penalty is -1 for every die of damage the blaster usually inflicts, up to a maximum of -10. The victim adds one-third of his DR to HT – that is, the blaster gets a (3) armor divisor instead of its usual (5). A failed roll results in the victim falling unconscious for minutes equal to the margin of failure.

Sonic Weapons

Sonic beam weapons project focused sound waves to hurt, incapacitate or kill. Their range is multiplied by air pressure in atmospheres, up to a maximum of two times the listed range. They won't work in a vacuum or trace atmosphere unless physically touching the target (range C).

Sonic weapons will work underwater if designed for that medium. Underwater sonic weapons get double range, but their statistics are otherwise identical.

Sonic Nauseators (TL9)

These weapons use acoustic heterodyning technology to process ordinary audible sound into a complex ultrasonic signal. The original sound is bound within the column of ultrasonic frequencies, becoming a tight beam that can travel hundreds of yards with no distortion or loss of volume. It causes pain, temporary hearing loss, and nausea. The weapons are not as reliable for self-defense as other weapons, but are effective for riot control.

Nauseator beams are audible only to the target, and the beam is invisible. Nauseator range is multiplied by air pressure in atmospheres. It has no range in vacuum or underwater.

Nauseators emit a cone attack – see *Area and Spreading Attacks* (p. B413). The effect is a hearing-based affliction attack that ignores DR, but has no effect on someone who cannot hear. A victim gets a HT roll to resist at the penalty noted for the weapon; add +5 for Protected Hearing and +3 beyond 1/2D range. Failure means suffering the disadvantages Hard of Hearing and the Moderate Pain (p. B428) irritating condition for minutes equal to the margin of failure on the target's HT roll. Failure by 5 or more results in Deafness (making the target immune to further attacks) and retching (p. B429), plus loss of sphincter control, resulting in the Bad Smell disadvantage until cleaned up. The weapons are sometimes nicknamed "bowel disruptors" due to these unpleasant consequences.

These weapons are usually deployed as an alternative to electrolasers (p. 119), with a shorter range but wider beam and different effects.

Nauseator Weapons

Nausea Carbine (TL9): A short rifle-sized weapon. It is often used by police or troops assigned to riot squads.

Nausea Pistol (TL9): A handy pistol-sized version.

Tactical Nauseator (TL9): A tripod or vehicle-mounted riot-control weapon. It's often installed in specialized anti-riot vehicles, or set up to defend embassies and similar buildings that may be threatened by mobs of civilian attackers.

Sonic Screamers (TL9^)

These lethal sonic weapons fire a beam that vibrates, heats, and even liquefies the target. Although the primary beam is an inaudible subsonic or ultrasonic frequency, the nickname comes from a tooth-jarring whine produced as a side. Particularly baroque sonic designs may even have an audio trigger, modulating the user's battle cry or singing into an energy pulse!

These are superscience weapons. One possible explanation is that high levels of pulsed power are used to create discharges between electrodes in an insulating tube. The arcs ionize the air within the tube, causing a sudden expansion that generates a pressure pulse. Rapidly cycling these pulses creates a powerful acoustic wave in the form of a traveling vortex strong enough to damage the target.

Screamers deliver a cone attack – see *Area and Spreading Attacks* (p. B413) – that "shakes and bakes" victims, doing corrosion damage. Living targets suffer the symptoms of Hard of Hearing (p. B109) if the damage exceeds 1/2 HP or Deafness if over 2/3 HP; this doesn't heal until the injury that caused it recovers.

Screamer Weapons

Screamer Carbine (TL9^): A short, stubby weapon with a large, bell-shaped aperture; this is the most common screamer. Its short range limits its military utility. Like a shotgun, it is used for close-range hunting, home defense, and house-to-house combat.

Screamer Pistol (TL9^): A pistol-sized version, also called a "sonic disruptor pistol."

Tactical Screamer (TL9^): A heavy semi-portable weapon used by powered troopers, or mounted on a tripod or vehicle. It's also called a "tripod screamer."

Sonic Stunners (TL10)

These advanced stunners fire a narrow, intense beam of ultrasonic sound that can shut down the target's nervous system. Unlike a nauseator, a sonic stunner can affect someone who is deaf.

A hit requires a HT roll to resist at the penalty noted for the weapon. Add +3 beyond 1/2D range, and +1 per 5 DR the victim has at the point struck. If he fails, he suffers the Unconsciousness (p. B429) incapacitating condition for minutes equal to the margin of failure on his HT roll. The beam is narrow enough that if a limb or extremity is hit, it is incapacitated instead of the victim being rendered unconscious.

Sonic stunners may supplant nauseator (above) and electrolaser (p. 119) weapons.

Sonic Stun Weapons

Sonic Stun Cannon (TL10): A semi-portable weapon, usually tripod- or vehicle-mounted. Like the tactical nauseator, it's used by anti-riot vehicles and for nonlethal perimeter defense.

Dinosaur Stunner (TL10): A powerful stunner capable of stopping an elephant. Hunters use it to capture big game.

Sonic Stinger (TL10):A nonlethal alternative to the hold-out laser, the stinger is a tiny sonic stunner that can be disguised as an everyday item or strapped to the wrist.

Sonic Stunner (TL10): An effective palm-sized stunner, this self-defense weapon is also popular for covert operations. It has no grip and is held like a small flashlight or attached to the wrist.

Sonic Stun Pistol (TL10): A handgun-sized sonic stunner. It is effective enough that it can be issued as the standard sidearm for police or security guards.

Sonic Stun Rifle (TL10): A basic stun rifle. Like its electrolaser equivalents, it may be general issue to security and police.

Sonic Weapon Table

BEAM WEAPONS (PISTOL) (DX-4, other Beam Weapons-4, or Guns (Pistol)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
10	Sonic Stinger	HT-1(5) aff	1	2/6	0.02/A	1	18(3)	1	0	1	$15	4
10	Sonic Stunner	HT-2(5) aff	1	10/30	0.3/B	1	22(3)	3	-1	1	$120	4
10	Sonic Stun Pistol	HT-3(5) aff	3	30/100	1.8/C	1	66(3)	4	-2	1	$650	4

BEAM WEAPONS (PROJECTOR) (DX-4, other Beam Weapons-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9	Nausea Carbine	HT-4 aff (1 yd)	6	17/50	5/2C	1	56(3)	5†	-3	1	$2,000	4
9	Nausea Pistol	HT-3 aff (1 yd)	3	9/27	1.8/C	1	66(3)	4	-2	1	$650	4
9^	Screamer Carbine	4d cor (1 yd)	6	33/100	5/2C	1	56(3)	5†	-3	1	$4,000	4
9^	Screamer Pistol	3d cor (1 yd)	3	18/54	1.8/C	1	66(3)	4	-2	1	$1,300	4

BEAM WEAPONS (RIFLE) (DX-4, other Beam Weapons-4, or Guns (Rifle)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
10	Dinosaur Stunner	HT-6(5) aff	6	130/400	20/Dp	1	83(3)	10†	-5	1	$10,000	3
10	Sonic Stun Rifle	HT-4(5) aff	6	60/180	5/2C	1	56(3)	5†	-3	1	$2,000	4

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9	Tactical Nauseator	HT-8 aff (3 yd)	9	70/200	70/Dp	10	100(5)	18M	-8	1	$35,000	2
9	Tactical Screamer	8d cor (3 yd)	9	130/400	70/Dp	10	35(5)	18M	-8	1	$70,000	2
10	Sonic Stun Cannon	HT-8(5) aff	9	230/700	70/Dp	10	100(5)	18M	-8	1	$32,000	2

Plasma Weapons

Real plasma torches are short-range cutting tools; these weapons use plasma superscience to fire coherent streams or bolts of ionized gas.

Flamers (TL9^)

These weapons fire a low-velocity jet of high temperature plasma. Hydrogen fuel is fed into a magnetic containment chamber, heated and compressed to form a plasma, and then released as a continuous stream.

Flamers are effective incendiary and terror weapons, with a role similar to that of the flamethrower. They're also useful for disposing of vermin or microbot swarms.

Flamers inflict burning damage, but not tight-beam burning damage.

Flamer Weapons

Assault Flamer (TL9^): This rifle-sized plasma weapon is often used by armored infantry involved in spaceship boarding actions and house-to-house fighting.

Hand Flamer (TL9^): This large pistol is used as a military sidearm or a terror weapon.

*Heavy Flamer (*TL9^): An energy-based flamethrower with a backpack power supply.

Semi-Portable Flamer (TL9^): Also called a tripod flamer, this heavy, semi-portable infantry weapon can be terrifying even to a fighter in heavy armor. A heavy flamer can be mounted on a tripod or carried by a soldier in powered battlesuit. They are also popular in combat engineering and urban assault vehicles.

Plasma Flamer Table

BEAM WEAPONS (PROJECTOR) (DX-4, other Beam Weapons-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9^	Assault Flamer	5d burn	Jet	50/150	5.6/2C	1	28(3)	5†	-3	1	$2,300	2
9^	Hand Flamer	4d burn	Jet	30/90	3.3/2C	1	56(3)	6	-2	1	$1,200	3
9^	Heavy Flamer	8d burn	Jet	130/390	20/Dp	1	35(5)	10†	-5	1	$10,000	1

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9^	Semi-Portable Flamer	6d×3 burn	Jet	150/450	70/Ep	1	31(5)	18M	-8	1	$35,000	1

Plasma Guns (TL10-11^)

These weapons use a laser to zap a hydrogen pellet into a high-temperature plasma state. The plasma is magnetically confined for an instant, focused into a bolt, and then released at hypersonic velocities. When fired in atmosphere, the plasma bolt will ride a laser beam, which is used to create an evacuated channel, ensuring the plasma does not explode immediately upon contact with air.

The most powerful plasma guns are styled "fusion guns" since the star-hot temperatures in the ignition chamber are equivalent to that within a fusion reactor.

Plasma bolts have greater range, force, and accuracy than a flamer beam, but dissipate rapidly compared to laser or particle beams. However, they deliver a powerful explosive punch, thanks to their combination of thermal and kinetic energy effects, and are among the most energy-efficient beam weapons in terms of sheer destructive energy. The ionized plasma bolt can also short out electrical systems. Plasma bolts are bright and create a loud report as the bolt burns through air, followed by a noisy explosion when it strikes the target.

Plasma beam weapons first appear at TL10^ in the form of heavy weapons. At TL11^ lighter rapid-pulse versions are available. A plasma gun inflicts burning damage with the explosive damage modifier. This is *not* tight-beam burning damage. Unlike most beam weapons, plasma guns have significant recoil.

Plasma weapons do not use standard power cells. Instead, they use magazines with plasma power cartridges. Each round contains a hydrogen fuel pellet and a one-use power cell.

Personal Plasma Guns

Heavy Plasma Gun (TL10^): Favored by powered troopers as an assault rifle, or as a squad support weapon, this is one of the most devastating portable TL10 beam weapons.

Fusion Gun (TL11^): An even more powerful version of the heavy plasma gun.

Heavy Plasma Pistol (TL11^): A big plasma handgun that can blast a basketball-sized hole in a man's torso. It is almost too deadly for regular issue, and is usually found only in the wildest frontier regions.

Plasma Battle Rifle (TL11^): An rifle-sized plasma gun with a backpack power supply. It is capable of semi-automatic fire.

Plasma Pistol (TL11^): The smallest plasma gun, equivalent in size to a blaster pistol. It has a shorter range than a blaster, but delivers more destructive energy. An unarmored human struck by a plasma pistol bolt is usually nothing but charred bones.

Mounted Plasma Guns

Plasma Cannon (TL10^): This heavy vehicle-mounted weapon is a short-ranged but effective alternative to particle beams and lasers. It's usually mounted on tanks, although some spacecraft may use it for close combat.

Plasma Gatling Cannon (TL10^): A light-weight multi-barrel plasma cannon with a high rate of fire. An effective anti-missile and anti-aircraft weapon, devastating against infantry or lightly-armored vehicles.

Semi-Portable Plasma Gun (TL10^): A powerful weapon designed for use on a tripod mount or by heavy battlesuits.

Fusion Cannon, Semi-Portable Fusion Cannon, Fusion Gatling Cannon (TL11^): These advanced versions fire hotter and higher-velocity plasma bolts.

Gravity Weapons

Gravitic weapons are offensive manifestations of artificial gravity, tractor/pressor beam, or hypergravity technology.

Force Beams (TL10^)

These tightly focused pressor beams (p. 88) deliver a kinetic impact that can knock a person down or break bones. Unlike sonic stunners or electrolasers, they can affect targets in vacuum and inflict blunt trauma even through heavy armor. They're also favored by super-gadgeteers, since they're no more lethal than a powerful punch.

Force beams inflict crushing damage with the double knockback modifier. The beams are silent and invisible.

Kinetic Stun Setting (TL10^)

Any force beam can fire a kinetic stun setting that spreads the beam over a wider impact point.

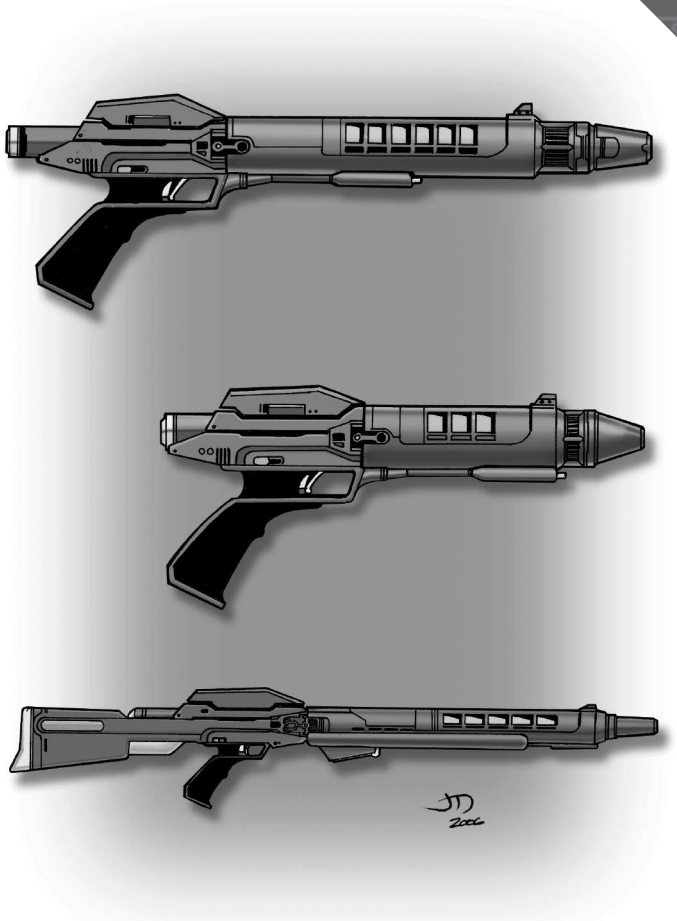
On "stun" the beam has no wounding effect (no HP are lost). It has its usual double knockback modifier, and can still inflict blunt trauma and knockback.

Force Beam Weapons

Force Beamer (TL10^): The ranged equivalent of brass knuckles. The impact of this palm-sized weapon's force beam feels like the kick of a mule.

Force Cannon (TL10^): A vehicle-mounted cannon intended to crack open vehicular armor. It's especially useful against unbalanced vehicles such as mecha.

Force Pistol (TL10^): A bulky gravity-beam handgun, favored for its impressive "stopping power." Its beam can hammer a man back 12 feet.



Force Rifle (TL10^): This weapon can stun an elephant or smash someone through a brick wall. This is a lethal weapon against foes without armor.

Heavy Force Cannon (TL10^): A force cannon suitable for mounting on ships.

Semi-Portable Force Beam (TL10^): This assault cannon is usually tripod- or vehicle-mounted, or carried by powered troopers. A human struck by its beam may be thrown back 50 feet, breaking every bone in his body.

Plasma Gun Table

BEAM WEAPONS (PISTOL) (DX-4, other Beam Weapons-4, or Guns (Pistol)-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
11^	Heavy Plasma Pistol	10d(2) burn ex	4	500/1,500	3.3/2C	3	33(3)	9	-3	2	$5,600	3
11^	Plasma Pistol	7d+2(2) burn ex	4	375/1,100	1.6/C	3	40(3)	6	-2	2	$2,200	3

BEAM WEAPONS (RIFLE) (DX-4, other Beam Weapons-4, or Guns (Rifle)-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
10^	Heavy Plasma Gun	3d×5(2) burn ex	8+3	750/2,250	20/Dp	3	20(5)	15†	-6	2	$40,000	1
11^	Heavy Fusion Gun	20d(2) burn ex	8+4	1,000/3,000	20/Dp	3	20(5)	15†	-6	2	$40,000	1
11^	Plasma Battle Rifle	3d×5(2) burn ex	8+2	750/2,250	10/2C	3	10(3)	10†	-4	2	$18,000	2

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
10^	Plasma Cannon	6d×25(2) burn ex	12	7,500/22,500	5,000/10Fp	1	40(5)	240M	-10	2	$2,000,000	1
10^	Plasma Gatling Gun	6d×5(2) burn ex	12	1,500/4,500	250/5Ep	10	100(5)	50M	-9	2	$320,000	1
10^	Semi-Portable Plasma Gun	20d(2) burn ex	12	1,000/3,000	70/Ep	3	100(5)	27M	-8	2	$140,000	1
11^	Fusion Cannon	4d×50(2) burn ex	12	10,000/30,000	5,000/10Fp	1	40(5)	240M	-10	2	$2,000,000	1
11^	Fusion Gatling Gun	8d×5(2) burn ex	12	4,000/12,000	250/5Ep	10	100(5)	50M	-9	2	$320,000	1
11^	Semi-Portable Fusion Gun	6d×5(2) burn ex	12	1,500/4,500	70/Ep	3	100(5)	27M	-8	2	$140,000	1

Gravity Beam Weapon Table

BEAM WEAPONS (PISTOL) (DX-4, other Beam Weapons-4, or Guns (Pistol)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
10^	Force Beamer	3d cr dkb	3	100/300	0.35/B	1	22(3)	3	-1	1	$150	4
10^	Force Pistol	4d+2 cr dkb	6	300/900	3.3/2C	1	56(3)	6	-2	1	$1,200	4

BEAM WEAPONS (RIFLE) (DX-4, other Beam Weapons-4, or Guns (Rifle)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
10^	Force Rifle	8d cr dkb	12	700/2,100	8/Dp	1	83(5)	7†	-4	1	$4,000	3

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
10^	Force Cannon	6d×10 cr dkb	18	18,000/54,000	1,000/Fp	1	66(5)	70M	-10	1	$500,000	1
10^	Heavy Force Cannon	6d×20 cr dkb	18	72,000/220,000	8,000/10Fp	1	83(5)	200M	-10	1	$4,000,000	1
10^	Semi-Portable Force Beam	8d×2 cr dkb	18	2,900/8,700	70/Ep	1	100(5)	18M	-8	1	$32,000	1

Graviton Beams (TL11^)

A refinement of force beam (p. 128) technology, these weapons project oscillating hypergravity fields that crush or vibrate internal organs or components while leaving the outside unharmed. Heavy graviton beams may envelop and crush a man-sized target.

Graviton beams are silent and invisible, but the victim will feel crushing pressure and suffocating pain as the beam squeezes him.

Graviton beams are focused on a discrete point in space rather than affecting everything in the beam's path.

Graviton beams inflict crushing damage with the No Knockback damage modifier. Although their damage is low, they are a cosmic attack that ignores all normal DR. Force screens protect against them, but do so at 1/100 of normal DR.

Graviton Beam Weapons

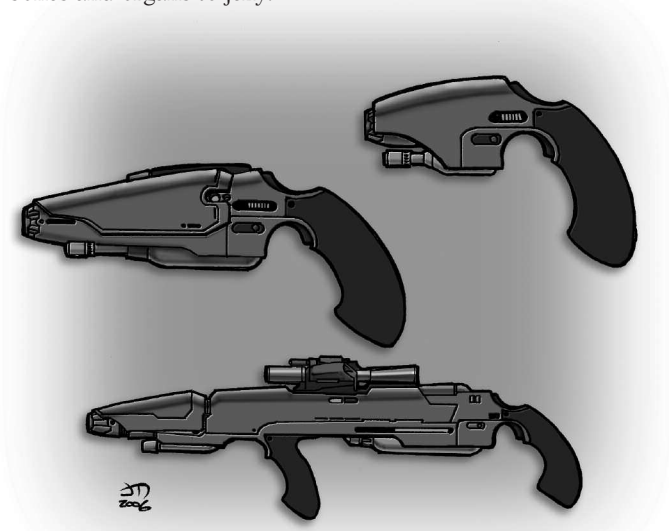
Graviton Beamer (TL11^): A pocket-sized holdout weapon. It has limited lethality, but can reach through the heaviest armor to grind bones and squeeze organs. It is sometimes used as a torture device.

Graviton Cannon (TL11^): Also called an "implosion beam." A single shot can reduce a man to a walnut-sized sphere, or crush a spaceship's insides one compartment at a time!

Graviton Pistol (TL11^): A basic gravity-beam pistol, somewhat more powerful than a beamer. One shot will usually cause enough shock to stop an average person.

Graviton Rifle (TL11^): Also called an assault grav-beamer. It crushes a fist-sized area, inflicting enough damage to leave a man unconscious!

Semi-Portable Graviton Beam (TL11^): A heavy personal weapon with a foot-wide area of effect. Its beam can reduce bones and organs to jelly.



Graviton Weapon Table

BEAM WEAPONS (PISTOL) (DX-4, other Beam Weapons-4, or Guns (Pistol)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
11^	Graviton Beamer	1d(∞) cr	1	100/300	0.35/B	1	22(3)	3	-1	1	$600	3
11^	Graviton Pistol	1d+2(∞) cr	6	200/600	1.5/C	1	57(3)	4	-2	1	$2,200	3

BEAM WEAPONS (RIFLE) (DX-4, other Beam Weapons-4, or Guns (Rifle)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
11^	Graviton Rifle	3d(∞) cr	12	700/2,100	8/Dp	1	83(5)	7†	-4	1	$16,000	2

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
11^	Graviton Cannon	6d×5(∞) cr	18	72,000/220,000	8,000/10Fp	1	83(5)	200M	-10	1	$1,800,000	1
11^	Semi-Portable Graviton Beam	6d(∞) cr	18	2,900/8,700	70/Ep	1	100(5)	18M	-8	1	$130,000	1

Nucleonic Beams

Like nuclear dampers (p. 193), these weapons interfere with the strong or weak nuclear forces that bind matter together.

Disintegrators (TL12^)

Disintegrators fire a beam that causes matter to disintegrate. The process is not instant, but most weapons can destroy a man-sized target in a second. Denser materials take a bit longer to flash out of existence, but the hardness doesn't matter.

Disintegrators use a narrow focusing beam, but the disintegration effect can encompass a larger area, and may be selectively specified at the moment of firing. A shot can disintegrate a person without affecting the floor he's standing on, or vaporize someone's weapon, or even take out two people standing together. This is an area effect attack (p. B413) with the Selective Area (p. B108) enhancement.

Disintegrators inflict corrosion damage with a cosmic armor divisor (∞) that ignores DR, except for force screens (p. 190) and stasis webs (p. 193). Force screens protect with 1/10 of normal DR; stasis webs completely block them. Anyone reduced to -10×HP or less is disintegrated; otherwise, the beam bores a hole into or through the victim. They inflict large-area injury (p. B400); unless noted otherwise, they can focus on a one-yard radius.

Disintegrators require tremendous amounts of energy, and use cosmic power cells (p. 19).

Weapons

Disintegrator Pistol (TL12^): Perhaps the ultimate handgun, this weapon fires a beam that can obliterate a man.

Disintegrator Rifle (TL12^): This rifle can destroy a light armored vehicle in a single shot, or completely disintegrate smaller targets such as people.

Heavy Disintegrator Cannon (TL12^): This terrifying weapon may be the main armament of TL12^ military starships and main battle tanks. Almost any target will be annihilated unless protected by force screens; a barrage can lay waste to a city.

Holdout Disintegrator (TL12^): A small, easily concealed weapon of unmatched destructive power for its class.

Light Disintegrator Cannon (TL12^): A smaller version of the heavy disintegrator cannon. It is still capable of disintegrating a tank-sized target in a single shot.

Semi-Portable Disintegrator (TL12^): An oversized weapon carried by powered troopers, or mounted on a tripod or vehicle. It can disintegrate a car-sized vehicle, or drill a hole several feet across through a larger target.

Disintegrator Table

BEAM WEAPONS (PISTOL) (DX-4, other Beam Weapons-4, or Guns (Pistol)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
12^	Disintegrator Pistol	6d×6(∞) cor	6	1,000/3,000	2.5/2C	10	22(3)	4	-2	1	$5,000	2
12^	Holdout Disintegrator	7d×5(∞) cor	3	500/1,500	1/C	10	17(3)	3	-1	1	$1,500	2

BEAM WEAPONS (RIFLE) (DX-4, other Beam Weapons-4, or Guns (Rifle)-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
12^	Disintegrator Rifle	6d×7(∞) cor	12	5,000/15,000	5.6/2C	10	10(3)	5†	-3	1	$4,600	1

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
12^	Heavy Disintegrator Cannon	6d×200(∞) cor	18	720,000/2,200,000	8,000/10Fp	10	83(5)	200M	-10	1	$40,000,000	0
12^	Light Disintegrator Cannon	6d×100(∞) cor	18	180,000/540,000	1,000/Fp	10	66(5)	70M	-10	1	$5,000,000	0
12^	Semi-Portable Disintegrator	6d×40(∞) cor	18	30,000/90,000	70/Ep	10	100(5)	18M	-8	1	$320,000	1

Conversion Beams (TL12^)

These weapons convert a few milligrams of the target into antimatter or energy. Either way, the result is a devastating explosion. Conversion beams are almost identical to the disintegrators described above, but they have a (10) armor divisor instead of ignoring DR. They also inflict follow-up dice of burning damage equal to their corrosion damage, with no armor divisor but with the explosion, radiation, and surge damage modifiers.

Reality Disruption Beams

These exotic weapons cause localized space/time warps or probability disruptions. They're often related to FTL, matter transmitter, parachronic, or time travel technology.

Ghost Particle Beam (TL11^)

This fires a beam of exotic particles that passes through solid material as if it wasn't there. After a fraction of a second, the particles decay into an explosive combination of high-energy particle-antiparticle pairs and gamma rays. Probability field manipulation ensures the particles decay nearly simultaneously at a desired point in space and time . . . inside the target.

These are indirect-fire weapons operated using Artillery skill. A ghost particle beam is not affected by atmosphere and ignores intervening cover. It is also invisible and intangible – the only visible effect is a brilliant explosion inflicting burning damage with the cosmic, radiation, and surge modifiers. The cosmic modifier means that if the beam hits the desired target, *ignore* the target's DR; it is an internal explosion, doing three times normal damage (see p. B415). This only applies on a direct hit. Do not ignore DR for the collateral damage from the explosion. Reality-stabilized force screens (pp. 190-192) protect against ghost particle beams with one-fifth of the screen's normal DR.

Weapons

Ghost particle beams require precise stabilization and targeting systems. They are only available as vehicle-sized weapons.

Reality Disintegrator (TL12^)

These weapons erase the target from existence. Some alter probability so that the target no longer exists, at least in this universe! Others project a field of "nothingness" incompatible with the existence of normal matter, or are ranged matter transmitters that will scatter a target's component particles across space.

Reality disintegrators are identical to disintegrators (p. 130), except for the defenses effective against their cosmic armor divisor. Force screens and DR protect only if they are reality-stabilized (p. 192).

If reality disintegrators disrupt probability or scatter the target across multiple dimensions, someone with Temporal Inertia (p. B93) may be immune!

Displacer (TL12^)

A displacer is a matter transmitter weapon that rips open a warp in space and sends its target *elsewhere*. It is targeted on an area rather than an individual – use the Area Effect rules (pp. B413-414).

A wormhole forms at the target point. Anything inside is sucked into the rift. If an object's shortest dimension is greater than the radius of effect, it is too large to fit through the warp and will be unaffected. A displacer *will* affect a target in a stasis field, provided the field diameter is small enough.

A reality stabilizer (p. 194) or reality-stabilized force screen (pp. 190-192) can protect against a displacer: roll against the reality stabilizer's HT (usually HT 12) to resist the beam.

Where a particular displacer transports its target is up to the GM. Interstellar space, another parallel dimension, the heart of a sun, the past, or solid ground a few miles (or light years) away are all possibilities. The attacker does not have any control over the effect, but it's usually more fun to send heroes and important NPCs to interesting places than to kill them.

The effect might be totally random, or it might follow specific rules, such as warping the target into the same place but 10d centuries into the past, or into an adjacent parallel world. If the effect is too safe and predictable, however, characters may start to use it as a cheap form of transportation. If displacers send their victims very, very far away, some societies might use displacers as a punishment: a cross between exile and disintegration! It is also possible that the inventors and users of displacers may *think* they have a space/time disruptor . . . not knowing that the targets may survive!

Weapons

Displacer Cannon (TL12^): A heavy displacer cannon, capable of creating a warp large enough to spirit away a small house or a tank-sized vehicle!

Portable Displacer (TL12^): This bulky, barely man-portable weapon tears open a two-yard radius wormhole. It's sometimes nicknamed a "tachyon shotgun."

Ghost Particle Weapon Table

ARTILLERY (BEAMS) (IQ-5)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
11^	Ghost Particle Cannon	6d×10(∞) burn ex	15	18,000/54,000	1,000/Fp	10	66(5)	70M	-10	1	$1,000,000	1
11^	Heavy Ghost Particle Cannon	6d×20(∞) burn ex	15	72,000/220,000	8,000/10Fp	10	83(5)	200M	-10	1	$8,000,000	1

Displacer Weapon Table

BEAM WEAPONS (RIFLE) (DX-4, other Beam Weapons-4, or Guns (Rifle)-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
12^	Portable Displacer	spec. (2 yd.)	18	200	70/2Dp	1	8(5)	15†	-8	1	$100,000	1

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
12^	Displacer Cannon	spec. (10 yd.)	18	1,000	8,000/F	1	8(5)	M	-10	1	$12,000,000	1

Psionic Beams

These psychotronic devices work on the same principles as psi abilities.

Mind Disruptors (TL12^)

These weapons are similar to neural disruptors (p. 121), but instead of emitting electromagnetic fields, they are psionic in nature. They are very effective against opponents who lack psionic shielding, but do not affect anyone with IQ 0 or the Digital Mind advantage.

Different versions of mind disruptor are available. All require a Will roll to resist (at +3 beyond 1/2D range). Mind Shields add to the roll to resist. Normal DR is ineffective against them. The options are:

Hypnogogic Beam ("Eraser"): The standard mind disruptor fires a beam of telepathic noise. It's sometimes called a dazer or eraser. If the victim fails to resist, he suffers the Daze incapacitating condition (p. B428). He is unable to act until struck or shaken, or until a number of *minutes* pass equal to the margin of failure. If he fails by 5 or more, he falls unconscious (p. B429), and then will be dazed as above after recovery. The dazer also disrupts short-term memory: victims never remember what happened to them during the second they were shot, or the second before that. This can be useful for covert operations!

Death Beam: This beam carries a hypnotic compulsion to die. If the resistance roll fails, the victim suffers the Choking incapacitating condition (p. B429) for seconds equal to twice the margin of failure. There's nothing lodged in his throat, but he will lose 1 FP per second unless he doesn't need to breathe. If he fails by 5 or more, he suffers the heart attack mortal condition.

Insanity Beam: This beam unleashes bizarre and terrifying visions from the victim's subconscious mind. He suffers the hallucinating incapacitating condition (p. B429) for one minute times the margin of failure. If he fails by 5 or more, the result is a coma (p. B429) in which he is tormented by horrific dreams. If the subject survives the coma, he gains the Nightmares (12) disadvantage for 1d weeks after.

Tunable Mind Disruptors

Add +50% to cost for each extra setting that a mind disruptor possesses. It takes one second and a Ready maneuver to change settings.

Psionic Neutralizer

If psychotronic technology exists, *psionic neutralizer* is another possible setting for neural disruptors or mind disruptors. This beam scrambles the areas of the target's nervous system that control psi powers. Anyone struck loses all his psionic powers for a number of minutes equal to the margin of failure.

Mind Disruptor Weapons

Mind disruptors come in the same models as neural disruptors (p. 121), from tiny holdout disruptors to heavy projectors. See the table below for statistics.

Mind Disruptor Table

BEAM WEAPONS (PROJECTOR) (DX-4, other Beam Weapons-4)

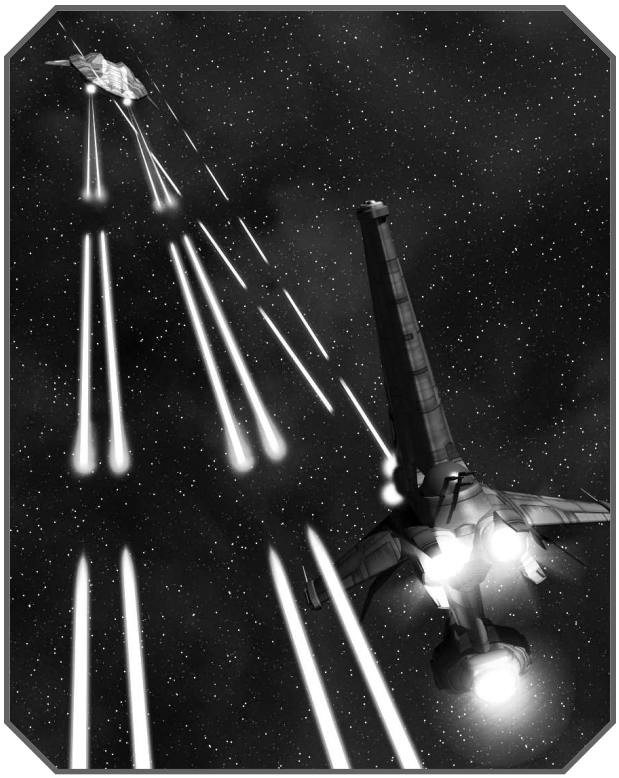
TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
12^	Heavy Mind Disruptor	Will-6 aff	12	90/270	20/Dp	1	83(3)	10†	-5	1	$100,000	2
12^	Holdout Mind Disruptor	Will-2 aff	3	10/30	0.3/B	1	22(3)	3	-1	1	$1,200	2
12^	Mind Disruptor Pistol	Will-3 aff	6	23/70	1.8/C	1	66(3)	4	-2	1	$6,500	2
12^	Mind Disruptor Rifle	Will-4 aff	12	40/120	5/2C	1	56(3)	5†	-3	1	$20,000	2

GUNNER (BEAMS) (DX-4, or other Gunner-4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
12^	Tactical Mind Disruptor	Will-8 aff	18	160/480	70/Dp	10	100(5)	18M	-8	1	$320,000	1

Options

These options can be combined with TL9-12 or superscience beam weapons to create extremely powerful or efficient weapon systems. It's possible to add superscience upgrades to weapons that do not themselves require superscience. For example, a laser rifle (TL10) may be upgraded with grav focus (TL10^) technology.



Superscience Power Cell (TL^)

Many science fiction settings assume beam weapons can fire continuously for extended periods. The superscience power cell option multiplies the weapon's number of shots by 5. Note that the Shots listed for all beam weapons in the ***GURPS Basic Set*** assume superscience power cells; divide Shots by 5 if using mundane cells.

Field-Jacketed (TL10^)

A field-jacketed beam is enclosed in a force field or space-folding effect that prevents interference with atmosphere (or lack of atmosphere, as the case may be). This technology allows ultraviolet, X-ray, and gamma-ray lasers to be effective in atmosphere, and charged particle beams, electrolasers, and sonic weapons to work normally in vacuum. Beam weapons that cannot otherwise function underwater also do so at normal efficiency.

At the GM's option, field-jacketing a laser or other beam may make it visible, even in vacuum. This may explain the pretty colors observed in space opera movies!

Field-jacketing can be added to all beam weapons (although some types may not need it). It's a standard superscience space opera effect, and doesn't have to cost anything. A field-jacketed weapon may also be twice as expensive as one without this feature.

Gravitic Focus (TL10^)

This uses a hypergravity field to create a synthetic virtual lens that can focus and/or accelerate an energy beam. The technology trades beam energy for range, and permits space battles over thousands or millions of miles, rather than hundreds.

Grav-focusing is available for any type of laser, for microwave beams, and for any type of particle beam. It is usually used only on larger weapon systems, such as vehicular laser cannon.

Each level of grav-focus halves the damage but multiplies the range by 10. Up to (TL-9) levels of grav focus are possible. Gravity focus can always be turned off. If so, the weapon inflicts its normal damage. Each level *doubles* the weapon's cost.

FTL (TL11^)

Any beam weapon may take this option. The beam travels instantly to the target at many times light speed. Treat the beam as field-jacketed (above) – that is, it ignores any of the usual environmental restrictions that might affect it (so a laser beam can travel underwater, etc.). In addition, its 1/2D range becomes the same as its max range. Accuracy does not increase, but the user suffers only half the usual speed/range penalties. For example, a target 100 yards away is -5, not -10.

These beams may be subject to setting-specific restrictions similar to those that apply to faster-than-light travel. They usually only function in vacuum (although the GM may rule otherwise) and may only function when far away from a sizable gravity well, such as that of a planet. These beams also imply the existence of instantaneous faster-than-light communications and sensors, which would use similar technology.

Hotshots and Overheating

Ordinary beam weapons have cooling systems, but sustained fire can overheat them. The GM can ignore heat in most situations, but have the weapon overheat if dramatically appropriate. In general, firing more than (RoF × 10) shots will overheat the weapon. This can be avoided by either a 10-second pause between each attack, or by not firing any shots for a full minute.

Beam weapons can be overloaded to fire *hotshots*. A hotshot counts as two shots. Multiply damage (or radius of effect, or HT/Will penalty) by 1.3, or add +1 damage per die. When firing a hotshot, the weapon has a malfunction number of 14. Plasma guns that use power cartridges cannot fire hotshots, but can be loaded with "hot" power cartridges (p. 127) which have the same effect.

Some beam weapons are "Gatlings." They do not overheat, but they may not fire hotshots.

Effects of Overheating: If a beam weapon has overheated, it can still be fired, but will malfunction on a 14 or more (12 or more if firing hotshots while overheated) until it has been allowed to cool for at least a minute.

If a beam malfunctions, roll on the table on p. B407.

Fluid Projectors

These weapons project streams of liquid or gas. They are fired using Liquid Projector skill (p. B205).

Sprays

These are pressurized aerosol spray cans or tanks. Their utility as ultra-tech weaponry comes from exotic biochemical or nanotech fillers.

Weapons

Pocket Aerosol (TL9): A palm-sized disposable tank that sprays a single dose. It is used for black ops or self-defense. Respiratory agents must be sprayed into the face, but there's no location penalty to hit due to the size of the cloud. Contact agents can be sprayed onto the body.

Spray Can (TL9): The size of a can of bug spray, it holds 10 doses of gas. It can spray up to three doses at once to fill a one-yard radius. The cloud lasts 10 seconds indoors, but dissipates quickly in a strong wind.

Spray Tank (TL9): A spray gun attached by a short hose to a tank, which can be worn as a backpack. The tank has DR 10, but is under pressure: any penetrating damage can rupture it, releasing the entire store of chemicals. This has the same effect as a 100mm biochemical warhead (p. 153). Spray tanks are often integrated into buildings as part of their security systems.

Vortex Ring Projectors

These advanced gas projector weapons consist of a reservoir tank, a chamber for mixing the delivery gas with a propellant, and a wave-shaping chamber that forms the ejected cloud into a *vortex ring* – a high-velocity smoke ring. This allows the weapon to deliver doses of gas at long range. Vortex rings retain their momentum and cohesion for a long distance, and are not affected by light winds. They break up, depositing their payload, on direct collision with a solid object . . . but will bounce from a glancing impact. Thus, they can be bounced around corners, if the user is skilled and knows where his target is. Each bounce gives -2 to hit and -10% to range per bounce; e.g., a weapon with Range 30 could bounce four times at -8, but this would limit the total path length to 18 yards.

Vortex ring projectors can fire almost any gas. Some of the more exotic "gas missiles" include carbon dioxide to choke internal combustion engines, Halon to extinguish fires, and even explosive vapors. On a smaller scale, vortex ring projectors may be the enabling technology behind high-efficiency medical inhalers.

Vortex ring projectors are regular ranged weapons that deliver a linked area-effect release of whatever gas they are loaded with. The vortex ring also has enough velocity to inflict crushing damage with double knockback.

Weapons

Underbarrel Vortex Ring Projector (VRP) (TL9): A vortex ring projector that can be clamped under the barrel of a rifle or other long arm in place of a grenade launcher. Use the Bulk, ST, and sighting bonuses of the weapon it is installed in.

Vortex Pistol (TL9): A vortex ring sidearm the size of an ordinary automatic pistol.

Backpack Vortex Ring Projector (TL9): A heavy flamethrower-like device sometimes used by combat engineers or police for house-to-house fighting or riot control. It's also occasionally used for non-combat applications, such as projecting fire-extinguishing foam.

Fluid Projector Table

LIQUID PROJECTOR (SPRAYER) (Defaults to DX-4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9	Backpack Vortex Projector *linked*	spec. (2 yards) 1d-3 cr dkb	3	30	12/12p	1	10(5)	10†	-4	1	$1,200	3
9	Pocket Aerosol	spec.	Jet	1	0.1	1	1	1	-1	1	$10	4
9	Spray Can	spec. (1 yard)	Jet	2	1/0.5	1	10(5)	2	-2	1	$25	4
9	Spray Tank	spec. (1 yard)	Jet	3	8/5	1	10(5)	4	-4	1	$400	4
9	Underbarrel Vortex Projector *linked*	spec. (1 yard) 1d-3 cr dkb	2	20/40	5/3	1	10(3)	–	–	1	$150	4
9	Vortex Pistol *linked*	spec. (1 yard) 1d-3 cr dkb	2	15	1.8/0.8	1	5(3)	7	-2	1	$100	4

Guns and Launchers

The simplest way to kill or injure at a distance is with a projectile. Guns and launchers can carry inert slugs, explosives, or chemical weapon. The difference between them is that a launcher fires a self-propelled projectile, such as a rocket, that continues to accelerate after it has left the weapon.

Guns and launchers are described with the name of the weapon followed by a designation for the ammunition it fires. The designation is a projectile diameter in millimeters and a letter code used to differentiate it from others of the same diameter. The damage on the weapon tables assumes a solid projectile, but all guns and launchers (except ice guns) may also fire weapons with more exotic warheads. See *Warheads and Ammunition*, pp. 152-159.

Ammunition Tables

Projectile weapons require ammunition. The weight of a loaded magazine of ammunition is given in the Weapon Tables, after the weapon's weight. The price of ammunition is not included, however, and adventurers may also wish to buy individual rounds.

Ammunition Tables provide the following information about individual rounds of ammunition:

TL: The tech level of the ammunition.

Name: The name of the ammunition, e.g., 7mmCL.

WPS: The weight per shot, in pounds.

CPS: The cost per shot, in dollars. This is increased if using specialized warheads (pp. 152-159).

LC: The legality class of the ammunition (if firing ordinary solid projectiles).

Different weapons can't share magazines except where indicated, but if the ammunition is identical, it's possible to remove individual rounds from one magazine and load them into another; e.g., ammo taken from any 7mmCL weapon will work in any other 7mmCL weapon.

Conventional and ETC Guns

These weapons use the expanding gases from a burning chemical propellant to push a projectile down a barrel. In many ultra-tech settings, ordinary TL7-8 slug throwers continue to be used even at high TLs; see ***GURPS High-Tech*** for a full range of suitable hardware.

Conventional Small Arms (TL9)

These firearms are conservative, evolutionary developments of mid-TL8 weapons. They use light polymer-cased or caseless telescoped ammunition, in which a projectile is embedded into a block of solid propellant. This reduces the ammunition's weight and bulk so that more shots can be carried. The propellant is ignited with an electrical system; this is integrated into the weapon's smartgun electronics and uses the same power cell.

Preloaded Barrels: Some conventional guns replace their ammunition feed and ejection systems with alternating propellant charges and projectiles stacked *inside* the gun barrel. These are fired electronically, singly or in very rapid sequence. The theoretical rate of fire can exceed a million rounds per minute, but the shots that fit into a barrel limit the effective rate of fire! In practice, the rounds can be fired fast enough that any recoil impulse is minimized. The whole barrel must be changed to reload; most guns of this sort have more than one barrel.

Pistols

These ultra-tech versions of 20th-century handguns feature advanced composite construction and caseless ammunition.

Heavy Pistol, 10mmCLP (TL9): This powerful pistol uses the same round as the machine pistol (below).

Holdout Pistol, 7.5mmCLP (TL9): This is a small, easily concealed semi-automatic pistol. It files rounds at a higher velocity than many TL7-8 pistols of the same caliber.

Magnum Pistol, 15mmCLP (TL9): This semi-automatic pistol fires a powerful magnum round. Its size makes it hard to conceal, and only a strong person can shoot accurately with it.

Medium Pistol, 7.5mmCLP (TL9): The standard TL9 semi-automatic pistol, with a sturdy plastic and alloy frame and a high-capacity magazine.

Submachine Guns

These are compact fully-automatic assault weapons with pistol grips, folding front foregrips, and retractable telescoping stocks. They are favored by special forces, police SWAT teams, and criminals.

Machine Pistol, 10mmCLP (TL9): This weapon fires the same medium-velocity pistol-caliber round as the 10mm pistol. Police SWAT teams like them – the gun has good stopping power, but errant rounds are unlikely to tear through walls (or targets) and hit bystanders.

Personal Defense Weapon (PDW), 5.7mmCL (TL9): A PDW fires a small, high-velocity bullet that resembles a miniature rifle round, with better accuracy and range than the pistol ammo used in a submachine gun. This weapon has a big magazine that runs horizontally alongside the weapon. An ergonomic handgrip completely encloses the firing hand.

Urban Assault Weapon, 10mmCLP (UAW): A double-barrel weapon with a 10mm machine pistol and 18.5mm shotgun (use the underbarrel shotgun statistics). It's intended for use by SWAT teams and special operations soldiers, especially in buildings.

Rifles

These weapons incorporate shoulder stocks, and are designed to be used two-handed. Too large to holster, they come with carrying slings.

Anti-Materiel Rifle, 15mmCL (TL9): The 15mm AMR is a large-caliber sniper weapon powerful enough to cripple light vehicles more than a mile away. Special forces and recon units use them to pin down or neutralize high-value targets such as command posts, guided-missile teams and combat robots. This gun becomes especially fearsome when upgraded with electrothermal or liquid propellant! The rifle's Acc assumes an integral 8× telescopic sight (+3 bonus).

Assault Carbine, 7mmCL (TL9): This bullpup-configuration assault rifle is a basic but effective infantry weapon.

Gatling Carbine, 5.7mmCL (TL9): This triple-barreled, electric-motor-driven chaingun boasts a carbine format no larger than an ordinary assault rifle. It fires the same 5.7mm round as the PDW (p. 135). Its long magazine slides and locks into the back of the weapon. A separately loaded B cell provides power for 19,500 shots.

Hunting Rifle, 7mmCL (TL9): This plastic-and-alloy semi-automatic rifle fires the same high-velocity ammunition as the assault carbine.

Payload Rifle, 25mmCL (TL9): A bulky semi-automatic rifle, similar to an anti-materiel rifle, that fires a medium-velocity 25mm cannon shell. This provides a long-ranged alternative to a grenade launcher. It has a very effective muzzle brake.

Storm Carbine, 10mmCL (TL9): Sometimes you need more punch than an assault carbine can provide. This weapon fires a more powerful 10mm caseless round, making it popular with troops who expect to face armored opponents. Its drawbacks include heavier ammunition and noticeably higher recoil.

Storm Rifle, 10mmCLR (TL9): A heavier semi-automatic version of the storm carbine, this fires a higher-velocity, full-sized ("10mm Caseless Long Rifle") bullet. It's used as a sniper or hunting weapon.

Machine Guns

These automatic weapons are designed to be fired in long bursts from a bipod or tripod mount. They use an ammunition belt, which is sometimes contained within a cassette. When firing on the move, machine guns can be carried in an articulated weapon harness or a gyrostabilized weapon harness (p. 150).

Assault Cannon, 25mmCL (TL9): This is a tripod- or vehicle-mounted automatic cannon firing medium-velocity shells, similar to those of the payload rifle (above).

Light Support Weapon (LSW), 7mmCL (TL9): This light machine gun comes with a folding bipod for accurate prone firing. The LSW normally employs a belt feed, but it fires the same bullet as the assault carbine (above), and can use its magazines if necessary.

Minigun, 7mmCL (TL9): This portable, tripod-mounted Gatling gun boasts six rotating barrels and an electric action, firing up to 100 rounds per second. A separately loaded C cell powers it for up to 15 minutes.

Storm Chaingun, 10mmCLR (TL9): This is an electric-motor-driven, machine-gun version of the storm rifle (above). It uses a 100-shot belt contained within an ammo cassette. It can also use the same 30-shot 10mmCLR magazines as the storm rifle, but it cannot fire storm-carbine ammunition. The storm chaingun incorporates a folding bipod for accurate prone firing. A separately loaded B cell provides 15 minutes of power.

Heavy Chaingun, 15mmCL (TL9): This electric-motor-driven, single-barrel machine gun fires the same round as the anti-materiel rifle. It is used for perimeter defense or as a vehicular weapon. Normal humans can't handle its weight without a tripod, but powered troopers can use it as a handheld weapon. A separately loaded C cell provides 15 minutes of power.

Shotguns

Shotguns are a special category of slugthrower: low-powered, short-barrel smoothbores firing large rounds, often with multiple projectiles. Most ultra-tech conventional shotguns fire 18.5mm (12 gauge) plastic-cased ammo.

Civ Shotgun, 18.5mmPC (TL9): A semi-automatic shotgun used as a hunting and police weapon, although it also finds its way into the hands of criminals who can't get anything better. It is fitted with a plastic shoulder stock.

Close Assault Weapon (CAW), 18.5mmPC (TL9): A fully-automatic assault shotgun favored for house-to-house fighting.

Underbarrel Shotgun, 18.5mmPC (TL9): A modular pump-action shotgun that can be clamped under any weapon with Bulk -3 or more. Use the Bulk, ST, and sighting bonuses of the weapon it is installed in.

Shotgun Pistol, 18.5mmPC (TL9): A wide-bore pistol that fires shotgun ammunition. It is ideal for house-to-house work or for firing from a vehicle. It's also a favorite police undercover weapon, despite its substantial recoil.

Mortars and Grenade Launchers

Underbarrel Grenade Launcher (UGL), 25mmPC: This is a tube-fed pump-action grenade launcher firing medium-velocity plastic-cased shells. It may be clamped under the barrel of any weapon with Bulk -3 or more. Use the Bulk, ST, and sighting bonuses of the weapon it is installed in.

Underbarrel Grenade Launcher (UGL), 40mmPLB (TL9): This grenade launcher fires low-velocity shells. Like its 25mm counterpart, it's designed to be clamped under another weapon with Bulk -3 or more. Each "magazine" is actually a preloaded barrel stacked with five 40mm shells and propellant charges. It can fire up to three grenades before any recoil impulse is felt. Use the Bulk, ST, and sighting bonuses of the weapon it is installed in.

Mortar Box, 40mmPLB (TL9): A four-tube version of the 40mm UGL. Designed for remote control firing, it has a cable jack and its own short-range radio (p. 44).

Mortar Box, 64mmPLB (TL9): A larger version of the 40mm mortar box, consisting of a pod holding six mortar barrels, each containing five stacked 64mm shells. This potent "area denial weapon" can deliver as many as 30 shots in a single salvo!

Cannon

Tank Cannon, 100mm (TL9): A medium tank gun with an automatic loader. It is often upgraded with liquid propellant or electrothermal options, or loaded with APEP (p. 152) ammunition.

Light Anti-Armor Weapons

Splat Gun, 15mmPLB (TL9): Designed to destroy light armored vehicles and battlesuit troopers, this is a favorite weapon of mercenaries fighting on low-tech worlds. It is a bulky, multi-barrel weapon resembling a short, thick bazooka, with a pistol grip, a padded shoulder stock, and a bipod. Nicknamed the "splat gun," it has six preloaded barrels stacked with 15mm shells and propellant. Its electronic ignition can fire up to 30 shells before any recoil impulse is felt. The shooter can also fire a smaller number of shells by adjusting a selector switch (this is a Ready action).

Conventional Smallarm Table

GUNS (PISTOL) (DX-4, or most other Guns at -2)

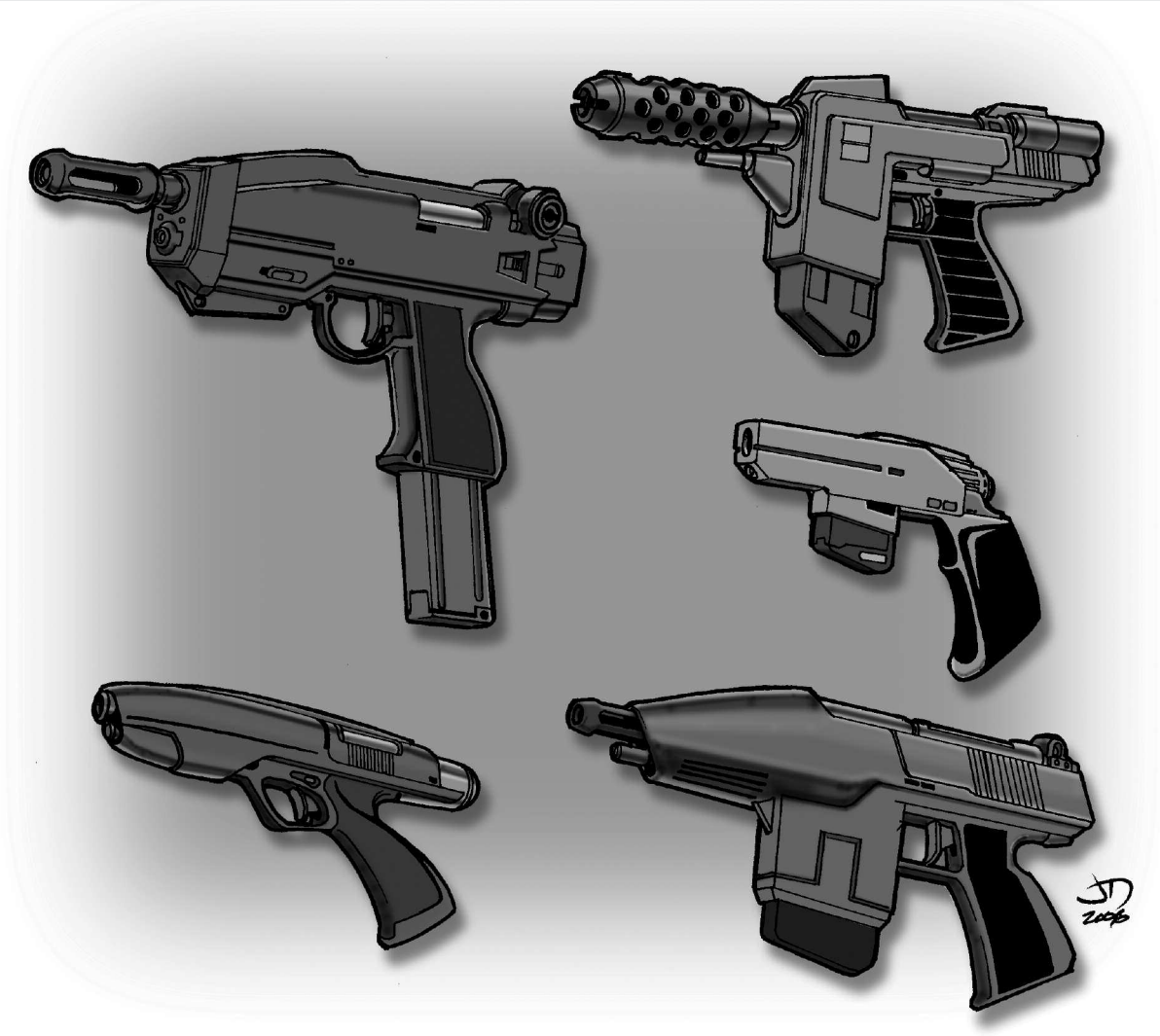
TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9	Heavy Pistol, 10mmCLP	3d pi+	2	180/2,000	2.5/0.7	3	20+1(3)	10	-2	3	$540	3
9	Holdout Pistol, 7.5mmCLP	2d pi-	1	100/1,200	1/0.2	3	18+1(3)	6	-1	2	$240	3
9	Magnum Pistol, 15mmCLP	4d+1 pi++	2	235/2,600	3/1	3	9+1(3)	11	-3	4	$870	3
9	Medium Pistol, 7.5mmCLP	2d+2 pi-	2	150/1,900	2/0.5	3	30+1(3)	9	-2	2	$450	3

GUNS (SMG) (DX-4, or most other Guns at -2)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9	Machine Pistol, 10mmCLP	3d pi+	2	180/2,000	3/1	10	30+1(3)	10	-2	3	$750	2
9	Personal Defense Weapon, 5.7mmCL	4d pi-	4	350/3,000	4.5/1	10	100+1(5)	9†	-3	2	$1,000	2
9	Urban Assault Weapon,											
	SMG barrel, 10mmCLP	3d pi+	4	200/2,100	8/1	10	40+1(3)	9†	-3	3	$2,100	2
	Shotgun barrel, 18.5mmPC	4d+4 pi++	2	100/500	– /0.75	2	5+1(3i)	10†	–	1		

GUNS (RIFLE) (DX-4, or most other Guns at -2)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9	Anti-Materiel Rifle, 15mmCL	15d pi++	6+3	2,000/9,000	30/2	3	10(3)	12B†	-6	4	$8,000	3
9	Assault Carbine, 7mmCL	6d pi	4	700/4,000	7/1.5	15	50+1(3)	9†	-4	2	$1,600	2
9	Gatling Carbine, 5.7mmCL	4d pi-	4	350/3,000	10/2	40	200(5)	9†	-4	2	$2,400	1
9	Hunting Rifle, 7mmCL	6d+1 pi	5	750/4,200	7/0.3	3	10+1(3)	9†	-5	2	$800	3
9	Payload Rifle, 25mmCL	10d pi++	4	700/8,500	38/10	3	8+1(3)	12B†	-6	4	$8,000	2
9	Storm Carbine, 10mmCL	7d pi+	4	700/2,100	8/2	10	50+1(3)	10†	-4	3	$1,800	2
9	Storm Rifle, 10mmCLR	9d pi+	5	1,300/5,800	10/1.2	3	12+1(3)	10†	-5	3	$2,700	3



GUNS (SHOTGUN) (DX-4, or most other Guns at -2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	Civilian Shotgun, 18.5mmPC	4d+4 pi++	3	100/500	6/0.75	3	5+1(3)	10†	-5	4	$450	3
9	Close Assault Weapon, 18.5mmPC	4d+4 pi++	3	100/500	10/1.5	10	10+1(3)	11†	-5	4	$800	2
9	Shotgun Pistol, 18.5mmPC	4d pi++	1	100/500	4/0.7	3	5+1(3)	10	-3	5	$330	3
9	Underbarrel Shotgun, 18.5mmPC	4d+4 pi++	2	100/500	1.5/0.75	2	5+1(3i)	10†	–	4	+$300	3

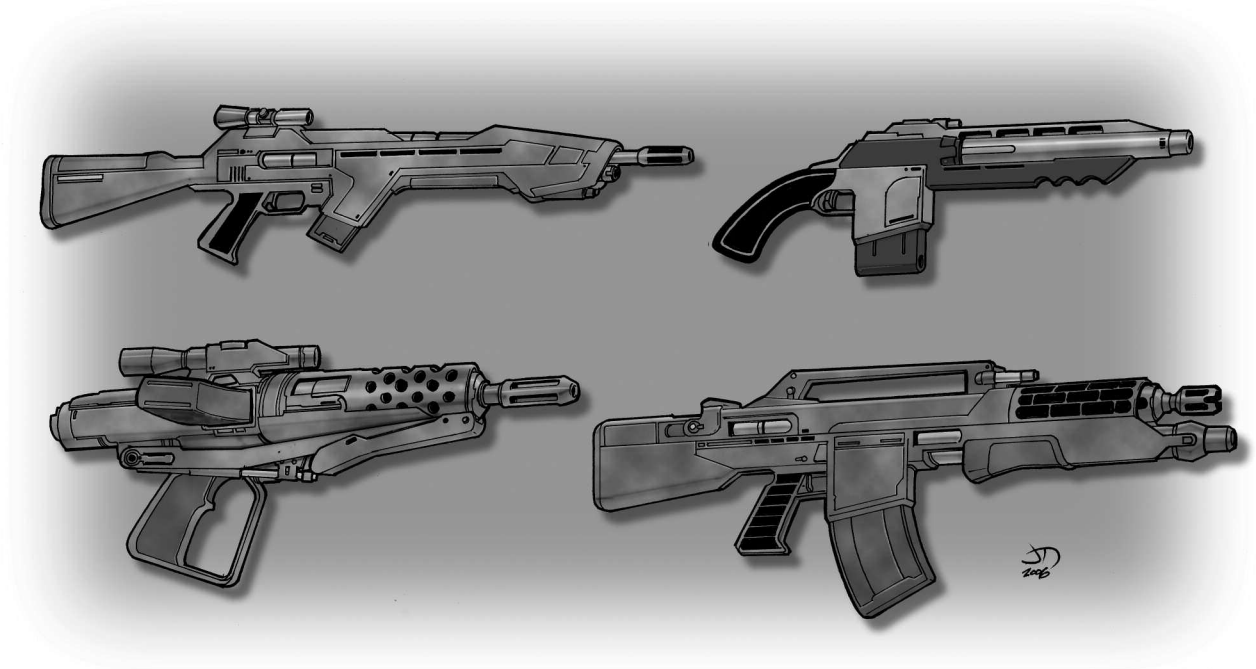
Infantry Support Weapons Table

GUNS (GRENADE LAUNCHER) (DX-4, or most other Guns at -4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	Underbarrel Grenade Launcher, 25mmPC	4d pi++	4	360/2,200	1.5/0.8	1	3(3)	10	–	3	+$300	1
9	Underbarrel Grenade Launcher, 40mmPLB	1d pi++	2	75/450	3/2	3	5(5)	10	–	1	+$200	1

GUNS (LIGHT MACHINE GUN) (DX-4, or most other Guns at -2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	Light Support Weapon, 7mmCL	6d pi	5	700/4,000	15/5	15	200(5)	9B†	-5	2	$3,000	1
9	Storm Chaingun, 10mmCLR	9d pi+	5	1,300/5,800	20/6	10	60(5)	11B†	-6	3	$11,000	1



GUNS (LAW) (DX-4, or most other Guns at -4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	Splat Gun, 15mmPLB	3d+2 pi++	4	220/2,000	20/10	30	30(30)	10†	-6	1	$3,000	1

Mounted Weapons Table

ARTILLERY (CANNON) (IQ-5)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
9	Mortar Box, 40mmPLB	1d pi++	2	75/450	12/8	4×4	16(20)	12M	-6	1	$1,000	1
9	Mortar Box, 64mmPLB	6d×2 pi++	3	360/3,000	160/80	6×5	30(30)	25M	-10	1	$6,000	1

GUNNER (CANNON) (DX-4, or other Gunner-4)

9	Tank Cannon, 100mmCL	6d×25 pi++	6	3,000/10,000	2,500/40	1	1(4)	150M	-10	4	$100,000	1

GUNNER (MACHINE GUN) (DX-4, or other Gunner-4)

9	Assault Cannon, 25mmCL	10d pi++	4	700/8,500	40/12	8	34(5)	20M	-8	2	$17,000	1
9	Heavy Chaingun, 15mmCL	15d pi++	6	2,000/9,000	75/12	12	50(5)	20M	-8	2	$34,000	1
9	Minigun, 7mmCL	6d pi	5	700/4,000	33/10	100	400(5)	15M	-7	2	$14,000	1

Conventional Ammunition Table

Pistol Ammo

TL	*Ammo*	*WPS*	*CPS*	*LC*
9	7.5mmCLP	0.006	$0.12	3
9	10mmCLP	0.014	$0.28	3
9	15mmCLP	0.060	$1.2	3

Rifle and PDW Ammo

TL	*Ammo*	*WPS*	*CPS*	*LC*
9	5.7mmCL	0.009	$0.18	3
9	7mmCL	0.027	$0.54	3
9	10mmCL	0.04	$0.8	3
9	10mmCLR	0.06	$1.2	3
9	15mmCL	0.2	$4	3

Shotgun Ammo

TL	*Ammo*	*WPS*	*CPS*	*LC*
9	18.5mmPC	0.092	$1.8	3

Payload Rifle and Cannon Ammo

TL	*Ammo*	*WPS*	*CPS*	*LC*
9	25mmCL	1	$20	2
9	100mmCL	40	$400	1

Splat Gun Ammo

TL	*Ammo*	*WPS*	*CPS*	*LC*
9	15mmPLB	0.27	$7	2

Grenade Launcher and Mortar Ammo

TL	*Ammo*	*WPS*	*CPS*	*LC*
9	25mmPC	0.22	$4.4	3
9	40mmPLB	0.4	$10	3
9	64mmPLB	2	$40	2

Electrothermal-Chemical (ETC) (TL9-10)

These weapons augment chemical energy with electrical power. A controlled plasma burn provides a smoother and more complete utilization of propellant, increasing the projectile velocity without a significant increase in recoil.

They are introduced in armored vehicle cannon in late TL8. By TL9 they are commonly available, and by mid-to-late TL9 appear in small arms. Conservative forces and civilians continue to use them through TL10.

ETC weapons are not shown on the weapon table. Instead, all conventional slugthrowers are also available in ETC-boosted versions.

ETC guns have 1.5 times the piercing damage and range of a conventional caseless-propellant gun. They are also twice as expensive.

They require electrical power as well as ammunition, although this power requirement is much less than an electromagnetic gun or a beam weapon. The grip or stock of an ETC slugthrower incorporates a removable A cell (for pistols), B cell (for SMGs, PDWs, shotguns, rifles), or C cell (for heavy weapons) to provide electrical power. Each power cell can fire 10 magazines of ammunition.

Liquid-Propellant Slugthrowers (TL9)

Liquid propellants are an advanced option for chemical propellant. Propellant and oxidizer are kept in a separate bottle, then squirted into the firing chamber and ignited electrically when the trigger is pulled. Binary propellants are often used; the chemicals are inert until combined in the firing chamber.

Liquid propellant is a bit more powerful and easier to store, but its chief advantage is precise control of propellant velocities. In additional to standard velocity, they have two other options:

Boosted velocity dumps extra propellant into the firing chamber: increase the piercing damage by +1 per die and multiply range by 1.3. Each counts as 1.5 shots for purposes of draining the propellant bottle.

Low velocity dumps much less propellant into the firing chamber, making the weapon subsonic. Reduce the piercing damage and range by half! Rolls to hear the weapon fire are made at -3. Each counts as 1/4 shot for draining the propellant bottle.

Liquid propellant weapons use the same statistics as conventional caseless weapons, but they get 1.5 times as many shots per magazine and are 1.5 times as expensive. (The mechanical design is more complex, so this technology is often limited to specialized sniper and artillery weaponry.) A propellant bottle can fire three magazines of shots and takes five seconds to reload. Additional propellant bottles weigh as much as a normal loaded magazine.

Gas-Powered Air Guns

These use air or carbon dioxide, compressed and stored in liquid form. When the trigger is pulled, the liquid is released and expands into a gas, propelling the projectile.

Gas-powered air guns are quiet and have no muzzle flash. They are often used as sporting weapons, and tend to have a higher Legality Class than other weapons.

Weapons

Needler, 3mm (TL9): A small-caliber air gun that can fire a bullet, or a drugged dart holding one dose of any injectable biochemical poison. Also called a "needle pistol."

Needle Rifle, 3mm (TL9): A higher-powered air rifle, otherwise similar to the needle pistol.

Paint Carbine, 15mm (TL9): A large-caliber, low-velocity air gun used to fire plastic pellets containing paint or biochemical liquid ammunition (p. 153). It is electrically powered (a B cell can fire 10 magazines of ammunition) and capable of automatic fire. It may be designed as a replica of an actual rifle or carbine.

Paint Pistol, 15mm (TL9): A large-caliber, low-velocity air gun used to fire plastic pellets containing paint or biochemical liquid ammunition (p. 153). Some models are designed as replicas of pistols.

Tangler, 25mm (TL9): A compressed gas gun about the size of a shotgun, with a folding stock. It fires a 25mm projectile at a very low velocity. It usually fires tangler (p. 155) ammunition, but can also fire other 25mm warhead rounds or solid metal slugs.

Tangler Pistol, 25mm (TL9): A pistol-sized tangler that uses a less powerful compressed air charge.

Wrist Needler, 3mm (TL9): A needler designed to be strapped to the wrist and concealed up a sleeve. It incorporates a simple neural input sensor reading muscle signals. A trained shooter can fire it with no more effort than pointing a finger, but it's tricky to use without practice. Double penalties for lack of familiarity.

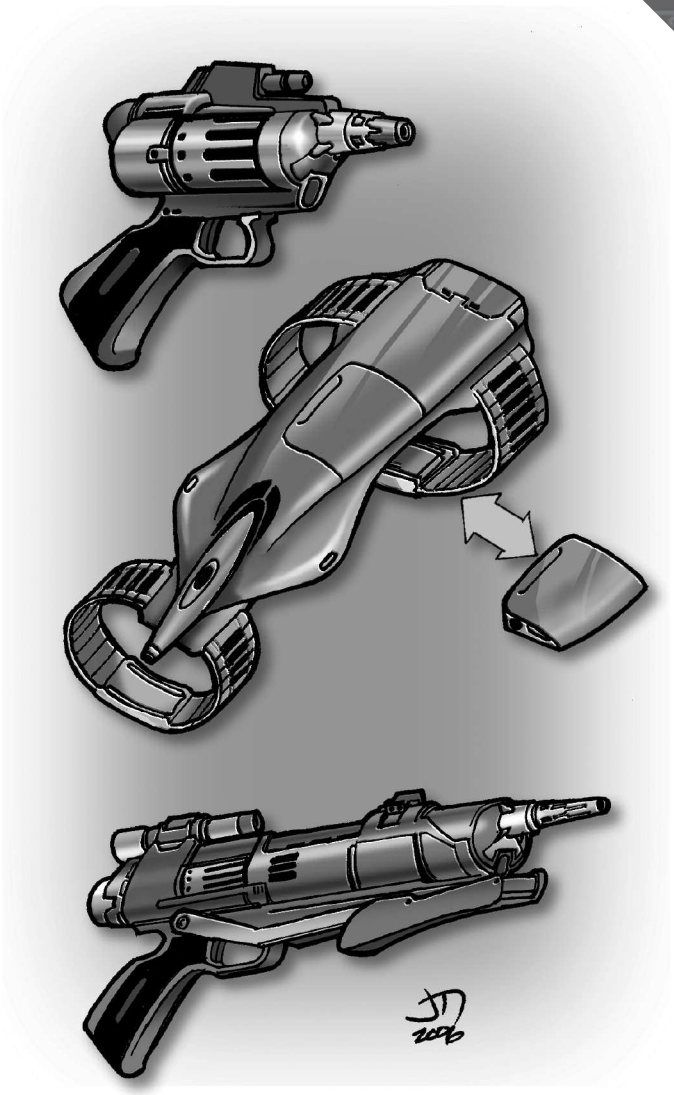
Ice Gun (TL10): These use compressed gas to fire needles of frozen liquid. The needles dissolve without a trace in the target's body. They are intended for survival or assassination. Each 20-shot magazine includes a self-contained refrigeration unit. Pour a cup of water into the magazine, activate the refrigeration unit, and in half an hour (five minutes at TL11, one minute at TL12), 20 new ice needles will be ready to fire. A single C cell can freeze 100 magazines' worth of ice needles.

An ice gun may also deliver drugged rounds. A dose of any hypo-injected drug or poison can be pre-frozen into a sliver and fired, with the normal follow-up effect if it penetrates. Add the cost of 20 doses of that drug or poison.

Partisan Needler, 3mm (TL10): This spring-rifle weapon is designed for low-tech guerrilla fighters, or for use by people planning a long stay in cultures that can't produce sophisticated ammo. The solar-powered flywheel foundry in the stock makes its own ammunition. It can produce 140 needles in an hour using a 2×3×1-inch metal block ($1), which can be made by any village blacksmith with access to ore. After that, it must recharge for 10 hours in the sun.

Option: Non-Metallic

All these weapons except the partisan needler may be made of non-metallic materials for 1.5 times normal cost, allowing an unloaded weapon to bypass ordinary metal detectors.



Gas-Powered Air Gun Table

GUNS (PISTOL) (DX-4, or most other Guns at -2)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9	Needler, 3mmN	1d+2 pi-	1	50/150	1/0.3	3	100(3)	7	-2	2	$500	3
9	Paint Pistol, 15mm	1d-4 pi++	1	14/90	1/0.5	3	20+1(3i)	8	-2	2	$100	4
9	Tangler Pistol, 25mmT	1d pi++	1	20/130	2/0.5	1	4+1(3i)	10	-3	2	$300	4
9	Wrist Needler, 3mmN	1d-2 pi-	1	25/100	0.1/0.03	3	25(3)	3	-1	2	$200	3
10	Ice Gun, 3mm ice	1d-1(0.2) pi-	1	50/150	1/0.2	3	20(3)	7	-2	2	$600	2

GUNS (RIFLE) (DX-4, or most other Guns at -2)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9	Needle Rifle, 3mmN	2d pi-	4	75/300	5/1	3	100(3)	7†	-4	2	$600	4
9	Paint Carbine, 15mm	1d-4 pi++	2	20/130	4/1	10	50+1(3i)	6†	-2	2	$400	4
9	Tangler, 25mmT	1d pi++	2	30/190	5/1	3	8+1(3i)	7†	-4	2	$600	4
10	Partisan Needler, 3mmN	2d pi-	4	75/300	12/1	3	140(3)	10†	-5	2	$1,500	4

Air Gun Ammunition Table

TL	*Ammo*	*WPS*	*CPS*	*LC*
9	3mmN	0.005	$0.1	4
9	15mm	0.025	$0.5	4
9	25mmT	0.12	$2.4	4

Electromagnetic Guns

These weapons use magnetic fields to accelerate projectiles to very high velocities. This translates into high accuracy, range, and kinetic damage. They do not require chemical propellant, which makes storing ammunition safer (less risk of fire or explosion) and reduces the magazine weight and volume. They appear as heavy weapons at TL9, and personal weapons at TL10+.

The electromagnetic pulse produced when an electromagnetic gun fires may be detectable, but it will usually be difficult to localize. The only noise is the crack of the projectile breaking the sound barrier. Ammunition velocity can also be varied, exactly as for a liquid-propellant slugthrower (p. 139). The primary disadvantage of electromagnetic guns is their high power consumption.

Electromagnetic guns may use Gauss guns or railgun technology. Gauss guns – also called coilguns or mass-drivers – accelerate a conductive projectile down a series of coils via a quickly changing magnetic field, and can achieve very high rates of fire. Railguns use two conductive rails to generate a current flow that accelerates a saboted projectile to high velocities. In game terms, both use the same rules, differing only in their combat statistics. Railguns usually do more damage and have superior range to equivalent-size Gauss guns, but tend to have slower rate of fire.

Pistols

Gauss Minineedler, 3mm (TL10): One of the smallest machine pistols available, this is an ultra-compact holdout version of the Gauss needler.

Gauss Needler, 3mm (TL10): A short-ranged but rapid-firing machine pistol.

Gauss Pistol, 4mm (TL10): A long-barreled hypervelocity pistol with more kinetic energy than a 15mm magnum pistol, but only a fraction of the recoil.

Submachine Guns

Gauss Machine Pistol, 4mm (TL10): The Gauss machine pistol's compactness, high rate of fire, and stopping power make it popular with military officers, special forces, and terrorists.

Gauss Personal Defense Weapon (PDW), 4mm (TL10): A compact assault weapon that accelerates bullets to a velocity between that of the Gauss pistol and Gauss rifle.

Rifles

Sniper Railgun, 7mm (TL9): An early sniper railgun used by and against battlesuits and combat robots, or for shooting down aircraft. It fires a 7mm dart at 10,000 feet per second, with twice the power of a 15mm sniper rifle. It has a comparatively low recoil, and can be fired without a bipod.

Portable Railgun, 10mm (TL10): This long-barreled, semi-automatic Gauss rifle fires 10mm slugs at hypersonic velocities. Used as a heavy sniper rifle, its advantage over conventional weapons is its larger ammunition capacity and lighter weight, especially when loaded.

Gauss Needle Rifle, 3mm (TL10): This weapon fires 3mm darts at very high rate of fire.

Gauss Rifle, 4mm (TL10): This may be a standard military rifle at TL10. It is an automatic weapon that accelerates a 4mm bullet to almost 5,000 feet per second.

Shotguns

Gauss Close Assault Weapon (CAW), 18.5mm (TL10): Essentially a Gauss auto-shotgun, this is a fearsome close-combat weapon firing a swarm of 12-gauge projectiles at 150% of the velocity of a conventional shotgun.

Gauss Shotgun Pistol, 18.5mm (TL10): Similar to the Gauss CAW (above), but in pistol format. This big-bore, snub-nosed semi-automatic is a favorite police sidearm, due to the many types of warheads it can fire.

Machine Guns

Gauss Minigun, 4mm (TL10): This weapon spits out high-velocity projectiles at up to 10,000 rounds per minute. It is used as a heavy machine gun and point-defense weapon. The cryogenic cooling jacket surrounding the barrel and the huge ammo cassette allow sustained automatic fire.

Gauss Heavy Machine Gun (HMG), 7mm (TL10): This tripod-mounted 4mm machine gun fires the same round as the Gauss sniper rifle from a 200-round ammo cassette.

Gauss Light Support Weapon (LSW), 4mm (TL10): A heavy-barrel version of the Gauss rifle, used as a machine gun or battlesuit sidearm. It can fire 3,000 rounds per minute.

Cannon, Grenade Launchers, and Mortars

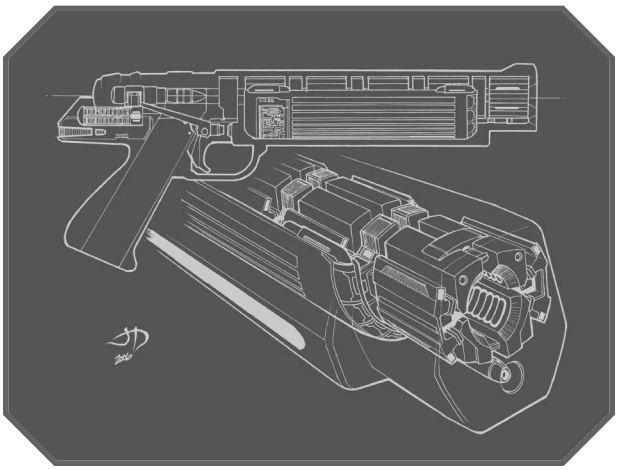
Electromag Grenade Launcher (EMGL), 40mm (TL10): An EMGL is a stubby, shotgun-like Gauss gun, similar in shape to 20th-century grenade launchers.

Electromag Auto Grenade Launcher (Auto EMGL), 40mm (TL10): A bulky weapon firing the same round as the EMGL, but at higher velocities. It's used as a tripod-mounted infantry support weapon, or by powered troopers.

Electromag Mortar, 64mm (TL10): This heavy base-mounted tube is a standard semi-portable infantry artillery piece. It's also found mounted in vehicle turrets.

Railgun, 40mm (TL10): An electromagnetic cannon with a very long barrel, firing a projectile at hypersonic velocities. It's a suitable main gun for a tank or small warship.

Underbarrel Electromag GL, 25mm (TL10): This is a Gauss grenade launcher that can be attached under any weapon with Bulk -3 or more. It's also called a mini-GL. Use the Bulk, ST, and sighting bonuses of the weapon it is installed in.



Electromagnetic Gun Table

ARTILLERY (CANNON) (IQ-5)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC	Notes
10	Electromag Mortar, 64mm	6d×3 pi++	4	1,000/6,000	50/10	1	4(5)	12M	-10	2	$40,000	1	[4]

GUNS (PISTOL) (DX-4, or most other Guns at -2)

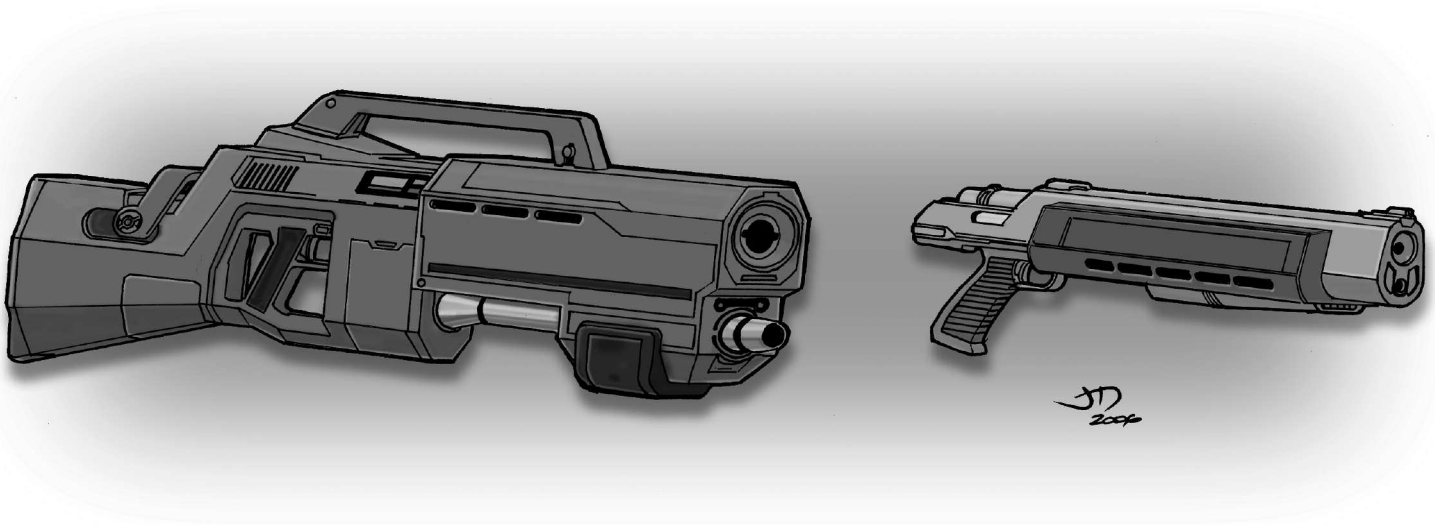
TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC	Notes
10	Gauss Minineedler, 3mm	1d(3) pi-	1	50/200	0.1/0.03	4	25(3)	3	-1	2	$800	3	[1]
10	Gauss Pistol, 4mm	3d(3) pi-	3	500/2,100	2/0.5	3	40(3)	9	-2	2	$1,700	3	[2]

GUNS (SMG) (DX-4, or most other Guns at -2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC	Notes
10	Gauss Machine Pistol, 4mm	3d(3) pi-	3	500/2,100	3/0.5	20	40(3)	9	-2	2	$2,600	2	[2]
10	Gauss Needler, 3mm	2d(3) pi-	2	100/300	1.5/0.5	12	100(3)	7†	-2	2	$2,000	2	[2]
10	Gauss PDW, 4mm	4d(3) pi-	6+1	700/2,900	4.6/1	16	80(3)	9†	-3	2	$3,600	2	[3]

GUNS (RIFLE) (DX-4, or most other Guns at -2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC	Notes
9	Sniper Railgun, 7mm	6d×2(3) pi	7+3	2,400/10,000	20/1.4	1	30(3)	11B†	-6	2	$18,000	2	[4]
10	Gauss Needle Rifle, 3mm	2d+1(3) pi-	4	500/2,000	6/1	20	100(3)	8†	-3	2	$3,000	2	[3]
10	Gauss Rifle, 4mm	6d+2(3) pi-	7+2	1,200/4,800	8.5/1.4	12	60(3)	10†	-4	2	$7,100	2	[3]
10	Portable Railgun, 10mm	5d×3(3) pi+	7	3,000/12,000	20/1.5	3	25(3)	10†	-6	3	$18,000	1	[3]



GUNS (SHOTGUN) (DX-4, or most other Guns at -2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC	Notes
10	Gauss CAW, 18.5mm	8d pi++	4	200/1,000	10/1.5	15	30(3)	10†	-4	3	$2,400	2	[3]
10	Gauss Shotgun Pistol, 18.5mm	8d pi++	2	200/1,000	3/0.5	3	10(3)	10	-3	4	$2,000	3	[3]

GUNS (GRENADE LAUNCHER) (DX-4, or most other Guns at -4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC	Notes
10	EMGL, 40mmG	4d pi++	3	150/1,000	10/3	1	3(5)	8†	-5	2	$7,000	1	[3]
10	Underbarrel EMGL, 25mmG	4d pi++	4+2	360/2,200	2/1	1	3(3)	10	–	2	$1,000	1	[3]

GUNS (LMG) (DX-4, or most other Guns at -2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC	Notes
10	Gauss LSW, 4mm	6d+2(3) pi-	7+2	1,200/4,800	20/7	20	300(5)	12B†	-5	2	$13,000	1	[3]

GUNNER (CANNON) (DX-4, or other Gunner at -4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC	Notes
10	Auto EMGL, 40mmG	8d pi++	4	300/2,000	64/10	1	20(5)	14†	-8	2	$54,000	1	[4]
10	Railgun, 40mm	6d×25(3) pi++	8	8,000/29,000	4,000/150p	20	200(5)	57M	-10	2	$630,000	1	[5]

GUNNER (MACHINE GUN) (DX-4, or other Gunner at -4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC	Notes
10	Gauss HMG, 7mm	16d(3) pi	8	3,000/12,000	64/20	20	200(5)	20M	-8	2	$44,000	1	[4]
10	Gauss Minigun, 4mm	10d(3) pi-	8	1,800/7,200	64/20	100	1,000(5)	20M	-8	2	$44,000	1	[4]

[1] Powered by a B cell.
[2] Powered by two B cells.
[3] Powered by a C cell.
[4] Powered by a D cell.
[5] External power.
The weapon's power cell provides enough energy for firing its specified number of Shots, and is included in the weight.

Electromagnetic Gun Ammunition Table

TL	Ammo	WPS	CPS	LC
10	3mm	0.004	$0.04	3
10	4mm	0.006	$0.06	3
10	7mm	0.024	$0.24	3
10	10mm	0.08	$0.8	3
10	18.5mm	0.037	$0.37	3
10	25mmG	0.09	$0.9	3
10	40mmG	0.33	$5	3
10	40mm	6	$60	2
10	64mm	2	$20	2

Grav Guns

Grav guns use a pressor beam to accelerate hyperdense slivers to a high fraction of light speed, neutralizing recoil with inertial compensation systems. In atmosphere, each shot is preceded by a low-power laser beam, which creates an evacuated channel through which the projectile can pass. The rounds turn to plasma and explode as they hit the target, inflicting impaling damage with the incendiary modifier and a (10) armor divisor.

Grav Needler Weapons

Grav Mini-Needler (TL11^): A small holdout pistol powered by two B cells.

Grav Needler (TL11^): A hypervelocity machine pistol with a rapid rate of fire. Powered by a C cell.

Grav Needle Rifle (TL11^): A grav gun assault rifle, capable of turning a light armored vehicle into Swiss cheese with a single burst. Powered by a C cell.

Gravitic Railgun (TL11^): A tank-sized gravitic cannon firing darts at near-light speed. External power.

Heavy Grav Needler (TL11^): A rapid-fire machine gun powered by a D cell.

Sniper Grav Gun (TL11^): A long-barrel sniper version of the grav needler rifle. Powered by two C cells.

Grav Gun Table

GUNS (PISTOL) (DX-4, or most other Guns at -2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
11^	Grav Minineedler	2d(10) imp inc	1	50/200	0.1/0.03	4	100(3)	3	-1	1	$200	3

GUNS (SMG) (DX-4, or most other Guns at -2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
11^	Grav Needler	3d(10) imp inc	5	500/1,500	1.5/0.5	20	500(3)	7†	-2	1	$2,000	2

GUNS (RIFLE) (DX-4, or most other Guns at -2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
11^	Grav Needle Rifle	4d(10) imp inc	10	2,000/6,000	6/1	20	1,000(3)	8†	-3	1	$10,000	2
11^	Sniper Grav Gun	8d(10) imp inc	11	4,000/12,000	10/1	3	1,000(3)	9†	-4	1	$18,000	1

GUNS (LMG) (DX-4, or other Guns at -2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
11^	Heavy Grav Needler	8d(10) imp inc	10	4,000/12,000	20/4	100	4,000(5)	11†	-5	1	$32,000	1

GUNNER (CANNON) (DX-4, or other Gunner at -4)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	ST	Bulk	Rcl	Cost	LC
11^	Gravitic Railgun	6d×15(10) imp inc	15	10,000/30,000	1,000/10Fp	20	2,000(5)	34M	-10	1	$2,000,000	1

Grav Gun Ammunition Table

TL	Ammo	WPS	CPS	LC
11	Grav Needler Round	0.001	$0.01	3
11	Grav Railgun Round	0.3	$30	2

Gyrocs

Gyrostabilized rocket launchers fire spin-stabilized rockets the size of bullets. Primitive TL7 rocket pistols such as the Gyrojet were notably inaccurate and slow to accelerate. TL9 developments in rocket fuels and microelectromechanical systems stabilize even unguided rockets, and allow miniaturized homing systems at extra cost. (Not all "gyrocs" actually use gyrostabilization – some have smart skins that steer them in flight via tiny aerodynamic bumps or fins.)

Since they are propelled by a rocket motor, gyrocs have a flat trajectory with a maximum range similar to the 1/2D range. Gyroc launchers are also light compared to conventional guns – almost half a typical gyroc weapon's weight is its ammunition. They're effectively recoilless, and quieter than ordinary guns. The hissing sound the rockets make is hard to localize: a Hearing roll is needed to spot the firer by sound alone.

Gyrocs have a few disadvantages. They're less accurate than conventional bullets. Also, like most rockets, they take some time to accelerate: divide their piercing damage by 3 at one or two yards and by 2 at three to 10 yards. This limits their utility as civilian or police weapons unless using specialized (e.g., explosive) ammunition. Gyroc ammo is also bulky and expensive, which limits the number of shots their magazines can be loaded with. Users often rely on homing ammunition (see *Gyroc Micromissiles*, below), substituting precision for volume of fire.

Gyroc Weapons (TL9)

Gyrocs are available in several configurations. Typical gyroc weapons include:

Gyroc Carbine, 15mm: This is a popular infantry weapon, especially when loaded with armor-piercing explosive rockets (such as HEMP ammunition, p. 155).

Gyroc Launch Pistol, 15mm: A semi-automatic magazine-fed rocket pistol.

Gyroc Light Support Weapon, 15mm: An electrically powered machine gun-sized gyroc with a large ammunition cassette and full automatic fire capability. A B cell provides up to 15 minutes continuous fire.

Gyroc Pistol, 15mm: A simple and compact weapon – basically a four-shot revolver. Different rockets can be loaded in each chamber.

Holdout Gyroc, 15mm: Also called the "sleeve gyroc," this is an single-shot rocket launcher. It's often worn attached above the wrist.

Underbarrel Gyroc, 15mm: An alternative to a grenade launcher, this compact weapon is designed to be clamped onto (or built into) an assault rifle for extra firepower. Use the Bulk, ST, and sighting bonuses of the weapon it is installed in.

Gyroc Micromissiles (TL9)

Gyrocs are often equipped with homing projectiles (sometimes called "micromissiles" or "viper gyrocs") – see *Homing Projectiles*, p. 146. Micromissiles are quite expensive, so troops may not be issued full magazines of them, receiving a few as "silver bullets" in addition to the regular gyroc ammo load.

Gyroc Launcher Table

GUNS (GYROC) (DX-4, or most other Guns at -4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*	*Notes*
9	Gyroc Carbine, 15mm	6d pi++	2	1,900	4/1	3	10(3)	7†	-3	1	$500	2	
9	Gyroc Launch Pistol, 15mm	6d pi++	1	1,900	2/0.7	3	6(3)	10	-2	1	$300	3	
9	Gyroc LSW, 15mm	6d pi++	2	1,900	12/3	10	30(5)	10†	-4	1	$1,400	1	
9	Gyroc Pistol, 15mm	6d pi++	1	1,900	1/0.4	3	4(3i)	9	-2	1	$200	3	
9	Holdout Gyroc, 15mm	6d pi++	0	1,900	0.25/0.1	1	1(3i)	6	-1	1	$50	3	
9	Underbarrel Gyroc, 15mm	6d pi++	2	1,900	1.5/0.7	3	6(3)	6†	–	1	$150	2	[1]

[1] May be attached to any weapon of Bulk -3 to -6; use that weapon's Bulk.

Gyroc Ammunition Table

TL	*Ammo*	*WPS*	*CPS*	*LC*
9	15mm gyroc	0.1	$5	3

Rockets and Missiles

These are missile launchers larger than the gyroc weapons. The standard weapons are solid propellant rockets, but superscience reactionless-drive missiles are also possible.

Infantry Missile Launcher (IML) (TL9-10)

This is a single-shot launch tube with a pistol grip and an electronics system. It holds one mini-missile, but can be reloaded after each shot if extra missiles are carried. It is light enough (six pounds loaded) that every soldier could carry one.

The launcher fires a supersonic missile with a 64mm warhead. It produces a dangerous backblast when fired, doing 2d burning damage to everyone within a cone up to two yards behind the launcher.

Each missile costs $100 without a warhead; homing missiles (p. 146) cost more. The usual warhead is a solid "kinetic kill" projectile inflicting the listed piercing damage. The warhead costs $10; multiply this figure for the more expensive warheads listed under *Warheads and Ammunition* (pp. 152-159).

Multiple Light Anti-Armor Weapon System (MLAWS), 64mm (TL9-10)

The MLAWS is a six-tube launcher with a loaded weight of 35 pounds. It is quite hefty, but its lack of recoil allows an ordinary person to fire it. The MLAWS is used as a squad support weapon, although it's not uncommon to see them attached to post mounts on vehicles or hung under the pylons of attack aircraft. The MLAWS fires the same missile as an IML (see above), with the same options and backblast hazard.

Tactical Missile Launcher (TML), 100mm (TL9)

This bulky launch tube holds a single pre-packaged missile. An unguided rocket costs $400; missiles with guidance systems cost more. The basic warhead is a 100mm solid "kinetic kill" projectile that inflicts the listed piercing damage. This costs $40; multiply this figure for the more expensive warheads listed under *Warheads and Ammunition* (pp. 152-159). It has a potentially lethal backblast when fired, doing 4d burning damage to everyone within a cone up to three yards behind the launcher.

Reactionless Missiles (TL11^)

Any of the above missiles can have superscience reactionless drives. The missiles have no backblast and get five times the normal max range (1/2D range and speed don't increase). The missiles are twice as expensive; the costs of the launchers and warheads are unchanged.

Missile Launcher Table

ARTILLERY (GUIDED MISSILE) (IQ-5, or other Artillery at -4)

TL	*Weapon*	*Damage*	*Acc*	*Range*	*Weight*	*RoF*	*Shots*	*ST*	*Bulk*	*Rcl*	*Cost*	*LC*
9	IML, 64mm	6d×3 pi++	3	500/4,000	4/2	1	1(5)	7†	-4	1	$2,000	1
9	MLAWS, 64mm	6d×3 pi++	3	500/4,000	35/12	1	6(5)	11B†	-8	1	$23,000	1
9	TML, 100mm	6d×30 pi++	3	2,000/10,000	35/25	1	1(20)	11B†	-8	1	$10,000	1
10	IML, 64mm	6d×5 pi++	3	750/6,000	4/2	1	1(5)	7†	-4	1	$2,000	1
10	MLAWS, 64mm	6d×5 pi++	3	750/6,000	35/12	1	6(5)	11B†	-8	1	$23,000	1
10	TML, 100mm	6d×50 pi++	3	3,000/15,000	35/25	1	1(20)	11B†	-8	1	$10,000	1

All statistics are for "baseline" high-velocity rockets with solid warhead. Most weapons will fire homing projectiles (below) with a more specialized warhead!

Homing Projectiles

Ultra-tech projectile weapons may contain sensors and steering systems that enable the projectile to home in on a target by itself.

Gyroc, missile, and rocket launchers often fire homing projectiles. Guns may fire homing projectiles if the homing system can fit in the bullet or shell – this requires high TLs for small caliber rounds. Homing projectiles use the *Homing Weapon* rules (p. B413). The firer rolls against Artillery (Guided Missile) to *aim.* On a success, the missile gets its Acc bonus. The weapon's "1/2D" range is its speed in yards/second. The missile's skill and type of homing attack depends on the type of homing systems installed:

Infrared Homing ("Viper") (TL9)

These inexpensive systems are available for 15mm or larger projectiles at TL9, 10mm or larger at TL10, 7mm or larger at TL11, and all projectile sizes at TL12.

They make a Homing (Infravision) attack. They have a skill of 13, +1 per TL after introduction. Add 300% to the base projectile cost (i.e., a projectile costs four times as much).

Multi-Spectral Homing (TL9-12)

These sophisticated guidance systems are available for 40mm or larger projectiles at TL9, 25mm or larger at TL10, 15mm or larger at TL11, and 10mm or larger at TL12.

They can be set for "passive" homing, making a Homing (Hyperspectral Vision) attack. They can be set for "anti-radiation" to track any radio or radar signals the target emits, making a Homing (Detect Radar and Radio) attack. Finally, they may be set for "active" homing, making a Homing (Imaging Radar) attack.

They have a skill of 14, +1 per TL after introduction. Add 900% to the base projectile cost (i.e., a projectile costs 10 times as much).

Multiscanner Homing (TL11-12^)

These superscience guidance systems are available for 15mm or larger projectiles at TL11, and 10mm or larger at TL12. They make a Homing (Penetrating Para-Radar) attack, guided by the same technology as the ultrascanner (p. 66). They can even home in on targets behind thin walls, and will attack targets behind cover if their sensors suggest they have a chance of penetrating. They have a skill of 12, +1 per TL after introduction. Add 900% to the base projectile cost.

Brilliant Weapons (TL9-12)

These are robotic missiles capable of autonomous flight and target selection. Unlike a normal homing weapon, which the user locks onto a target he can see or otherwise detect, a brilliant weapon is simply released to look for targets on its own. See *Robot Weapons* (pp. 168-169) for examples of various brilliant weapons.

Hand Grenades

Traditional hand grenades are convenient and deadly weapons in close combat – and a powered suit (pp. 181-186) or robotic body can throw them much further than humanly possible!

There are three standard grenade sizes:

Hand Grenade: This is the standard grenade, about the size of a baseball. It has the same effect as a 64mm warhead. $40, 1 lb.

Mini Hand Grenade: An easy-to-conceal grenade the size of a golf ball. It has the effect of a 40mm warhead. $10, 0.25 lbs.

Thimble Grenade: A tiny grenade one inch in diameter. It has the same effect as a 25mm warhead. $2.5, 0.06 lbs.

The effect of a grenade, its TL, and its LC depends on the grenade's warhead. See *Warheads and Ammunition* (pp. 152-159). The cost given is the base cost for a high explosive fragmentation grenade. Other warhead types may have a multiple to cost, e.g., a stasis grenade is 500 times normal cost.

Standard ultra-tech grenades have an activator handle and a two-second delay. To use the grenade, take one second to "pull the pin" and arm the grenade. The grenade will explode two seconds after the user releases the grenade (usually by throwing it).

Smart Grenades (TL9)

These grenades incorporate a computer chip and microcommunicator (p. 43). A smart grenade can be controlled by any computer terminal, usually a wearable system. To activate them, the user must first press an arming switch on the grenade (this is manual, to prevent unauthorized remote activation). The grenade sends out a signal, and if the user is in range, a grenade arming display pops up on the user's interface. He can then select any menu option for the grenade.

The options are: a specified *time delay* (up to two weeks), *command detonation* (detonates by radio command; each grenade carried has its own frequency), *impact fusing* (goes off if struck, dropped, or thrown against a hard surface), or *anti-tamper fusing* (as per command or delay, but goes off if touched). The user can reprogram the grenade if he uses its unique code, or he can lock the grenade so that its commands cannot be changed.

It takes three Ready maneuvers to program a smart grenade. Smart grenades *also* have a conventional pin that can be pulled, turning the grenade into an ordinary grenade that will go off two seconds after the grip is released. Sometimes a regular fuse is enough, especially when there's no time to mess around with computer menus!

At TL9, a smart grenade option adds $100 to the grenade's cost, after all modifiers for the type of warhead. At TL10+ the cost is trivial – all hand grenades can be smart at no additional expense.

Smart grenades may have a message option – see *Message Bombs* (p. 109).

Saucer Grenades (TL9)

These grenades come in a aerodynamic disk shape, and are sheathed in a flexible rubberized plastic. They are armed the same way as other grenades, and come in both ordinary and smart versions. Their effect is the same as a mini-grenade, but they're bulkier due to their shape; only one can fit in a large pocket.

Use Throwing skill to hurl them, but instead of using the throwing rules, treat them as a thrown weapon with the statistics shown below. The rubberized sheath allows them to be bounced around corners: roll at -3 to get the grenade to do this. If a saucer grenade misses and scatters (p. B414), and an obstacle blocks it before it travels the full scatter distance, the grenade will bounce back the remaining yards in the opposite direction.

Limpet Mines (TL9)

Limpets are similar to hand grenades, but are not balanced for throwing. Instead, they can stick (or unstick) to almost any surface upon receiving the correct communicator pulse. They can also be used as handheld weapons (with any preset delay) by slapping them on a target, from a human to a starship.

Limpets may be worn on armor as defensive decoys: e.g., limpets filled with prismatic smoke can be set to trigger instantly if laser sensors detect a laser beam. To remove a limpet without the proper code, roll vs. ST-5, one try per second. Pulling one off of flesh does one point of damage. Otherwise, limpet mines have the same statistics as smart grenades.

Hand Grenade Table

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	Cost	ST	Bulk
9	Hand Grenade	64mm warhead	0	per ST	1	1	T(1)	$40	6	-2
9	Mini Hand Grenade	40mm warhead	0	per ST	0.25	1	T(1)	$10	5	-1
9	Thimble Grenade	25mm warhead	0	per ST	0.06	1	T(1)	$2.50	4	-1
9	Saucer Grenade	40mm warhead	2	×3/×5	0.5	1	T(1)	$40	5	-1

Typical Weapons by TL

An enormous variety of weapons are possible, and individuals, organizations or cultures will have their own favorites. Some suggestions are given below.

TL9

Personal Sidearm: 10mm auto pistol, 3mm needle pistol, 15mm gyroc pistol, or a nonlethal electrolaser pistol, nauseator pistol, tangler pistol, or vortex pistol.

Paramilitary or Special Ops: 5.7mm PDW, 10mm machine pistol, 15mm gyroc carbine, urban assault weapon, 40mm grenade launcher. Snipers may use a 10mm sniper rifle, a 15mm anti-material rifle, or a laser sniper rifle. Biochemical, strobe, and tangler grenades are popular.

Infantry: 7mm assault carbine or 10mm storm carbine, with 25mm grenade launcher. Concussion, fragmentation, and shaped-charge grenades are popular.

Squad Support or Powered Infantry: 7mm LSW, 7mm sniper railgun, 25mm payload rifle, 40mm grenade launcher, or MLAWS launcher.

Holdout: Holdout pistol, sleeve gyroc, wrist needler.

Melee Weapons: Stun wand, superfine knife, zap glove. In superscience settings, monowire blades or whips are popular!

TL10

Personal Sidearm: 4mm Gauss pistol or laser pistol; sonic stunners.

Paramilitary or Special Ops: 4mm Gauss PDW, heavy laser pistol, gyroc carbine, or laser carbine; 40mm electromagnetic grenade launcher; snipers use a 10mm portable railgun, a dinosaur laser, or a laser rifle.

Infantry: 4mm Gauss rifle or laser rifle, with 25mm underbarrel EMGL; HEMP grenades are popular.

Squad Support or Powered Infantry: 4mm Gauss LSW, 15mm portable railgun, 40mm EMGL, Gatling laser, or MLAWS missile launcher.

Holdout: Gauss needler, holdout laser.

Melee Weapons: Neurolash; vibroblade knife; in superscience settings, the monowire switchblade is highly effective.

TL11

Personal Sidearm: Blaster pistol or rainbow laser pistol, often with electrolaser setting. In superscience settings, plasma pistols and neural disruptors, or force-jacketed X-ray lasers.

Paramilitary: Blaster carbine, rainbow laser carbine; snipers use a rainbow dinosaur laser. Superscience settings add force-jacketed X-ray laser carbines or dino lasers.

Infantry: Blaster rifle or rainbow laser rifle. In superscience settings, plasma rifles or force-jacketed X-ray laser rifles.

Squad Support or Powered Infantry: Heavy blaster, rainbow Gatling laser, or superscience fusion gun or force-jacketed X-ray Gatling laser.

Holdout: Holdout blaster, or holdout rainbow laser.

Melee Weapons: Hyperdense blades. In superscience settings, force swords and other force blade weapons are popular.

TL12

Personal Sidearm: Graser pistol or pulsar pistol, or superscience disintegrator or mind disruptor pistols.

Paramilitary or SWAT: Graser carbine or pulsar carbine, or superscience mind disruptor rifle. Snipers use a dinosaur graser.

Light or Mechanized Infantry: Graser rifle or pulsar rifle, or superscience disintegrator rifle.

Squad Support or Powered Infantry: Gatling graser or heavy pulsar; superscience semi-portable disintegrator.

Holdout: Holdout graser; superscience holdout disintegrator or mind disruptor.

Melee Weapons: In superscience settings, stasis switchblades and force whips may be popular.

Firearm Accessories

In combat, any edge can mean the difference between life and death – and technology is a great way to get that edge. This section presents devices and modifications to enhance almost any weapon.

Smartgun Electronics

Every TL9+ firearm has a laser sight (p. 149), a HUD link (below), a recognition grip or transponder ring (p. 150), and a diagnostic computer (p. 151) for free. These electronics are powered by an integral B cell, which is included in the basic weight of the gun. A tiny computer (p. 22) may also be included. However, these components can be ignored if they are not standard in a particular setting.

Targeting Systems

These help the shooter find his target and hit it.

HUD Link (TL9)

Connected to a heads-up display (p. 24), this shows augmented-reality targeting imagery in the user's field of view. The link shows him exactly where his firearm is pointing (+1 Acc within 300 yards, not cumulative with the Acc bonus for other targeting systems), the number of shots remaining, and – if using a laser sight or other active targeting device – the distance to the target. The user can exploit this to see around corners, exposing only his weapon.

Multispectral Laser Sight (TL9)

This device projects a low-powered eye-safe laser beam, placing a laser spot at the point where the weapon will hit. A standard feature of all TL9+ firearms, it helps the user aim or intimidate opponents.

A laser sight gives a +1 to skill when used out to the weapon's 1/2D range, provided the dot is visible to the shooter. It can be set to use any one of these frequencies:

Visible Light: This projects a visible red, blue, or orange spot. The laser beam itself is visible only in dusty or smoky environments – which might describe many firefights!

Infrared: An infrared laser beam projects a dot that is invisible without an infrared or hyperspectral vision system.

Ultraviolet: The dot of this ultraviolet laser beam is invisible without an ultraviolet or hyperspectral vision system.

Compact Targeting Scope (CTS) (TL9-12)

This video sighting system provides infravision at TL9 or hyperspectral vision at TL10-12. It has telescopic optics for normal viewing in daylight, and interfaces with the weapon's HUD sight. It provides a +2 bonus to aimed shots at TL9-10, +3 at TL11, or +4 at TL12.

The scope can also be used as a passive sensor, providing Infravision or Hyperspectral Vision with Restricted Vision (Tunnel Vision). It has 4× magnification at TL9-10, 8× at TL11, or 16× at 12. The user must aim the weapon at the target he is observing. $1,000, 0.5 lbs., A/100 hr. LC4.

Enhanced Targeting Scope (ETS) (TL9-12)

A powerful video sighting system used by snipers or heavy weapons gunners. It provides hyperspectral imaging (p. 61), plus telescopic optics for normal viewing in daylight. It interfaces with the weapon's HUD sight.

The weapon's sight automatically measures wind conditions, air temperature, and even local gravity conditions, adjusting the weapon's velocity to compensate.

The scope adds a +3 bonus to aimed shots at TL9-10, +4 at TL11, or +5 at TL12. Used as a passive sensor, it provides Hyperspectral Vision with Restricted Vision (Tunnel Vision) with 8× magnification at TL9-10, 16× at 11, or 32× at TL12. The user must aim his weapon at the target he's observing. $8,000, 2 lbs., B/400 hr. LC4.

Tactical Programs

These programs augment the tactical or strategic acumen of police and military personnel by automating error-prone tasks. They assist the user without replacing him.

Silhouette (TL9)

This optical recognition program specializes in identifying targets of military interest and providing background or technical data. The quantity and accuracy of supporting information depends on the databases used. High-quality commercial databases offer expensive subscriptions and constantly updated content, but lack detail. Military databases are usually encrypted and contain very detailed information, including hyperspectral emission profiles, countermeasure tactics, and usage instructions. Military databases require Military Rank or Security Clearance. Complexity 5; double normal cost.

TacNet (TL9)

A software tool (p. 25) useful for combat troops, TacNet helps a leader monitor a combat force by tracking and displaying their positions, firing arcs, blind spots, command relationships, and more. This gives a bonus to Tactics if all parties are in communication. Complexity 5 (+1 Tactics), LC3 or Complexity 6 (+2 Tactics), LC2. 10 times normal cost.

Targeting (TL9)

This software tool augments the capabilities of a HUD link (above) by improving target acquisition speed, ballistic modeling, environmental compensation (adjusting for air pressure, wind, humidity, temperature, etc.), and

prioritizing targets for threat assessment. The program gives a bonus to a single Gunner or Guns specialization if used with a HUD link. Complexity 3 (+1 skill) or Complexity 4 (+2 skill). Five times normal cost. LC2.

Target Tracking

Used in conjunction with a sensor system (see Chapter 3) such as a radar, radio direction finder, or hyperspectral optics, this tracks up to 10 distinct targets or emission sources at a time. It displays size, signal strength, bearing, vectors, and other appropriate information on a moving-map display. Complexity 2; five times normal cost. Add +1 to Complexity and double cost per tenfold increase in tracking ability. LC4.

Targeting with Active Sensors

The most accurate way to aim a weapon is to slave a targeting program (p. 149) to a "tactical" active sensor (see Chapter 3) that has locked onto a target. This feeds real-time ranging data to the gunner and shows the gunner exactly how to move the weapon (or vehicle, if a fixed weapon) to hit the target.

This can only be used for a mounted weapon (i.e., one using Gunner skill). The combination of targeting program and active sensor gives the maximum possible targeting bonus. *Replace* all bonuses for scopes, computers, sensors, etc. with a bonus equal to the weapon's base Acc, up to a maximum of +9. (Acc does still increase normally with Aim maneuvers – +1 after one second, +2 after two seconds, etc.)

In order to gain this bonus, the target must be in range of the active sensor, and the program must be able to provide data directly to either the vehicle operator or whoever is operating the weapon mount.

Other Accessories

These accessories can be added to most of the weapons in this chapter.

Accessory Rails (TL9)

Firearms often have accessory rails for attaching optional systems such as sights and grenade launchers. Up to four accessory rails per weapon are allowed (under barrel, over barrel, side of stock, top of stock) but this will vary with weapon size and configuration. $100 and 0.2 lbs. each.

Gyrostabilized Weapon Harness (TL9)

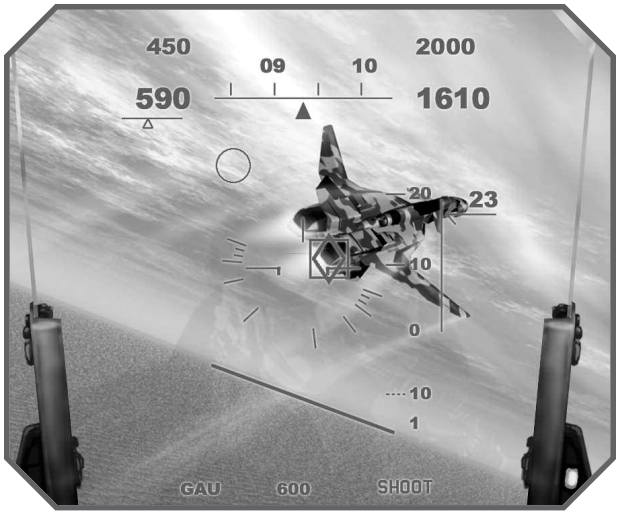
This articulated weapon harness (below) cancels the penalty for a Move and Attack (see p. B365). It is $1,000, plus $200 and 1 lb. per pound of loaded weight. LC4.

Access Control (TL9)

This electronic access system limits usage to authorized persons. The weapon will not fire for unauthorized users. Access control can be assigned to individual owners, but in military and paramilitary organizations it is common to set it so everyone in a unit can share the same weapons. Deactivating or reprogramming the safety system requires an Armoury (Small Arms) or Electronics Operation (Security) roll at a -2 penalty. The first attempt takes 10 seconds; subsequent attempts require 10 minutes per try.

Transponder Ring: A ring worn by the user that contains a radio transmitter with a one-inch range. The transmitter sends a coded authorization message to the weapon, which will not fire unless the correct ring is worn. The ring may be permanently built into an armored suit glove, if desired. $100. LC4.

Recognition Grip: A multi-function biometric scanner built into the grip. It can respond to palm prints or voice prints. It may also require both identifiers for maximum security. $100. LC4.



Self-Destruct Anti-Theft (TL10^)

A miniature biosensor in the weapon's handgrip automatically scans the genetic pattern of the holder. If that pattern matches one of the authorized users in its memory, the weapon will fire. If not, the weapon will lock its firing circuits and begin a destruct sequence. It may or may not warn its holder!

To abort the destruct sequence, the unrecognized holder must give the weapon's computer a verbal authorization code. If the correct code is not given in 10 seconds, the gun self-destructs, doing 6d×4 explosion damage.

With the correct code (a single word and number combination, e.g., "Wolf 323") the weapon can be reprogrammed to accept the biopattern of the holder. Each code is unique to each weapon. Special codes are also possible, such as one to delete biopatterns, or one which causes the weapon to destroy itself immediately when fired. Any attempt to circumvent the anti-theft system requires proper tools and a roll against Electronics Operation (Security)-3. Each attempt takes half an hour; failure activates the destruct sequence, while critical failure causes an immediate explosion. $100. LC3.

Articulated Weapon Harness (TL9)

This is used to steady very heavy weapons. It straps on and has a chest plate in front, with a supporting arm and

three hydraulic joints positioned to allow universal motion and easy suspension. It has the same effect as a bipod (ST requirement of the weapon is reduced by 2/3 and the weapon counts as braced), but can be used while standing up or moving. The user must still operate the weapon normally, using his own hands to aim and fire it.

The harness must be built for a specific weapon, and is generally limited to weapons with Bulk -4 or more. It is $50 and 0.5 lbs. per pound of loaded weight for the weapon it is built for – e.g., a harness for a 20-lb. machine gun is $1,000, 10 lbs. LC4.

Diagnostic Computer (TL9)

These smart integrated electronics give +1 to skill rolls to fix damage or malfunctions. Diagnostic computers are standard in all TL9+ firearms at no extra cost.

D-Tag (TL9)

This is a tiny receiver built into a weapon or other item. Upon receiving a coded signal on a specific radio frequency, it sends out a return signal. D-tags are often built into police equipment, and some regimes may put them in weapons sold to civilians. A successful Electronics Operation (Security) roll is required to find it; a second roll (at -2) must be made to deactivate it without disabling the weapon or notifying the authorities. $20. LC4.

IFF Interrogator (TL9)

Friendly fire casualties are a constant problem on chaotic battlefields. An IFF interrogator identifies friends and foes before a soldier pulls the trigger on the wrong target.

A TL9 interrogator is an eye-safe IR or UV laser (usually built into a weapon's standard laser sight) that emits a pulse-coded message at the target. TL10+ versions may differ in the type of signal beamed to the target, but the process is the same. This message contains an identification number, communication response frequency, and an encrypted code.

If the target is wearing an IFF system (p. 188), then it can decipher the code and transmit a brief message in reply. The interrogator then identifies the target as friendly, unidentified, or known hostile. Feedback is displayed on the soldier's HUD sight or augmented reality display, but blinking LEDs on the interrogator also provide positive response.

IFF systems have some disadvantages: over-reliance on technical identification, difficulty using the IFF interrogator in cluttered environments, and the potential for compromising the user's presence. The range of the IFF system is also limited: assume a range of 500 yards at TL9, doubling for each additional TL. Beyond this range, the GM may require Electronics Operations (Sensors) rolls to get a clear identification, with potentially disastrous results in the case of failure. $100.

Power Holster (TL9)

This is available for any pistol-type weapon or knife. It consists of three parts: a wrist sensor unit, a homing sensor on the handgrip of the weapon, and a break-away holster. When the wrist sensor detects nerve impulses that mean the wearer wants to draw, the holster ejects the weapon toward the hand. This lets the weapon be readied instantly. Each make of item requires a separate holster. A power holster adds +TL/2 to the Knife, Pistol, or Ammo specialization of Fast-Draw. $1,000, 2 lbs., B/100 uses. LC4.

Sniper Mirror (TL9)

A laser gunner using a visible-light laser may set up a high-quality optical mirror for ambushes. The sniper can fire at the target's image in the mirror; the beam will reflect off and strike the target. The mirror can be remotely controlled with a communicator.

The range is equal to the range of the target to the mirror, plus the range from the mirror to the sniper. The sniper is at -4 to skill when performing this maneuver.

When strategically placed (the GM may require a Tactics or Traps roll), these mirrors allow a laser sniper to fire around corners, and may confuse the enemy about the direction from which fire is coming. The standard mirror is about two feet across when in use, but folds to the size of a paperback book. $500, 1 lb. LC4.

Tripod (TL9)

A tripod may be added to any mounted weapon (M notation next to ST), allowing it to be set up on the ground rather than on a vehicle.

Ignore a weapon's ST requirement when it is tripod-mounted. Removing the weapon from its tripod or reattaching it takes at least three Ready maneuvers.

A tripod provides a 180º arc of fire and allows the weapon to be elevated or depressed. The weapon requires two hands to use, and the user must usually sit or kneel behind the tripod. A typical tripod can mount a weapon that requires ST 25 or less, or any non-weapon sensor that weighs up to 125 pounds. $1,250, 25 lbs. LC4.

Powered Tripod Mount (TL9)

A tripod can have an electric motor built into it. If the weapon has a sensor such as a radar or motion detector plugged into it (see *Plug-in Gadgets*, pp. 15-16), it can be remotely controlled via computer. If the computer has appropriate AI software, it can fire autonomously. A typical powered tripod can fire any weapon that requires ST 25 or less, or direct any non-weapon sensor up to 125 lbs. weight. $5,000, 50 lbs. D/100 hr. LC4.

Shoulder Servomount (TL9)

This is a strap-on half-backpack with a gyrostabilized servo arm. It holds a single weapon over the user's shoulder. The weapon is aimed with a heads-up display, and can swivel to fire at any target in front of the user.

The device has the same effect as a gyrostabilized weapon harness, with the addition that the user does not use his hands to control the weapon. This is equivalent to the Extra Arm (Weapon Mount) advantage.

A servomount weapon should be used with a HUD. If not, the user fires the weapon at a -2 penalty, and may not take Aim maneuvers. An AI can also control a servomount, freeing up the user for other activities, such as firing a handheld gun.

It's possible to wear up to two shoulder servomounts, one over each shoulder. The gear is heavy, so shoulder servomounts are most often used by battlesuit troopers, or by nonhuman or disabled warriors who lack usable limbs.

A shoulder servomount is $5,000 plus an extra $1,000 and 3 lbs. per pound of weapon loaded weight. Thus, a servomount for a seven-pound weapon is $12,000 and 21 lbs. LC3.

Smartgrip (TL10)

A smart-matter pistol grip and trigger can be added to any firearm. It automatically adjusts to the user's strength and hand shape. This makes the weapon easier to fire, reducing the ST requirement by 1. $500, LC4.

Gravitic Compensator (TL11^)

This inertia-damping gravitic field generator reduces the weapon's recoil and negates most of its weight. It can be added to any gun or beam weapon. When activated, it reduces Recoil to 1 and ST to 0. $100, 1 lb. and B/10 hr. per 10 pounds or fraction of loaded weight (excluding the weight of the gravitic compensator). LC4.

Warheads and Ammunition

The default warhead for guns and missiles is an inert metal projectile, such as a jacketed lead slug. However, most ultra-tech weapons routinely fire more sophisticated (and deadly) rounds. The warheads described below are additional options.

For mines and hand grenades, there is no default warhead; each grenade or mine must be given one of the options described below.

Some types of warheads are only available for certain size classes – for example, swarm warheads must be at least 25mm.

The warhead sizes are notional. Feel free to rename a 25mm warhead "20mm" or "30mm" if that better fits a particular weapon description.

Conventional

Conventional rounds are ordinary kinetic-energy, chemical, or explosive warheads.

Armor-Piercing Hard Core (APHC) (TL9)

These bullets or darts have a dense, armor-piercing core. Add a (2) armor divisor for most guns or missiles; this is not available for Gauss and rail guns, which already use similar ammunition. If the gun caliber is below 20mm, damage type degrades: pi++ drops to pi+, pi+ to pi, and pi to pi-. There is no effect on pi-. Unavailable for hand grenades or mines. Double normal cost. LC2.

Armor-Piercing Discarding-Sabot (APDS) (TL9)

A sub-caliber tungsten dart encased in a plastic sheath that falls away when the round leaves the barrel. APDS works like APHC, but has a higher velocity: add 50% to range and +1 damage per die. This option is unavailable for railguns (which already use saboted ammunition), hand grenades, or mines. Five times normal cost. LC1.

Armor-Piercing Enhanced Penetrator (APEP) (TL9)

An APDS round with a core made of tungsten-reinforced bulk amorphous metal (at TL9). This provides equivalent or superior performance to depleted uranium without toxic residue. Double range and give a (3) armor divisor to most guns and missiles; this is not available for Gauss and rail guns, which already use similar ammunition. Reduce the class of piercing damage by one step (to a minimum of pi-) unless the gun is 20mm caliber or larger. Unavailable for hand grenades or mines. Ten times normal cost. LC1.

Armor-Piercing Hardcore Explosive (APHEX) (TL9)

A warhead with a high-density penetrator and a small charge fused to explode after penetrating. APHEX inflicts normal piercing damage with a (2) armor divisor, along with the damage shown below as a follow-up attack:

APHEX Warhead Table

Warhead	*Damage*
10mm	1d-4 cr ex [1d-2]
15mm	1d-2 cr ex [1d-1]
18.5mm	1d-1 cr ex [1d]
25mm	1d cr ex [1d+1]
40mm	2d cr ex [2d]
64mm	4d cr ex [3d]
100mm	8d cr ex [5d]

Add +1 per die to the crushing explosive damage at TL10-12. Damage in brackets is cutting fragmentation damage.

This warhead is only available for 10mm or larger rounds; it is unavailable for hand grenades or mines. The normal armor divisor of Gauss guns and electromagnetic guns is downgraded to (2) when using APHEX ammunition.

APHEX warheads have four times normal cost. LC1.

Biochemical Aerosol (TL9)

This releases an airborne chemical agent (see *Gases and Clouds,* pp. 159-160). The cloud fills the indicated area, usually lasting for about five minutes if there's no wind. The effect depends on the agent.

Biochemical aerosol is available for any 10mm or larger round. A 10mm round will only affect a target if he's struck in the face; it carries too little gas to affect a significant area. Grenades and satchel charges inflict the damage shown below. Guns and launchers *replace* their normal piercing damage with the damage shown below. The table also shows the number of doses required to fill a typical warhead – for example, filling a hand grenade (64mm) will require 150 doses of the chemical.

Biochemical Aerosol Table

Warhead	Damage	Doses
10mm	spec. (face)	1
15mm	spec. (1 yard)	3
18.5mm	spec. (1.5 yard)	5
25mm	spec. (2 yards)	10
40mm	spec. (4 yards)	40
64mm	spec. (7 yards)	150
100mm	spec. (10 yards)	300

They are normal cost *plus* the cost of filler times the number of doses. See *Gases and Clouds* (pp. 159-160) for the cost of various fillers, their effects, and their LC.

Biochemical Liquid (TL9)

This is designed to release a ground-covering heavier-than-air liquid or foam. The effects are the same as biochemical aerosol, but with a different burst radius. Most liquids are persistent, remaining until cleaned up or evaporated.

Biochemical liquid is available for any 15mm or larger round.

Biochemical Liquid Table

Warhead	Damage	Doses
15mm	spec. (1 yard)	1
18.5mm	spec. (1.5 yards)	2
25mm	spec. (2 yards)	4
40mm	spec. (4 yards)	16
64mm	spec. (9 yards)	65
100mm	spec. (18 yards)	250

They are normal cost *plus* the cost of filler times the number of doses. See *Foams and Liquids* (pp. 160-161) for the cost of various fillers, their effects, and their LC.

Flare (TL9)

These release a pillar of smoke and burn brightly, removing all combat penalties for darkness over their illumination radius. They may start fires if in contact with flammable material, and will do 1d burning damage to anyone directly struck. They work normally underwater.

When a flare is set off, anyone within 1% of the illumination radius who is looking in that direction must succeed at a HT roll or be blinded for seconds equal to the margin of failure; this is a vision-based affliction effect. Roll at HT-3 if the flare is set off in darkness.

Flares burn for five minutes. They are visible to the horizon if fired at ground level and for up to 20 miles if fired in the air (weather and intervening terrain permitting). Flares are usually equipped with a small parachute or contragrav generator to allow them to stay in the air for the duration of the burn.

Flares are available for any 15mm or larger round. The radius shown under damage is the illumination radius.

Flare Table

Warhead	Damage
15mm	spec. (150 yards)
18.5mm	spec. (185 yards)
25mm	spec. (250 yards)
40mm	spec. (400 yards)
64mm	spec. (600 yards)
100mm	spec. (1,000 yards)

Flares are double normal cost. LC4.

High Explosive (HE) (TL9)

A warhead with a large explosive charge and a fragmenting case. This is the basic warhead for fragmentation hand grenades, and is also commonly used by grenade launchers and light artillery. It is available for any 10mm or larger round.

HE projectiles (except hand grenades) that are built at TL9 incorporate a programmable fuse that can be set for either impact or, if the target is at least 40 yards distant, for proximity detonation – see below.

Grenades and satchel charges with HE warheads inflict the damage shown below. When set for impact detonation, guns and launchers with HE warheads inflict their normal piercing damage with a (0.5) armor divisor, plus a follow-up attack causing the damage shown below.

HE Warhead Table

Warhead	Damage
10mm	1d cr ex [1d-2]
15mm	2d cr ex [1d-1]
18.5mm	2d+2 cr ex [1d]
25mm	4d cr ex [1d+1]
40mm	8d cr ex [2d]
64mm	8d×2 cr ex [3d]
100mm	6d×5 cr ex [5d]

Add +1 per die to the crushing explosive damage at TL10-12. Damage in brackets is cutting fragmentation damage. HE warheads are normal cost. LC2.

Proximity Detonation

If the warhead is fused for proximity detonation, a sensor will detonate it when it is in the air, close to the intended target. Use the *Attacking an Area* (p. B414) rules: roll to hit at +4, and the square of the margin of failure is the distance missed by. Proximity-fuse airbursts can attack areas in space or the air as well as an area of ground.

A proximity detonation round inflicts only fragmentation damage, typically in a cone in the direction of the shot. If used for indirect fire, apply the rules for *Airbursts* (p. B415): the fragments rain down from above, bypassing any cover that is not overhead and negating attack penalties to hit crouching, kneeling, sitting, or prone targets. Most HE rounds use laser proximity fuses, which are immune to radio-frequency jamming.

High Explosive Concussion (HEC) (TL9)

This has a light body to minimize fragmentation. It is available for any 10mm or larger round. Grenades and satchel charges with HEC warheads inflict the damage shown below. Guns and launchers with HEC warheads inflict their normal piercing damage with a (0.5) armor divisor (no armor divisor for electromagnetic guns), along with a linked attack causing the damage shown below:

HEC Warhead Table

Warhead	*Damage*
10mm	1d cr ex
15mm	2d cr ex
18.5mm	2d+2 cr ex
25mm	4d cr ex
40mm	8d cr ex
64mm	8d×2 cr ex
100mm	6d×5 cr ex

Add +1 per die at TL10-12. Concussion warheads are normal cost. LC2.

Hollow-Point (HP) (TL9)

These bullets expand in flesh, causing bigger wounds. This improves damage type: pi- becomes pi, pi becomes pi+, and pi+ becomes pi++. However, HP ammo has trouble penetrating barriers or armor; add an armor divisor of (0.5). Unlike lower-TL hollow-point ammo, ultra-tech hollow-points never have problems expanding. They're unavailable for grenades, mines, or weapons of 15mm+ caliber. Normal cost. LC4.

Shaped Charge (TL9)

This is a precision shaped charge with secondary explosive and fragmentation effects. The explosion forges the warhead into a high-velocity, high-temperature metal jet which can punch a small hole through most types of armor.

These warheads are available for any 25mm or larger round. Grenades and satchel charges use the damage listed below. Guns and launchers replace their normal piercing damage with the damage shown below.

Shaped Charge Warhead Table

Warhead	*Damage*
25mm	5d×3(10) cr inc + linked 2d cr ex [1d+1]
40mm	6d×4(10) cr inc + linked 4d cr ex [2d]
64mm	6d×7(10) cr inc + linked 8d cr ex [3d]
100mm	6d×10(10) cr inc + linked 8d×2 cr ex [5d]

Add +1 per die to the crushing incendiary damage at TL10-12. Damage in brackets is cutting fragmentation damage. Shaped charge warheads are double normal cost. LC1.

Memory Baton (TL9)

These expanding memory-plastic slugs are available for all weapons of 15mm or larger caliber. Change damage to crushing, add a (0.25) armor divisor and double knockback modifier, and reduce range to 1/5 range. They're unavailable for grenades or mines. Five times normal cost. LC4.

Monochain (TL9^)

This duplex-type round consists of two slugs with a foot-long strand of monowire slung between them. They spread apart after leaving the barrel, creating a high-speed flying garrote that slices anything in its path. Monochain has half the damage and range of an ordinary solid round, but gets +1 to hit. If it hits a neck, face, skull, extremity, or limb (or anywhere on a foe who has SM -2 or less) it does cutting damage with a (10) armor divisor. Unavailable for mines or hand grenades. Five times normal cost. LC2.

Shotshell (TL9)

Multiple-projectile rounds are available for grenade launchers, shotguns (including Gauss shotguns), and gyrocs. Divide the damage by 4, reduce the damage type from Pi++ to Pi, halve Range, add a ×9 multiplier to RoF, and reduce Rcl to 1. Normal cost. LC4.

Smart Explosively Forged Projectile (SEFOP) (TL9)

This is a multi-purpose sensor-fused round capable of top attack. The round will detonate several feet away and usually above the target, forging the warhead into a high-density slug that attacks from overhead.

SEFOP warheads are only available for homing projectiles. If fired to overfly the target, they may choose to attack the side they are facing or the top. If the warhead attacks from the top, it ignores penalties due to posture and cover that does not protect from above.

SEFOP warhead damage replaces the piercing damage of the weapon. TL10+ SEFOP warheads can also be programmed before firing to function as APHEX warheads. Decide which mode to use before the weapon is fired.

SEFOP Warhead Table

Warhead	Damage
15mm	4d (2) imp inc
18.5mm	5d (2) imp inc
25mm	5d×3 (3) cr inc
40mm	6d×4 (3) cr inc
64mm	6d×7 (3) cr inc
100mm	6d×10 (3) cr inc

Add +1 per die at TL10-12. SEFOP warheads are five times normal cost. LC2.

Tangler (TL9)

A tangler warhead releases a mass of sticky weblike polymers. Anyone struck is grappled and rooted in place. The victim cannot select the Move or Change Posture maneuvers or change facing, and is at -4 to DX. The ST of this effect depends on the warhead size; see the table below. Additional hits *layer* over a victim; each extra layer further increases ST.

To break free, the victim must win a Quick Contest of ST or Escape skill against the ST of the attack. Each attempt takes one second. If the victim fails to break free, he loses 1 FP but may try again. Alternatively, he may try to destroy the tanglestrands. Innate Attacks hit automatically; other attacks are at -4. External attacks take no penalty, but risk hitting the victim on a miss (see *Striking Into a Close Combat,* p. B392). The tanglestrands have DR = ST/3 (round down). Each point of damage reduces ST by 1. At ST 0, it is destroyed and the victim is freed.

The 64mm and 100mm tangler warheads fill a one-yard radius: anyone standing next to the target struck will also be affected, as an area-effect attack. Hand grenades and mines use the warhead damage. Guns and launchers replace their piercing damage with the damage shown below.

Tangler Warhead Table

Warhead	Damage
25mm	ST 15 (+1 per additional layer)
40mm	ST 24 (+2 per additional layer)
64mm	ST 36 (+2 per additional layer); 1-yard radius
100mm	ST 60 (+3 per additional layer); 1-yard radius

Tangler warheads are double normal cost. LC4.

Thermobaric (TL9)

These volumetric-slurry warheads produce high temperatures and massive overpressures by releasing a flammable explosive mixture and then igniting the cloud. They are used in mortars, missiles, and grenades, and their devastating effectiveness is one reason for the popularity of sealed combat armor.

They are available for 25mm and larger warheads. Hand grenades and mines use the warhead damage. Guns and launchers with thermal warheads replace their normal piercing damage with the warhead damage shown below.

Thermobaric warheads rely on combining with air for much of their blast. Divide the damage by 4 in trace or vacuum conditions, and by 2 in very thin atmospheres.

Warhead	Damage
25mm	8d cr ex inc
40mm	8d×2 cr ex inc
64mm	6d×5 cr ex inc
100mm	6d×10 cr ex inc

Add +1 per die at TL10-12. Thermal warheads are five times normal cost. LC1.

Burrow Darts (TL10)

These needles or bullets flex and change shape once they enter flesh, enlarging the wound channel and burrowing into the body. Burrow darts are only available for guns doing small piercing or piercing damage (i.e., under 10mm). They have a (0.5) armor divisor, plus a special cyclic follow-up attack: if even 1 point of injury was inflicted, the darts will burrow, inflicting 1 HP of injury each turn until the victim is dead, or seconds have passed equal to the caliber in mm. Digging a burrowing projectile out requires a sharp instrument and a First Aid roll (at -1 per second it has burrowed). Success or failure does one 1 HP of injury; success also removes the projectile. If a victim tries to remove a burrowing projectile from his own body, remember to also apply the shock penalty from its damage. Triple normal cost. LC2.

High Explosive Multi-Purpose (HEMP) (TL10)

This shaped-charge warhead can be miniaturized to fit into a bullet-sized projectile. HEMP is available for any 10mm or larger round. Guns and launchers replace their normal piercing damage with the damage shown below.

HEMP Warhead Table

Warhead	Damage
10mm	8d(5) imp inc + linked 1d-2 cr ex [1d-2]
15mm	5d×2(5) imp inc + linked 1d cr ex [1d-1]
18.5mm	6d×2(5) imp inc + linked 1d+1 cr ex [1d]
25mm	6d×3(10) cr inc + linked 2d cr ex [1d+1]
40mm	6d×5(10) cr inc + linked 4d cr ex [2d]
64mm	6d×8(10) cr inc + linked 8d cr ex [3d]
100mm	6d×12(10) cr inc + linked 8d×2 cr ex [5d]

Add +1 per die to the impaling incendiary or crushing incendiary damage at TL11-12. Damage in brackets is cutting fragmentation damage. HEMP warheads are double normal cost. LC1.

Stingray (TL10)

A stingray round is a charged capacitor sheathed in an insulator which is burned off in flight. This warhead is only available for 10mm or larger rounds, and not for hand grenades or mines. A stingray round inflicts half normal piercing damage with a (0.25) armor divisor, then discharges a linked attack that inflicts the lethal electrical damage (p. B432) shown below:

Stingray Round Table

Warhead	*Damage*
10mm	1d-3 burn sur
15mm	1d-1 burn sur
18.5mm	1d burn sur
25mm	1d+1 burn sur
40mm	2d burn sur
64mm	3d burn sur
100mm	5d burn sur

Stingray rounds are five times normal cost. LC2.

Swarm (TL10)

This is a padded container designed to release swarmbots (pp. 35-37). They are available for 40mm or larger warheads. The number of one-square-yard swarms carried by the warhead is shown below.

Hand grenades and mines use the warhead effect. Guns and launchers replace their normal piercing damage with the warhead damage shown below.

Swarm Warhead Table

Warhead	*Damage*
40mm	spec. (1-square-yard swarm)
64mm	spec. (4-square-yard swarm)
100mm	spec. (16-square-yard swarm)

They are five times normal cost *plus* the cost of the swarm. See *Swarmbots* (pp. 35-37) for the cost of various swarms, their effects, and their LC.

Armor Piercing Hyperdense Dart (APHD) (TL11)

"Hypercore" is a long fin-stabilized dart with a hyperdense metal penetrator. It has armor divisor (5) and double range. Reduce the class of piercing damage by one step (to a minimum of pi-) unless the gun is of 20mm or larger caliber. Unavailable for hand grenades and mines. Ten times normal cost. LC1.

Nuclear and Antimatter

In most societies, these weapons are strictly controlled. Their deployment is a matter for the highest levels of government, or the goal of a mastermind's sinister plot. An entire adventure may hinge on a single nuclear warhead, or the repercussions of its use.

However, that doesn't always have to be the case. Tactical nuclear warfare is common in some military science fiction, with every platoon, squad, or even infantryman issued one or more mininukes . . . usually in conjunction with a battlesuit to give them some chance of survival.

Mininuke (TL9)

A mininuke uses a small laser diode, nuclear isomer, metallic hydrogen explosive, or microscopic pellet of antimatter to trigger a nuclear fusion; similar technology is also used to create the fuel pellets for nuclear pulse drive spacecraft. This results in a "clean" nuclear fusion explosion with limited or no radioactive fallout (although there is still radiation from the blast itself).

Nuclear weapons are rated for their yield in kilotons of TNT. They inflict crushing damage with the explosion damage modifier, plus additional linked burning damage with the explosion, radiation, and surge damage modifiers. About half the energy is in the blast wave, and the rest is in the heat and radiation pulse. (Mininukes produce more radiation and less concussion than larger bombs.)

A mininuke has a dial-a-yield setting that can be set from 0.01 kilotons to one kiloton of explosive force. This takes a Ready maneuver. The *minimum* size of the mininuke depends on TL: 100mm at TL9, 64mm at TL10, 40mm at TL11, and 25mm at TL12.

Mininuke Warhead Table

Warhead	*Damage*
0.01 kiloton	6d×200 cr ex
linked	4d×200 burn ex* rad sur
0.1 kiloton	6d×600 cr ex
linked	6d×400 burn ex* rad sur
1 kiloton	6d×2,000 cr ex
linked	4d×2,000 burn ex* rad sur

* Divided by distance from the blast center, rather than by 3 × distance.

Cost is 1,000 times normal. LC0.

Micro-Antimatter Warheads (TL10)

These warheads contain small amount of antimatter in a shielded magnetic or force field "bottle." When the warhead is detonated, it reacts with ordinary matter and is annihilated, converting 100% of its own mass, and the same mass of ordinary matter, to energy. This inflicts burning damage with the explosion and surge damage modifiers, plus linked toxic radiation damage.

Unlike mininukes, antimatter warheads are not dial-a-yield weapons. They create an intermediate explosion greater than conventional munitions but smaller than a nuke, with a high gamma radiation output but no significant nuclear fallout. The *minimum* size of the micro-antimatter warhead depends on TL: 100mm at TL10, 40mm at TL11, and 10mm at TL12 . . . at which point large-caliber TL12 pistols and rifles can fire antimatter bullets.

There are three typical sizes of antimatter warhead: 0.1 micrograms, 1 microgram, and 10 micrograms:

Micro-Antimatter Warhead Table

Warhead	*Damage*
0.1 micrograms	6d×4 burn ex sur*
linked	6d×10,000 tox rad†
1 microgram	6d×12 burn ex sur*
linked	6d×100,000 tox rad†
10 micrograms	6d×40 burn ex sur*
linked	6d×1,000,000 tox rad†

* Divided by distance from the blast center, rather than by 3 × distance.

† Divided by square of the distance.

The cost is 10 times that of a normal round, plus the cost of the antimatter (see *Demolitions*, pp. 88-89). LC0.

ENERGY

Energy warheads contain a disposable power cell or explosive power cartridge and some form of energy emitter. Some energy warheads destroy themselves while emitting energy. Others activate for several seconds, and can be picked up or attacked.

EMP (TL9)

This uses an explosive power cartridge to energize a non-nuclear electromagnetic pulse. Anything electrical (or anyone with the Electrical disadvantage) in the radius of the special effect (below) must make a HT-8 (2) resistance roll or be knocked out of action for seconds equal to the margin of failure. Robots become unconscious, while total cyborgs suffer the Seizure incapacitating condition (p. 429), ignoring FP loss if they have the Machine meta-trait.

EMP warheads are available for any 15mm or larger round. Grenades and satchel charges inflict the damage shown below. Guns and launchers replace their normal piercing damage with the damage shown below.

EMP Warhead Table

Warhead	*Damage*
15mm	spec. (1 yard) + 1d-4 cr ex
18.5mm	spec. (1 yard) + 1d-3 cr ex
25mm	spec. (2 yard) + 1d-2 cr ex
40mm	spec. (4 yard) + 1d cr ex
64mm	spec. (8 yard) + 2d cr ex
100mm	spec. (16 yard) + 4d cr ex

EMP warheads are 10 times normal cost. LC2.

Expendable Jammer (TL9)

These neutralize all enemy radio equipment within a certain radius, swamping it with static. They are available for any 10mm or larger round.

When a jammer goes off, it gives a -10 penalty to all Electronics Operation (Comm) rolls made to operate radio and radar equipment in the radius of effect. The enemy will know immediately that a jammer is operating, but not where it is. Duration is 30 minutes.

Jammer Warhead Table

Warhead	*Radius*
10mm	10-yard radius
15mm	15-yard radius
18.5mm	20-yard radius
40mm	40-yard radius
64mm	60-yard radius
100mm	100-yard radius

Jammers include a digital timer that can trigger at any time desired. This feature is often used as a diversion. They are five times normal cost. LC3.

Strobe (TL9)

Strobe warheads emit intense light, pulsing at frequencies that can induce seizures in many individuals. Anyone within the area of effect who is facing the strobe warhead when it goes off suffers a vision-based affliction attack. Failing the HT roll results in stunning and Blindness for seconds equal to the margin of failure. Failing by 5 or more (or *any* failure by someone with the Epilepsy disadvantage) results in an incapacitating seizure for minutes equal to the margin of failure. The effects dissipate with distance: add +1 to HT to resist for every yard away from the center of the effect.

The strobe option is available for any 25mm or larger warhead. Strobe grenades and satchel charges inflict the damage shown below, and guns and launchers replace their normal piercing damage with this damage.

Strobe Warhead Table

Warhead	*Damage*
25mm	HT-3 aff (3-yard radius)
40mm	HT-4 aff (4-yard radius)
64mm	HT-6 aff (6-yard radius)
100mm	HT-10 aff (10-yard radius)

Strobe warheads are four times normal cost. LC3.

Warbler (TL9)

Warblers are sonic area denial warheads that produce an ear-splitting shriek. This hearing-based affliction area effect dissipates with distance: add +1 to resist for every yard from the center of the effect. A failed HT roll results in both Deafness and moderate pain (p. B428) for minutes equal to the margin of failure. A failure by 5 or more causes lingering hearing loss (recover as per a crippling injury).

The warbler continues to function for up to 10 seconds. Repeated resistance rolls will be required if someone fails to succumb but remains in the zone – most people without hearing protection *leave*! Anyone within the area of effect is also at -10 on any Hearing rolls; anyone within twice the radius is at -5, and anyone within five times the radius is at -2.

The warbler option is available for any 25mm or larger warhead. Hand grenades and mines use the warhead damage. Guns and launchers replace their normal piercing damage with the warhead damage shown below.

Warbler Warhead Table

Warhead	Damage
25mm	HT-3 aff (3-yard radius)
40mm	HT-4 aff (4-yard radius)
64mm	HT-6 aff (6-yard radius)
100mm	HT-10 aff (10-yard radius)

Warbler warheads are four times normal cost. LC3.

Force (TL10^)

These warheads emit an omni-directional gravity pulse. They are related to pressor beam (p. 88) technology. A force warhead inflicts crushing damage with the explosive and double knockback damage modifiers. Force warheads are often preferred for fighting in vehicles or buildings, since they are not incendiary and produce no fragmentation.

The force option is available for any 15mm or larger warhead. Grenades and satchel charges inflict the damage shown below. Guns and launchers inflict the damage shown instead of their normal piercing damage.

Force Warhead Table

Warhead	Damage
15mm	2d cr dkb ex
18.5mm	2d+2 cr dkb ex
25mm	4d cr dkb ex
40mm	8d cr dkb ex
64mm	8d×2 cr dkb ex
100mm	6d×5 cr dkb ex

They are five times normal cost. LC2.

Plasma (TL10^)

Plasma warheads are essentially one-shot power cartridges. When armed, the warhead's internal plasma generator compresses a pellet of hydrogen fuel, then releases it as a blast of ionized plasma. Guns that fire small-caliber plasma warheads are often confused with energy weapons.

Plasma is available for any 10mm or larger warhead. Plasma warheads inflict burning damage with the explosion and surge damage modifiers.

Hand grenades and mines use the warhead damage. Guns and launchers with plasma warheads replace their normal piercing damage with the warhead damage shown below.

Plasma Warhead Table

Warhead	Damage
10mm	1d+2 burn ex sur
15mm	3d burn ex sur
18.5mm	3d+2 burn ex sur
25mm	6d burn ex sur
40mm	6d×2 burn ex sur
64mm	6d×4 burn ex sur
100mm	6d×10 burn ex sur

Plasma warheads are 10 times normal cost. LC1.

Implosion (TL11^)

These warheads generate a spherical hypergravity tractor-beam effect. The power cell burns out in a microsecond, but not before the bomb creates a powerful implosive force, pulling everything in range toward it before collapsing into a pinhead of matter surrounded by a shell of debris.

Implosion warheads inflict linked crushing damage with the double knockback damage modifier, and toxic damage with the explosion and radiation damage modifiers. The knockback effect pulls victims toward the center of the explosion rather than away. The toxic damage is divided by the distance, rather than by three times the distance, from the blast.

The implosion option is available for any 40mm or larger warhead. Grenades and satchel charges inflict the damage shown below. Guns and launchers inflict the damage shown instead of their normal piercing damage.

Implosion Warhead Table

Warhead	Damage
40mm	6d×25 cr dkb ex + 6d×40 tox rad ex
64mm	6d×50 cr dkb ex + 6d×60 tox rad ex
100mm	6d×100 cr dkb ex + 6d×100 tox rad ex

Implosion warheads are five times normal cost. LC0.

Psi-Bomb (TL12^)

A psi-bomb generates a burst of deafening psychic "noise." Smaller psi-bombs are employed much like present-day stun munitions – shielded special ops teams use them to stun unprotected individuals without causing damage to property or innocent bystanders. Larger psi-bombs can be dropped on unprotected troops prior to an assault, or used in a continuous bombardment to wear down the morale of civilians or soldiers alike.

Psi-bombs are available for 25mm or larger hand grenades, mines, guns, and missiles. They deliver an area-effect affliction attack. (Guns and missiles with psi-bomb warheads replace their piercing damage with the warhead's effect.) They have no effect on anyone with a Digital Mind or IQ 0.

Everyone within the radius of effect must make a Will-5 roll to resist a stunning affliction attack; DR has no effect, but a Mind Shield adds its bonus. Anyone who fails is stunned, and must roll at a -5 penalty to recover. Failure by 5 or more results in unconsciousness for minutes equal to the margin of failure. Victims who fail to resist also lose the last two seconds of their short-term memories.

Psi-Bomb Table

Warhead	Damage
25mm	spec. (2 yard radius)
40mm	spec. (4 yard radius)
64mm	spec. (8 yard radius)
100mm	spec. (16 yard radius)

Psi bomb warheads are 10 times normal cost. LC2.

Message Psi-Bomb

As above, but instead of psychic noise, the message psi-bomb generates a pre-recorded psychic "shout." This may be a single image, a short sentence, or even an emotion. They are easier to resist (roll vs. Will-2 instead of Will-5) and do not cause unconsciousness. They are sometimes used for signaling, sometimes for propaganda.

On a failure by 5 or more, the victim hears a psychic "echo" of the message looping through his mind after recovering from being stunned. This lasts minutes equal to the margin of failure, and is an irritating condition. Treat it as moderate pain (p. B428) due to the distraction effect. LC3.

Terror Psi-Bomb

These induce a feeling of fear. As above, but instead of a Will roll to resist an affliction attack, the victim rolls a Fright Check at -5 (Mind Shield still provides the usual bonus). The attack may be accompanied by a fearsome image, or it may simply be an overpowering sense of dread. The usual rules for failed Fright Checks apply.

Stasis (TL12^)

This warhead generates a spherical stasis web (p. 193), enveloping anything within the area of effect that is not protected by appropriate force fields (p. 190). The result is a stasis bubble, a mirror-surfaced sphere. If the target was at ground level, the sphere will be half buried, but it can be dug up and carried off if desired. The duration of the stasis web must be set before it is used; most military bombs are set for anywhere from an hour to a few months.

Stasis is available for any 40mm or larger warhead. Hand grenades and mines use the warhead damage. Guns and launchers replace their normal piercing damage with the warhead damage shown below.

Stasis Warhead Table

Warhead	*Damage*
40mm	spec. (2-yard radius)
64mm	spec. (3-yard radius)
100mm	spec. (5-yard radius)

Stasis warheads are 500 times normal cost. LC0.

Vortex (TL12^)

These contain tiny wormhole or hyperspace generators designed to detonate within an atmosphere and gravity field.

An activated vortex warhead sucks everything within its listed radius of effect into hyperspace, or through a wormhole to a random location. How easy or difficult it is to return is up to the GM. Objects larger than the radius of effect will not fit through.

Vortex is available for any 40mm or larger warhead. Hand grenades and mines use the warhead damage. Guns and launchers replace their normal piercing damage with the warhead damage shown below.

Vortex Warhead Table

Warhead	*Damage*
40mm	spec. (2-yard radius)
64mm	spec. (3-yard radius)
100mm	spec. (5-yard radius)

Vortex warheads are 1,000 times normal cost. LC0.

Biochemical and Nanotech Weapons

Advances in chemistry and biochemistry make more potent chemical weapons available at every TL – from lethal nerve gas to subtle pheromones. At higher TLs, nanotechnology is deployed in terrifying weapons that can reconfigure minds or devour entire ecosystems.

This section presents the gases and drugs most commonly used in combat, including lethal and nonlethal biochemical weapons, as well as ultra-tech chemical obscurants.

Gases and Clouds

These come in many varieties, from sleep gas and nerve gas to smoke and prismatic smoke. They create a cloud with a radius depending on the dispersal mechanism (see below). Chemical clouds may disperse within a few seconds or linger for minutes, depending on the wind. Most chemical clouds last for 300 seconds before dispersing; in winds of one mile per hour or more, divide this duration by the wind speed in mph. Most chemicals have no effect once dispersed, but some virulent poison gases cause injury even when greatly diluted.

The usual dispersion methods are a biochemical warhead (p. 153), an aerosol spray (p. 134), or a vortex ring projector (p. 134).

Riot Gas (TL9)

A non-lethal incapacitating gas often used for crowd control. Any living being within the cloud who breathes the gas must make a HT-4 roll to resist every second. If the roll fails, he is nauseated (p. B428) for as long as he remains in the cloud. If it fails by 5 or more, he will become violently ill, retching (p. B429) for as long as he remains in the cloud; after leaving it, he will be nauseated for minutes equal to his margin of failure. $2 per dose. LC3.

Musk (TL9)

This malodorous fluid boasts a chemical formula similar to skunk oil. Highly persistent and almost impossible to wash away, it is used by police to mark demonstrators or fleeing suspects, and can also be a self-defense weapon! Anyone sprayed suffers the Bad Smell disadvantage. The effects wear off after two weeks. Each hour of washing with high-tech detergents can reduce the duration of the stench by one day. A sealed suit protects the wearer but not the suit. $2 per dose. LC4.

Nerve Gas, Lethal (TL9)

Nerve gases are aerosolized liquids which disrupt the enzyme that transmits nerve signals. After exposure, the nerves become uncontrollable, resulting in a loss of motor function, breathing problems, pain, vomiting, convulsions, and death.

This is an area-effect contact agent with no delay and a HT-6 roll to resist (HT-3 if touching a contaminated area after the initial attack). Failure to resist inflicts 1d toxic damage. This is repeated at one-minute intervals until six cycles have passed.

Loss of 1/3 HP results in coughing and the Neurological Disorder (Mild) disadvantage. Loss of 1/2 HP results in being nauseated plus the Neurological Disorder (Severe) disadvantage. Loss of 2/3 HP adds the Neurological Disorder (Crippling) disadvantage. The victim suffers only one disorder due to the nerve gas, with the severity increasing as he loses HP. The severity of the disorder is decreased as the victim recovers HP, and the disorder is removed when the HP lost are less then 1/3 HP. $10 per dose. LC0.

Sleep Gas (TL9)

An advanced sedative, such as an engineered variant of the heroin molecule, mixed with a skin-penetrating agent. It causes rapid incapacitation. It is a contact agent that requires a HT-6 roll to resist. Failure results in unconsciousness lasting for minutes equal to the margin of failure, followed by ordinary sleep. $0.50 per dose. LC2.

Smoke (TL9)

Smoke is used to obscure or mark an area. Screening smoke is white, gray, or sand-colored and gives a -10 penalty for visually aimed attacks or sighting through them (see Obscure, p. B72); it also blocks ladar. Smoke clouds take one second per five yards of burst radius to form. They linger for one to four minutes, depending on weather conditions.

Colored Smoke: used to mark targets or landing zones, but also difficult to see through (-7 penalty). $0.1 per dose. LC4.

Hot Smoke: Has the same effects as normal smoke. It also penalizes Infravision, Hyperspectral Vision, and Night Vision. $0.15 per dose. LC4.

Prism Smoke: Has the same effects as hot smoke, but also blocks most lasers. It has no effect on X-ray or gamma-ray lasers. $0.2 per dose. LC4.

Electromagnetic Smoke: Has the same effects as hot smoke, but is also effective against Radar and Imaging Radar. $0.3 per dose. LC4.

Anti-Tangler Aerosol (TL10)

This dissolves sticky foam (tangler) bonds in one second. $1 per dose. LC4.

Mask (TL10)

This agent neutralizes a wide spectrum of signature traces left behind by living beings. Any Forensics roll to detect chemical traces left by an individual or to track people by scent suffers a penalty of -6 if the trail passes through a Masked area. The masking agent itself is easily identified and tracked, making it somewhat less helpful to spray yourself with it! $30 per dose. LC2.

Paralysis Gas (TL10)

Paralysis gas is an advanced nerve gas. It is a nonlethal area contact agent that may be delivered via chemical warhead, spray, or vortex ring. For every turn spent in a paragas cloud, the victim must make a HT-6 roll to resist. If he fails by 1 or 2, he falls down and cannot move that turn. If he fails by 3 or more, he falls and is paralyzed for minutes equal to the margin of failure. On a critical failure, the paralysis gas causes 1d damage and results in a coma (p. B429). Paralysis gas is often used in riot control and security systems. $10 per dose. LC2.

Pheromone Spray (TL10)

Pheromone spray is a biochemical agent which enhances sexual attractiveness to members of the same species; aliens are almost never affected. It is a respiratory agent that requires a HT-2 roll to resist. Failure results in the Lecherousness (9) disadvantage for as long as the victim is in the cloud, plus minutes equal to the margin of failure. $20 per dose. LC3.

Radiant Prism (TL10)

A combination of prism and electromagnetic smoke. It lasts half as long, but also impairs infrared- and radar-aimed attacks or sighting (-5 penalty). If this smoke is breathed without a filter, it inflicts one point of damage per second. $3 per dose. LC3.

Foams and Liquids

These agents may be dispensed by liquid projectors or in biochemical liquid warheads.

Firefoam (TL9)

These fire-retardant chemicals put out any fire doing (TL-8) dice of damage or less within its area of effect, and temporarily reduce the damage of larger fires for 3d seconds. $1 per dose.

Metal Embrittlement Agent (MEA) (TL10)

This category of chemical agents induces rapid corrosion. Each agent is designed to weaken a specific metal,

inflicting 3d corrosion damage per hour to any object mostly made of that alloy, or with exposed vital parts made of it. If an SM +2 or larger object is completely within the area of effect, multiply the damage by the object's SM. The effect continues for 12 hours or until the object is decontaminated. $5 per dose, LC2.

Disassembler Nanoglop (TL11)

This consists of disassembler nanomachines in the form of a viscous slime rather than a diffuse cloud. At TL11-12, disassembler nanoglop fills much the same role as napalm. It has half the burst radius of normal chemical rounds; if that reduces burst radius to less than a yard, it means that it only affects a target that was directly hit.

Anyone in the affected area is covered with sticky nanoglop. The effect is the same as a disassembler nanocloud, but the greater density of the nanoglop *doubles* damage! The glop persists for only 15 seconds. If it misses, it splatters on the ground and begins eating through that. Disassembler nanoglop costs the same as disassembler clouds (p. 169).

Replicator Nanoglop (TL12): This has the same effect as replicating disassemblers (p. 169).

Poisons

Poisons may also be delivered by a hypo or by drug rounds, or as a contact poison (below). Two ultra-tech poisons:

Nerve Poison (TL9)

This is also available as a drug – a single dose injected into the body (by hypo, needler, etc.) requires a HT-7 roll to resist. Failure inflicts 1d toxic damage. This is repeated at one-minute intervals, until six cycles have passed.

Loss of 1/3 HP results in coughing and the Neurological Disorder (Mild) disadvantage. Loss of 1/2 HP results in being nauseated plus the Neurological Disorder (Severe) disadvantage. Loss of 2/3 HP adds the Neurological Disorder (Crippling) disadvantage. The victim suffers only one disorder due to the nerve gas, with the severity increasing as he loses HP. The severity of the disorder is decreased as the victim recovers HP, and the disorder is removed when the HP lost are less then 1/3 HP. $10 per dose. LC0.

Sleep Poison (TL9)

A sleep dose for hypos and dart guns is available. The victim must roll vs. HT-6.

Failure results in the subject becoming drowsy (p. B428), while failure by 5 or more results in unconsciousness, lasting for minutes equal to the margin of failure. $0.50 per dose. LC2.

Contact Poisons (TL9)

Contact versions of both nerve and sleep poisons may be placed on a blade (but not a vibroblade), smeared on a flat surface such as a doorknob, etc. As contact poisons, these are less effective. The HT roll not to succumb is at +2. Contact versions cost 10 times as much. The GM may require a roll against DX or Poisons skill to avoid an accident if applying it in haste. LC1.

Metabolic Nanoweapons

These nanomachines are designed to enter a living body and wreak havoc. They won't affect someone with Immunity to Metabolic Hazards, such as a machine. Metabolic nanoweapons can be delivered the same way as any other poison:

Blood Agent: This is a liquid spray that must enter a mucous membrane (eyes, mouth, open wound, etc.) to have effect. Use the *Blood Agent* rules (p. B437). Double normal cost.

Contact Agent: A nanoweapon mist designed to penetrate skin. Double cost for a gel that may be smeared onto an object, 10 times normal cost as a gas. Use the *Contact Agent* rules (p. B437).

Digestive Agent: A pill that can be dissolved in food or drink. Use the digestive agent rules (p. B437). Normal cost.

Follow-Up Poison: The nanoweapon must be injected, often via a hypo or drug projectile. Use the *Follow-Up Poison* rules (p. B437). Normal cost.

Respiratory Agent: A mist of active nanoparticles that must be breathed to have effect. Use the *Respiratory Agent* rules (p. B437). Five times normal cost.

Nanoburn (TL10)

An ultra-tech nerve agent using a suspension of nanomachines designed to invade the body and break down bodily functions, Nanoburn is effective against all carbon-based life forms. A HT-6 roll is required to avoid being paralyzed for three minutes times the margin of failure. If paralyzed, the victim takes 1d-1 toxic damage every three minutes over the next 30 minutes. Normal nerve poison antidotes are ineffective, but the drug Torpine (p. 206) stops the damage once taken. Aegis Nano (p. 206) is effective. $5 per dose. LC1.

Nanotracers (TL10)

These nanomachines function like a homing beacon (p. 105) except that they diffuse within the body. They are very difficult to remove without blood filtration (which requires a life support unit) or using Aegis or pharmophage nano (p. 206).

It takes one minute for nanotracers to spread through the body before they can begin signaling. They may use a radio signal, or they may cause the body to exude coded chemical cues which can be tracked by appropriate chemsniffers or someone with Discriminatory Smell. These will persist for a day or more, giving a +5 bonus to any tracking rolls to anyone who knows what the cues are and can detect them.

Nanotracers are designed to *hide*. Aegis nano (p. 206) get a roll against their skill to find them when they first enter the body, but roll at a penalty of -2 for TL10 nanotracers, -4 for TL11, and -6 for TL12.

Diagnostic nano can also find nanotracers: roll each hour of searching, at the penalties listed above. If diagnostic nano has identified them, Aegis nano can automatically destroy them. $100 per dose.

Splatter Nano (TL11)

Splatter is available only as a follow-up poison. Each "dose" contains thousands of cell-sized nanobot microbombs that circulate through the bloodstream. Upon command or after a programmed time delay, they explode and rip apart the victim's arterial system.

Splatter inflicts 1d toxic damage after it has circulated for at least a minute through the body. Each extra minute spent circulating in the body adds an extra +1d damage, to a maximum of 30d. Multiple doses increases the damage, e.g., three doses do 3d per minute to a maximum of 90d. Splatter comes in either timed or remote-control versions. Remote versions are triggered by receiving a specific coded radio pulse.

Aegis nano (p. 206) may be able to hunt down the splatter nanomachines before they detonate. Roll a Quick Contest of Skill each minute, with both nano types having a skill of 12 if they are TL11 or a skill of 14 if they are TL12. Each time the Aegis nano win a contest, the detonation damage is reduced by -1 per die. If the Aegis nano win six times, the splatter nano are exterminated.

The splatter nano may also detonate before the Aegis nano can extinguish them. For instance, suppose a dose of splatter is set to go off after a delay of five minutes. The Aegis nano get five contests of skill. They win three and lose or draw two. That means that damage becomes -3 per die, or 5d-15 instead of 5d. $100 per dose. LC2.

Shrike Nano (TL11)

Shrike nanomachines track down and eliminate defending Aegis nano (p. 206), clearing the way for other intruders. Each minute that shrike nanomachines are in the body, roll a contest of skill between the shrike nano and the Aegis nanomachines. If the Aegis nano wins, one dose of shrike nano is killed. If the shrike nano wins, the Aegis nano in the target's body is killed. Otherwise, they are still fighting.

Aegis nano defends with a skill of 10 at TL10, a skill of 12 at TL11, and a skill of 14 at TL12. Shrike nano have skill of 12 at TL10, a skill of 14 at TL11, and a skill of 16 at TL12. Their skill can be upgraded by doubling the number of doses the subject is injected with. Each doubling adds +1 to skill. If a user is impatient, shrike can be used simultaneously with other forms of invasive nano, in the hope that the shrike kills the Aegis nano before Aegis destroys the invaders. $500 per dose. LC2.

Dominator Nano (TL12)

These nanomachines enter the body, trick their way past the blood-brain barrier, and reconfigure deep neural structures in the subject's brain, altering his personality. This technology is similar to Instaskill (p. 59).

Each dose of dominator nanomachines is designed to permanently instill (or erase) a specific mental disadvantage or set of mental disadvantages. It only affects mundane mental disadvantages that are not self-imposed and that do not require a particular subject or object. The GM may also disallow any disadvantage that seems implausible, such as Unluckiness. Dominator nano often instills Amnesia, Cowardice, Non-Iconographic, Pacifism, Paranoia, and Slave Mentality.

Dominator nano has a six-hour delay and requires a HT-6 roll to resist. Failure results in the victim gaining (or losing) the programmed disadvantage. Superscience (TL12^) versions of dominator nano take effect after only a minute's delay.

Dominator nano's effects are permanent, but can be canceled by other nano, psych implants, etc. The attack has no effect if the user already has that disadvantage, or if he doesn't have the disadvantage that is to be erased.

Dominator nano costs $100 times the combined value of the mental disadvantages. For example, erasing or adding a -5-point disadvantage would cost $500 per dose. At double cost, dominator nano can reverse the changes it has wrought after a specified duration has passed. Superscience dominator nano is twice as expensive.

Some types of dominator nano erase disadvantages that a society finds offensive, or add those it considers desirable. Such types are LC2 and may be available to licensed physicians. Other types are LC1.

Parasite Seed (TL12)

A parasite seed is a template for a bioplas nanomorph (p. 111). To be activated, the apple-seed-sized capsule must be injected into or swallowed by an organic life form. It then releases nanomachines that begin transforming that being, using its body mass as raw material to construct a nanomorph. Each hour, the subject makes a HT-4 roll. Any success kills the parasite seed.

Any failure reduces the victim's HT by 3. When HT is reduced to 0, the victim dies and his body is transformed into that of a nanomorph: apply the nanomorph template.

The parasite seed includes the nanomorph's own AI, which overwrites that of the host's mind. It may also trap and store his mind as a ghost program. $10,000 per dose ($100,000 for mind-trapping seeds). LC1.

Melee and Thrown Weapons

No matter how advanced ranged weapons become, there will be times and places – stealthy assassinations, boarding actions, riot control, or just a startown brawl – where hand-to-hand combat cannot be avoided.

Physical Weapons

These weapons inflict damage by cutting, crushing, or impaling their victims, or by delivering explosive devices. Some are powered; others use ultra-tech material science.

Karatands (TL9)

These memory plastic gloves are flexible, but harden into an edge when the user strikes someone. They have the same effect as brass knuckles, but they're not as obvious. They can also be installed in flexible armor. $100 each, neg. weight. LC3.

Limpet Mine Dispenser (TL9)

A close-combat weapon designed to attach to a battlesuit or robot's arm. It is a "sleeve dispenser" for sticky limpet mines to slap onto the target. The mines attach themselves with molecular suction pads, then detonate after a preset interval.

To plant one, use Brawling or DX. A successful hit does no immediate damage; instead, it sticks a limpet mine onto the target.

The dispenser may be programmed to set mines with a time delay from 0 (going off at the end of the attacker's turn) to 100 seconds. Removing a limpet mine requires a Ready action and a successful ST roll, minus one-tenth the DR of whatever the mine is stuck to or -20, whichever is less.

If the mine was stuck to flesh, it does 1 HP damage when pulled off. If a mine is slapped on a part that cannot be reached (for instance, the small of the back), it can't be removed without help.

Limpet-mine dispenser magazines hold 10 limpet mines. Each mine has a 25mm warhead, and is identical to a shaped-charge limpet mine grenade. Limpet mines can also be stuck to the floor, walls, etc. for use as booby traps, but may not be thrown.

Rocket Striker (TL9)

A great axe, pick, scythe, spear, or warhammer may be fitted with a rocket striker, a small liquid-fuel engine that amplifies the force of the user's swing, thrust, or throw. A button on the weapon's haft triggers the rocket engine; skilled users activate it at the right moment. It has enough fuel for six boosted attacks at TL9 (doubled per TL after introduction).

The rocket striker must be activated before the to-hit roll. It adds +6 to Striking Strength. However, it also adds +3 to the weapon's ST requirement – it is easier to lose control of the weapon! This drawback does not apply to thrown spears. Add $500 and 1 lb. LC3.

Superfine Blade (TL9)

Superfine blades are advanced alloy, ceramic, or crystalline blades superior to steel. Any edged weapon that does cutting or impaling damage can have a superfine blade. It adds +2 to cutting and impaling damage and has a (2) armor divisor. Superfine blades are six times normal cost. LC4.

Monowire Blade (TL9^)

Monowire weapons owe their superior cutting ability to a strand of super-strong wire a few molecules thick, which is stretched along the edge of a reinforced sword or knife.

Monowire blades inflict +2 cutting damage and get a (10) armor divisor. Since the monowire is only along a blade's edge, it cannot cut into a flat surface. Any melee or thrown weapon that inflicts cutting damage can be made in a monowire version for 10 times normal cost. This upgrade is incompatible with superfine or vibroblade weapons. For other rules, see p. B406. LC3.

Monowire Whip (TL9^)

This is a weighted length of monomolecular wire attached to a short handle. It is a dangerous weapon, especially in the hands of an unskilled user (who may lose control of the weapon and injure himself with it). A control allows the wielder to vary length from one to seven yards, changing both reach and ready time. Adjusting the length requires a Ready maneuver.

When used to snare an opponent or a weapon, the whip cuts into its target, inflicting thrust+1d(10) cutting damage every turn it is pulled taut until the victim escapes. A "drop weapon" critical miss indicates the wielder hit himself or a friend. LC2.

Monowire Switchblade (TL10^)

This weapon combines elements of both a monowire blade and whip. It consists of a weighted monomolecular memory wire attached to a powered knife hilt. As long as the hilt feeds an electric current into the "smart" wire, the wire remains rigid like a sword. Toggle switches in the hilt allow the user to play out more wire to vary the blade length from 0 inches (retracting the blade into the hilt) to 15 feet, or to turn the current on or off. If the current is cut off, the wire becomes a flexible razor-sharp monowire whip. Changing length or switching the current on and off requires a ready action.

Limpet Mine Damage Table

BRAWLING or DX

TL	*Weapon*	*Damage*	*Reach*	*Parry*	*Cost*	*Weight*	*ST*	*Notes*
9	Limpet Mine Dispenser	varies	C,1	no	$200	2/0.6	–	See above

Monowire Whip Table

MONOWIRE WHIP (DX-6, Kusari-3, or Whip-3)

TL	*Weapon*	*Damage*	*Reach*	*Parry*	*Cost*	*Weight*	*ST*	*Notes*
9^	Monowire Whip	sw+1d-2(10) cut	1-7*	-2U	$900	0.5	5	See above

As a rigid weapon, the monowire switchblade's reach may vary from C to 5. It does swing + 1d + R(10) cutting damage, where R is its current reach (treat C as 0). It cannot thrust. The switchblade requires Force Sword skill when rigid. It can parry normally. The user must have enough room to swing the weapon: reach 3 to 5 isn't possible without that many yards of vertical or horizontal space. As a flexible weapon, the monowire switchblade's reach may vary from one to five yards, and it functions like a monowire whip (p. 163). If it runs out of power, the memory wire can no longer stay rigid, and the weapon functions only as a whip. B/10 hr. LC2.

Monowire Switchblade Table

FORCE SWORD (DX-5 or any sword skill at -3)

TL	*Weapon*	*Damage*	*Reach*	*Parry*	*Cost*	*Weight*	*ST*	*Notes*
10^	Monowire Switchblade	sw+1d+R(10) cut	C-5	0	$2,000	0.5	5	See above

MONOWIRE WHIP (DX-6, Kusari-3, or Whip-3)

–	*or*	sw+1d-2(10) cut	1-7*	-2U	–	–	5	

Vibroblade (TL10)

These blade weapons vibrate thousands of times per second. Any edged weapon that does cutting or impaling damage can be a vibroblade. Turning on the vibro effect takes a Ready action. A successful Fast-Draw roll activates it as the blade is drawn.

A vibroblade adds +1d to cutting damage and has a (3) armor divisor. This armor divisor increases to (5) if the blade is also superfine, or (10) if it is also hyperdense (below). If the vibro effect is turned off, it functions like an ordinary blade (with the normal benefits of superfine or hyperdense construction, if applicable).

The blade vibrates so rapidly that its movement is invisible, and it is impossible to tell a vibroweapon from a regular weapon of the same type. A Hearing roll made from one yard away will detect a faint hum that marks a vibroweapon for anyone familiar with it. Anyone parrying (or whose weapon is parried by) a vibroblade will recognize its nature as the blade cuts into their own.

Vibroblades are not compatible with monowire or nanothorn blades.

Vibroblades are powered by C cells; the cell powers them for 300/weapon weight seconds. Thus, a half-pound knife operates for 600 seconds. Vibroblades cost 10 times as much as regular melee weapons (30 times as much if also superfine). LC3.

Vibroblade damage improves at higher tech levels. Add +1 at TL11, or +2 at TL12.

Hyperdense Blades (TL11)

Any bladed weapon can have an edge of collapsed matter. Hyperdense blades add +2 to cutting and impaling damage and have a (5) armor divisor. Multiply the weapon's weight and ST requirement by 1.5 (round up).

Hyperdense blades cost $500 times the weight of the original weapon (before the modification) or 10 times normal cost, whichever is higher. LC3.

Nanothorn Blades (TL11^)

Nanothorn blades use branching monomolecular nanostructures that fit into and rip apart intermolecular bonds. The edge of such a weapon appears to be a smoky haze, and matter in contact with the blade appears to disintegrate. A nanothorn blade is available for any cutting weapon. It replaces the weapon's normal cutting damage with corrosion damage, with a (10) armor divisor. 20 times normal cost, or four times normal cost to upgrade a monowire whip or switchblade to use a nanothorn blade. LC1.

Stasis Switchblade (TL12^)

A stasis blade consists of a monomolecular wire (p. 103) stiffened by a stasis web (pp. 193-194). Its effect is identical to a monowire switchblade, but the blade may extend out to reach 30. Due to the stasis web, the switchblade cannot be broken and can be used to parry a force blade or similar energy-based attack. LC2.

Stasis Switchblade Table

FORCE SWORD (DX-5 or any sword skill at -3)

TL	*Weapon*	*Damage*	*Reach*	*Parry*	*Cost*	*Weight*	*ST*	*Notes*
12^	Stasis Switchblade	sw+1d+R(10) cut	C-30	0	$20,000	0.5	5	See above

MONOWIRE WHIP (DX-6, Kusari-3, or Whip-3)

–	*or*	sw+1d-1(10) cut	1-30*	-2U	–	–	5	

Energy Weapons

These include contact energy-discharge weapons, as well as weapons that generate a blade of energy.

Electric Stun Wands (TL9)

Also called shock clubs or stun sticks, these batons use low-powered electric currents to disorganize nerve function – an effect called electromuscular disruption.

They are often carried by police officers. Some are jointed, to prevent a victim taking damage even when struck by an adrenaline-charged riot policeman; others do damage as a baton.

The victim gets a HT-5 roll to resist. Nonmetallic armor gives a bonus equal to its DR, and the stun effect has a (0.5) armor divisor: add +2 to HT for every DR 1. On a failure, the victim's voluntary muscles convulse, and he is knocked down and paralyzed. He may roll vs. HT-5 each second to recover; however, the user may take a Concentrate maneuver to hold the baton in contact. This prevents recovery until it is removed, but drains a charge each second. DR does not add to HT on recovery rolls.

Stun wands are wielded using Shortsword skill. They use a B cell and strike 20 times before losing power. $100, 1 lb. LC4.

Zap Glove (TL9)

A zap glove looks like a heavy glove, but it contains electrical insulation (for the wearer) and a high-voltage generator. A person can attack with a zap glove by touching the victim. Boxing, Brawling or Karate allow the zap and normal damage simultaneously; Judo, Wrestling or a normal grapple apply the zap before any other effect. No attack roll is needed in social situations such as shaking hands.

A zap glove has two settings: "stun" and "kill." Changing settings takes a Ready maneuver. On "stun," the effect is the same as an electric stun wand. On "kill," the zap glove does 2d burning damage and uses the rules for lethal electrical damage (p. B432).

A B cell in the lining of the glove provides sufficient power for 10 zaps (each zap on "kill" setting counts as two). The glove protects the hand with DR 5. It can also be built into existing armor or vacc suit gauntlets. This increases the armor's cost and weight by $400 and one pound. A zap glove is LC3.

Electric Stun Wand Table

BOXING, BRAWLING, KARATE, or DX

TL	*Weapon*	*Damage*	*Reach*	*Parry*	*Cost*	*Weight*	*ST*	*Notes*
9	Zap Glove	HT-6(0.5) aff	C	No	$400	1	2	See above
	or "kill"	2d burn	C	No	–	–	2	

SHORTSWORD (DX-5, Broadsword-2, Force Sword-4, Jitte/Sai-3, Knife-4, Saber-4, Smallsword-4, or Tonfa-3)

TL	*Weapon*	*Damage*	*Reach*	*Parry*	*Cost*	*Weight*	*ST*	*Notes*
9	Electric Stun Wand	sw cr	1	0	$100	1	5	See above
	linked	HT-5(0.5) aff						
	or	thr cr	1	0	–	–	5	
	linked	HT-5(0.5) aff						

Neurolash (TL10)

These contact neural disruptor weapons use neural induction technology to stimulate paralysis, pain, or orgasmic pleasure in the brain and nervous system. Neurolash weapons are used for covert operations, pranks, as self-defense or dueling weapons, or by slavers, prison guards, and police of oppressive regimes.

Neurolash effects are affliction attacks identical in effect to a strike from a neural disruptor (pp. 121-122). Neurolash weapons come in all standard neural disruptor versions.

A neurolash is usually integrated into a baton or whip, but it may be added to any melee weapon. It delivers a HT-5 (2) affliction attack. A neurolash generator is not compatible with force blade, sonic, vibro, or monowire weapons. Add $500, .5 lbs., and a B cell (20 strikes). LC3.

Neuroglove (TL10)

The neuroglove delivers a neural shock by touch. It functions like a neural lash, but the larger contact area of the glove makes it more effective: it delivers a HT-6 (2) affliction attack. It can be used to strike with, or to ambush unsuspecting victims by shaking hands with them. It is also a favorite interrogation tool. Pain neurogloves delivering an Agony affliction are the most common, but gloves delivering all neural disruptor effects are available.

A neuroglove resembles an ordinary winter glove, and has DR 2. Any damage to the hand that penetrates its DR has a one-in-six chance of wrecking it as a weapon. $500, 0.5 lbs., B cell (20 strikes). LC2.

Tunable Neurolash (TL11)

A tunable neurolash or glove can be set to deliver different types of neurolash effect. Add +50% to the cost for each setting after the first one. It takes a Ready maneuver to change settings.

Tunable neurolash weapons are available in normal or high-power versions. High-power neurolash weapons can deliver a contact effect identical to a death beam, i.e., any failed resistance roll causes the Heart Attack mortal condition. LC3, or LC2 if high-power.

Neurolash Weapon Table

BOXING, BRAWLING, KARATE OR DX

TL	*Weapon*	*Damage*	*Reach*	*Parry*	*Cost*	*Weight*	*ST*
10^	Neuroglove	HT-6(2) aff	C	No	$500	0.5	2

SHORTSWORD (DX-5, Broadsword-2, Force Sword-4, Jitte/Sai-3, Knife-4, Saber-4, Smallsword-4, or Tonfa-3)

TL	Weapon	Damage	Reach	Parry	Cost	Weight	ST
10^	Neurolash Baton	sw cr	1	0	$520	1.5	6
	linked	HT-5(2) aff					
	or	thr cr	1	0	–	–	6
	linked	HT-5(2) aff					

WHIP (DX-5, Kusari-3, or Monowire Whip-3)

TL	Weapon	Damage	Reach	Parry	Cost	Weight	ST
10^	Neurolash Whip	sw-2(0.5) cr	1-3*	-2U	$560	6.5	8
	linked	HT-5(2) aff					

Sonic Shuriken (TL10^)

This throwing weapon is designed for use by assassins and commandos. A sonic shuriken appears to be a one-inch plastic disk. When activated and thrown it emits a disk of coherent sound twice its own diameter. Due to its small power source, the sonic blades only last for a second, but this is enough time for it to hit its target.

For an extra $50, a sonic shuriken may be fitted to spray a drug, poison or virus along the disk (two doses are required). This is a follow-up attack – if the shuriken penetrates armor, it delivers the drug or poison.

A sonic shuriken uses an A cell, which is completely drained after one use. It is reusable if its power cell is replaced. Because they use only A cells and are so easy to conceal (Bulk 0), these weapons are favorites with assassins. LC2.

THROWN WEAPON (SHURIKEN) (DX-4 or Throwing-2)

TL	Weapon	Damage	Acc	Range	Weight	RoF	Shots	Cost	ST	Bulk
10^	Shuriken	thr (3) cut	1	×0.5/×1	0.1	1	T(1)	$400	5	0

Force Swords (TL11^)

A force sword is an energy weapon that consists of a powered hilt, similar in size and appearance to a regular sword hilt. When activated, a blade of annihilating energy extends from the hilt and is held in shape by a force field.

A force sword may be activated as it is being readied on a successful Fast-Draw roll. Otherwise, it takes a Ready maneuver to activate it. In either case, it takes one second for the blade to form and stabilize.

A force sword inflicts tight-beam burning damage with a (5) armor divisor. Wounds that are injured are cauterized.

The force field is solid enough to allow it to parry objects or other force blades as well as containing the energy beam. The blade cannot break, and damages any weapon or body part it parries. It also damages any weapon or body part which parries or blocks it unless the defense roll was a critical success. Only another force sword or a sonic blade is unaffected.

A force sword can also be used as a very powerful cutting tool, doing its regular damage against any material.

Force Sword Weapons

Force Blade (TL11^): Generates a knife-like blade of energy up to 18." A good weapon for the startown docks when a force sword is a bit too fancy. C/300 seconds. LC3.

Force Glaive (TL11^): A suitable weapon for the guards of the galactic emperor. This collapsible staff contains a generator for an elongated force blade. When the blade is inactive, the weapon can be used as an ordinary baton or staff. 2C/420 seconds. LC2.

Force Sword (TL11^): The basic force sword: a powered hilt that generates a brilliant beam of annihilating energy. This weapon is as elegant as it is deadly. C/300 seconds. LC2.

Variable Force Sword: For an extra $500, the force sword's magnetic field may vary from dagger-sized to the length of a bastard sword. Changing the length requires a Ready action, and allows the reach to be altered from C to 2.

Force Whip (TL12^)

This is a *flexible* field of matter-disrupting energy with a 25' reach. It is more clumsy and random than a force sword, but very difficult to counter! B/100 seconds. LC2.

Force Sword Table

FORCE SWORD (DX-5 or any sword skill at -3)

TL	Weapon	Damage	Reach	Parry	Cost	Weight	ST
11^	Force Blade	6d(5) burn	C, 1	-1	$2,000	0.5	2
11^	Force Glaive	9d(5) burn	2, 3	0	$14,000	6	7†
11^	Force Sword	8d(5) burn	1, 2	0	$10,000	2	3

FORCE WHIP (DX-5, Kusari-3, Monowire Whip-3, or Whip-3)

TL	Weapon	Damage	Reach	Parry	Cost	Weight	ST
12^	Force Whip	4d(5) burn	1-8*	-2U	$5,000	1.25	3

Combat Robots

Combat robots may not be as flexible or versatile as human soldiers, and sophisticated machines may be individually more expensive. But they obey orders, they can survive where people can't, and they have no mothers to weep for them.

Warbots and Combat Androids

A warbot is a fighting machine designed to replace soldiers and supplement combat vehicles.

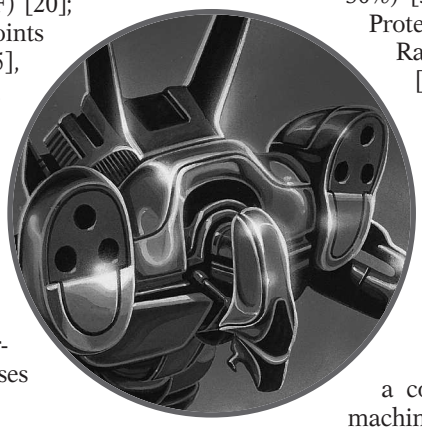
A combat android is a humanoid machine that can use the same equipment and facilities as ordinary soldiers. Some are also disguised as living beings.

Combat Android (TL9-12)

371 points

This is a humanoid combat machine, strong and heavily armored. Depending on the choice of traits, it could be designed as an assassin, bodyguard, police officer, or soldier.

Attributes: ST+10 [100]; DX+3 [60]; HT+2 [20].
Secondary Characteristic Modifiers: None.
Advantages: Absolute Direction [5]; Detect (Radio, Lasers, and Radar; Signal Detection, +0%) [20]; Discriminatory Hearing [15]; Doesn't Breathe [20]; Hyperspectral Vision [25]; Machine [25]; Sealed [15]; Silence 1 [5]; Temperature Tolerance 20 (-85°F to 210°F) [20]; Ultrahearing [5]; Vacuum Support [5]. 60 points chosen from among Ambidexterity [5], Appearance [var.], Combat Reflexes [15], Enhanced Time Sense [45], High Pain Threshold [10].
Perk: Accessory (Microframe computer) [1].
Disadvantages: Electrical [-20]; Restricted Diet (Very Common, power cells) [-10].



Lenses

Select *one* of these TL lenses. Then choose a machine intelligence lens (p. 27) and biomorphic lens (p. 28), and consider the optional lenses detailed below.

TL9 Model (+145 points): Add DR 30 [150]; Maintenance (one person, weekly) [-5]. $300,000, 150-300 lbs., 2D/8 hr. LC2.
TL10 Model (+231 points): Add DR 45 [225], Maintenance (one person, bi-weekly) [-3], Reduced Consumption 2 [4], and Telescopic Vision 1 [5]. $200,000, 100-300 lbs., 2D/24 hr. LC2.
TL11 Model (+329 points): Add DR 60 [300], Maintenance (one person, monthly) [-2], Reduced Consumption 3 [6], and Telescopic Vision 5 [25]. $150,000, 70-300 lbs., 4D/1 week. LC2.
TL12 Model (+483 points): Add DR 90 [450], Reduced Consumption 4 [8], and Telescopic Vision 5 [25]. $50,000, 50-300 lbs., 4D/1 month. LC2.

Optional Lenses

Combat Exoskeleton (-20 points): The robot resembles a metallic skeleton. Add Numb [-20].
Infiltrator (+40 points): The robot is covered with living flesh and appears human. It is optimized for black ops, undercover, or bodyguard missions. Add DR 30 (outer layer) (Ablative, -80%) [30] and Mimicry [10]. Add +20% to model price.
Chameleon (+21 points): Add Chameleon 3 (Extended, Infravision, and Ultravision, +40%) [21].
Nuclear-Powered (+20 points): Add Doesn't Eat or Drink [10]; *remove* Restricted Diet (Very common, power cells) [-10].
Weapon Mount (+2 points): Add Extra Arm 1 (Weapon Mount, -80%) [2].

Warbot (TL9-12)

290 points

The warbot is a nonhumanoid fighting machine the size of a subcompact car. It weighs half a ton (without weapons) and is available in submarine, walking tank, and aircraft versions. All models have a pair of manipulator arms.

Attribute Modifiers: ST+15 (Size, -30%) [105]; DX+2 [40].
Secondary Characteristic Modifiers: SM+3; HP+15 (Size, -30%) [21]; Per+5 [25].
Advantages: Extra Arms 3 (Weapon Mount, -80%) [6]; Hyperspectral Vision [25]; Lifting ST +15 (Size, -30%) [32] Machine [25]; Payload 5 [5]; Protected Senses (Hearing, Vision) [10]; Radiation Tolerance 5 [10]; Sealed [15].
Perk: Accessory (Microframe computer) [1].
Disadvantages: Electrical [-20]; Restricted Diet (Very Common, E cell) [-10].
Availability: $200,000, 1,000 lbs. *plus* the cost of its brain. LC2.

Lenses

Select *one* of these TL lenses, plus a configuration lens. Then choose a machine intelligence lens (pp. 27-28) and consider the optional lenses detailed below.

TL9 Model (+115 points): Add DR 50 (Cannot wear armor, -40%) [150], Maintenance (3 persons, weekly) [-15], and Numb [-20].
TL10 Model (+229 points): Add DR 75 (Cannot wear armor, -40%) [225], Maintenance (one person, weekly) [-5], Reduced Consumption 2 [4], and Telescopic Vision 1 [5].
TL11 Model (+329 points): Add DR 100 (Cannot wear armor, -40%) [300], Maintenance (one person, monthly) [-2], Reduced Consumption 3 [6], and Telescopic Vision 5 [25].
TL12 Model (+483 points): Add DR 150 (Cannot wear armor, -40%) [450] and Reduced Consumption 4 [8].

Configuration Lenses

Select *one* of these lenses.

Submarine (+62 points): Basic Move becomes Water Move; ground Move is 0. Add Absolute Direction [5], Aquatic [0], Enhanced Move (Water) 1 [20], Pressure Support 1 [5], and Sonar (Increased Range 10×, +30%; LPI, +10%; Targeting, +20%) [32].

Walking Tank (+87 points): An insectoid ground combat machine. Add Absolute Direction [5], Enhanced Move 1 (Ground) [20], Extra Legs (4 legs) [5], Radar (Increased Range 10×, +30%; LPI, +10%; Multi-Mode, +50%; Targeting, +20%) [42], Super Jump 1 [10], and Vacuum Support [5].

Vertol (+142 points): This robot can fly and hover using ducted fans. Basic Move becomes Air Move; ground Move is 0. Add 3D Spatial Sense [10], Aerial [0], Enhanced Move (Air) 3 [60], Flight (Small wings, -10%) [36], Noisy 3 [-6], and Radar (Increased Range 10×, +30%; LPI, +10%; Multi-Mode, +50%; Targeting, +20%) [42].

Vertol (Contragrav) (+140 points): The machine uses contragravity generators for lift and thrust; this is TL10^. Its Basic Move becomes Air Move; ground Move is 0. Add Aerial 0], [Enhanced Move (Air) 3 [60], Flight (Planetary, -5%) [38], and Radar (Increased Range 10×, +30%; LPI, +10%; Multi-Mode, +50%; Targeting, +20%) [42].

Robot Weapons

Robotic missiles are designed to destroy the target in a suicidal attacks. Robot mines are simple automated weapons that wait for targets to appear – sometimes for years or millennia – before making their attack.

Genius Missiles (TL9-11)

The most advanced ultra-tech homing missiles are small, autonomous combat robots. They seek out and destroy their targets using programmed tactics such as loitering and stealthy low-altitude approaches. As far as the game rules are concerned, they're trained animals. Although not very bright by AI standards, they're sometimes classed as "genius missiles" (to distinguish them from TL8 smart and brilliant missiles). Another, more accurate term is "sentient missiles."

Instructing a genius missile requires an Artillery (Guided Missile) skill roll. Use the guidelines on p. B458 for what the missile can do. Missiles are very good at recognizing sensory profiles of particular targets, and can receive new target information and other updates through their communications links.

Genius missiles are also useful as reconnaissance machines – firing one over a hill and seeing what it sees! If the user is worried about hacking, they can be told to "go dark" and receive no other commands.

Hunter Missile (TL9)

An arm-sized missile powered by a turbojet engine. It can fly at up to 1,000 mph, but can't slow down below 1/4 its speed. A hunter missile's Payload may be any 64mm warhead. It can be fired from a 64mm missile launcher, such as the IML or MLAWS (p. 145). It flies for one minute and then will crash and self-destruct.

A hunter missile uses a low-probability intercept multi-mode radar (2,000-yard range) as its main sense. It can also detect laser, radar and radio emissions and use that to find targets. It can receive command updates via radio, and use inertial guidance to fly to map coordinates.

The hunter missile's maximum straight-line range is 16 miles.

ST 3; **DX** 14; **IQ** 5; **HT** 12.
HP 6; **Will** 5; **Per** 12; **Speed** 6; **Dodge** 9; **Move** 0 (Ground).
SM -4; 5 lbs.

Traits: Absolute Direction; Aerial; AI; Automaton; Blindness; Deafness; Detect (Lasers, Radio, and Radar, Signal Detection); Electrical; Enhanced Move 2 (Air speed 480); Flight (Cannot Hover; Limited Use, Fast Reload, 1 minute; Air Move 120); Injury Tolerance (No Head, No Neck); Mute; No Manipulators; No Sense of Taste/Smell; Noisy 4; Numb; Payload 3; Radar (LPI, Multi-Mode); Radio (Burst, Secure).

Cost: $2,500 ($500 at TL10). LC2.

Striker Missile (TL9-10)

A larger, smarter, and faster version of the hunter missile. It has a maximum speed of 2,000 mph and a maximum range of 32 miles. Its radar has a 4,000-yard range, but it can turn that off and use Hyperspectral Vision instead. A striker missile's Payload may be any 100mm warhead. It can be fired from any 100mm missile launcher such as the Tactical Missile Launcher (p. 145).

The TL10 version uses much cheaper nano-electronics, but is otherwise similar.

ST 6; **DX** 14; **IQ 6**; **HT** 12.
HP 12; **Will** 5; **Per** 12; **Speed** 6; **Dodge** 9; **Move** 0 (Ground).
SM -2; 17 lbs.

Traits: Same as Hunter Missile except delete Blindness, add Hyperspectral Vision, upgrade to Enhanced Move 3 (Air speed 480), and give Radar (Increased Range ×2).

Skills: Aerobatics-10, Observation-11.

Cost: $17,000 ($3,400 at TL10). LC1.

Floater Missile (TL10^)

Similar to the Striker Missile, but its reactionless thrusters and contragravity technology enhance maneuverability and range (320 miles).

ST 3; **DX** 14; **IQ** 6; **HT** 12.
HP 6; **Will** 6; **Per** 13; **Speed** 8; **Dodge** 11; **Move** 0 (Ground).
SM -4; 5 lbs.

Traits: Absolute Direction; Aerial; AI; Automaton; Blindness; Deafness; Detect (Lasers, Radio, and Radar, Signal Detection); Electrical; Enhanced Move 2 (Air speed 480); Flight (Limited Use, Fast Reload, 10 minutes; Air Move 120); Injury Tolerance (No Head, No Neck); Mute; No Manipulators; No Sense of Taste/Smell; Noisy 4; Numb; Payload 3; Radar (LPI,

Multi-Mode); Radio (Burst, Secure).
Skills: Aerobatics-12, Observation-11.
Cost: $5,000 ($1,000 at TL11). LC1.

Smart Shuriken (TL11^)

A razor-sharp missile that uses contragrav to reach speeds of 200 mph. It may be shaped like a knife, wedge, card, or disk. At low speed it is dangerous and highly maneuverable, and can hide and sneak up on foes, but its most lethal attack is to accelerate up to its full speed and ram. This uses the rules for sharp collisions (see p. B430): it inflicts half-normal collision damage but that damage is *cutting*.

A smart shuriken can be fired from a 25mm missile launcher or simply *thrown* – often, after hitting or missing all programmed targets, it returns to the thrower's hand. It can fly for 10 minutes; then it's immobile until its C cell is replaced.

ST 1; **DX** 14; **IQ** 5; **HT** 12.
HP 1; **Will** 5; **Per** 10; **Speed** 6; **Dodge** 9; **Move** 0 (Ground).
SM -10; 0.1 lb.
Traits: Aerial; AI; Automaton; Blindness; Electrical; Enhanced Move 3 (Air speed 96); Flight (Limited Use, Fast Reload, 10 minutes; Air Move 12); Injury Tolerance (No Head, No Neck); Machine; Mute; No Manipulators; No Sense of Taste/Smell; Noisy 4; Numb; Radar (LPI, Imaging).
Skills: Brawling-12; Stealth-10.
Cost: $500. LC2.

Devourer Swarm (TL10)

These swarmbots have small diamond jaws; a swarm can chew through almost any barrier or armor, given time. They inflict 1d(2) corrosion damage per second to anyone caught within the swarm. This is considered an area-effect attack, and only sealed DR will protect against it. High-density swarms are most effective! $8,000 per square yard. LC1.

Gremlin Swarm (TL10)

The swarm is equipped with tiny drills and cutters. It is programmed to crawl inside electronic or mechanical devices , then jam up the works by slicing through wires, eating circuits, and so on. Only sealed machinery or electronics, or devices lacking small moving parts, will be safe. The sabotage is not immediately obvious.

Each square yard of swarm does one point of damage per turn to unsealed machinery, ignoring armor DR. The machinery acquires a malfunction number (p. B407) of 17, with an extra -1 each time it loses 10% of its HP. Check nonweapon devices for malfunction when they are turned on and each minute they are in use

Damage caused by gremlins doesn't physically destroy an object, but is treated like other damage for repair purposes. $2,000 per square yard. LC2.

Sentry (TL10)

These microbots are equipped with weapons optimized for combating other microbots. Each hex inflicts 2d damage per turn on other microbot swarms. $5,000 per square yard. LC3.

Stinger Swarm (TL10)

These tiny robots have stinging needles with soporific venom. The swarm does one point of Fatigue damage per turn to living beings (only) in contact with it unless they have Sealed protection. $1,500 per square yard. LC2.

Terminator Swarm (TL10)

These microbots have tiny jaws or poison needles. The swarm does one point of toxic damage per turn to living beings (only) in contact with it, unless they have Sealed protection. $1,500/square yard. LC1.

Disassembler Swarm (TL11)

This cloud of nanomachines is programmed to break down matter; the nanobots stick to anything in the area of effect and begin to eat, reducing the target to powder or goo. A disassembler swarm inflicts 1d-2(10) corrosion damage per second to anyone caught within the swarm. This is considered an area-effect attack, and only sealed DR will protect against it.

Used as a digging tool, disassemblers can turn packed earth or stone into fine powder, digging two inches within the radius of the cloud every second.

Specialized disassembler nano can be manufactured not to eat certain chemical compounds, or to only eat certain compounds, or to last for shorter or longer times than the standard 30 seconds. It's possible to design disassemblers that won't touch organic materials, that will only eat organics ("kill the people but leave the buildings standing"), or that will eat anything except a certain complex polymer or alloy being used to line the container in which they are stored.

Disassembler costs $10,000 per square yard for standard types, possibly more for custom models. It is not available as a microbot swarm. LC1 (for most types).

Cannibal Swarm (TL12)

This swarm is programmed to cannibalize other objects to build a single, specific gadget. It must first find an object that contains raw materials suitable for the task. Creating mechanical devices such as guns and engines requires objects made of metal. Plastics can be broken down to make gas and propellants. Creating electronic devices requires cannibalizing other electronic systems; any such device in the area takes damage as per a disassembler swarm (above). Whatever is cannibalized is destroyed – or, more accurately, transformed.

Each cannibal swarm is specific to one gadget or weapon. However, a swarm may build several closely related gadgets that are put together into one object. For example, a swarm may build a gun with a laser sight, a helmet with built-in infrared goggles, or a robot. The maximum weight of the gadget is 10 pounds per square yard of the swarm.

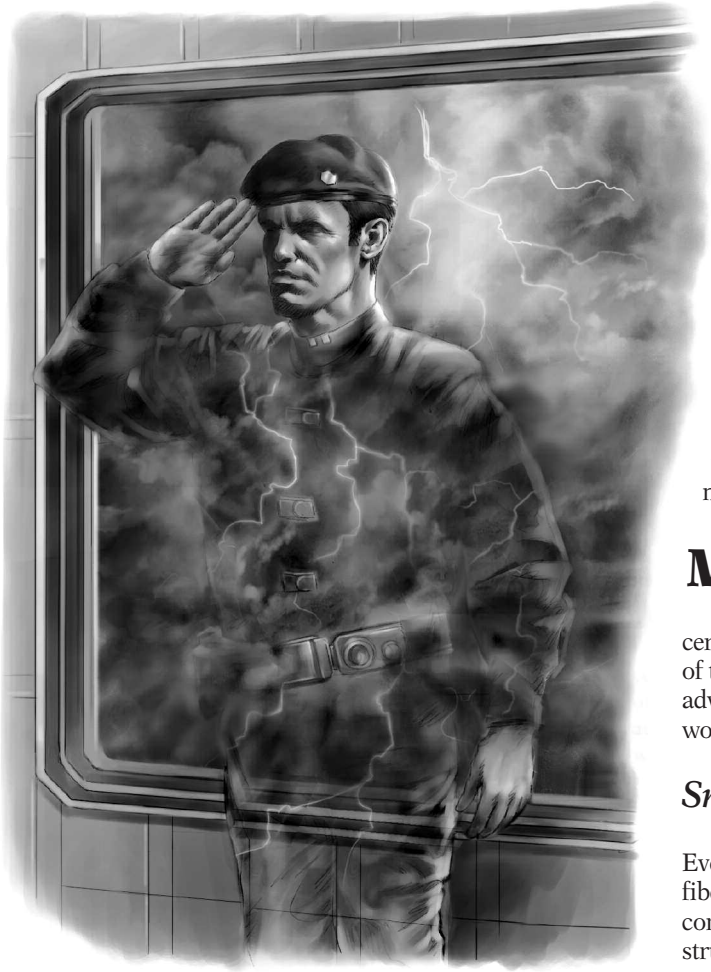
Assembly takes one minute per pound of gadget weight, divided by the size of the swarm in square yards. The process produces residual heat, so it is best to employ it on a nonflammable surface (such as a concrete floor) and turn off the smoke detectors. A cannibal swarm's cost is 15 times that of the intended gadget or $15,000 per square yard, whichever is greater. Cannibal swarms are LC1 or the LC of whatever they build, whichever is lower.

Chapter Seven
DEFENSES

The location of the Imperial Secret Service's Galactic Operations Division headquarters was top secret. The only way in or out was by a long-range matter transmission booth. It kept unwanted visitors away, and made it hard for the enemy to know where to aim an antimatter bomb.

Colonel Erasmus thought this was a sensible precaution. It made him feel better about living inside a force field floating deep inside a gas giant's atmosphere. His eye strayed to the synthetic diamond window, and to the vast lightning storm that raged above the ammonia clouds. If the field ever collapsed, he consoled himself, it would be quick.

Suddenly, the MT booth sparkled into life. Dancing motes of energy solidified into the colonel's best operative. Today he looked like a young Terran, and wore a chameleon-surface biosuit and a beret.



"Special Agent Raphael, reporting as ordered," the infiltration cyborg said, stepping out of the booth and saluting.

Erasmus returned the salute, then paused, nonplussed. Raph was standing in front of the picture window, and his biosuit had changed color. Now he was the flickering color of the Jovian storm. It was distracting.

"Turn off that damn cammo, Special Agent."

"Sorry, sir." Raphael subvocalized a command, and the suit returned to the GOD's regulation black and silver. "I just returned from the field."

"Have a seat." A floating grav chair drifted over. "I heard Sargon was rough."

"My teams have arranged for all the nuclear dampers to be secretly buried. We've blanketed Sargon from pole to pole. As long as they stick to fission-triggered warheads, they can go nuclear all they like." He smiled wickedly. "I wonder what they'll do when 7,000 atomic warheads turn into wet firecrackers?"

Colonel Erasmus sighed. "Try to get antimatter nukes. Actually, they already are, to make clean tactical weapons. But Gabrielle is handling that. I have another job for you. What do you know about the Thearchy of Buckminster?"

Defenses and weapons compete in a constant arms race. As weapons become more deadly, stronger and more effective defenses are developed to protect against them . . . leading to more powerful weapons. This chapter covers both general defenses, such as armor and force screens, and specific defenses, such as protective fields that shield against particular weapons, or electronic countermeasures designed to warn against or defeat attack.

Enemy action is not the only danger. Filter masks, vacc suits, and powered exoskeletons are just some of the gear that can protect the wearer in hostile environments and on the battlefield.

Materials

Ultra-tech armor may be made of tough synthetic fibers, ceramics, plastics, or alloys similar to lower-TL armor. All of these technologies improve at higher TLs due to ongoing advances in material technology, but two materials are worthy of special mention.

Smart Bioplastic (TL10)

This is a tough, flexible, pseudo-alive smart material. Every square inch of it contains electrically-active muscles, fibers and nerve endings. A coded electrical impulse can command these muscles to move, allowing an item constructed of bioplas to change its shape!

Bioplastic is very resistant to damage. If it has access to normal air and solar radiation, it can repair itself, healing any damage it has suffered at 1 HP every six hours. (Items with 20 HP or more heal faster – see *High HP and Healing*, p. B424.) Bioplastic items in regular use include bioplas armor (p. 174), biosuits (p. 179), and survival modules (p. 79). Bioplastic can even be used to make houses.

Living Metal (TL12)

Living metal devices are assembled using advanced nanotech, but the microscopic construction robots remain active within the object after it is built. Unless the object has been totally destroyed (-5 × HP or worse), any damage to the object will be regenerated in a matter of hours. Living metal items with fewer than HP 20 heal at 1 HP per hour; items with more HP heal faster (see *High HP and Healing*, p. B424).

This repair speed assumes that no parts are missing. If part of the original device is missing, but the proper material is available very close by, the construction robots can use it to replace missing parts; this halves the "regeneration" speed for that percentage of the device that must be rebuilt from scratch.

Implications of this include:

Any broken fragment of a living metal device can regrow the whole device under the right circumstances.

It is dangerous to set a broken living metal device on a metal surface; you may return to find the device repaired, or partially repaired, and the surface pitted where the robots took material from it!

A million-year-old device made of living metal will seem as new as the day it was first built. Corrosion and other damage will have been repaired as quickly as it occurred.

Powerful radiation can "kill" the robots, eliminating their self-repair capacity. Worse, it might "mutate" them, causing them to rebuild the device differently! The robots can withstand single bursts of up to 1,000 rads, or up to 500 rads in an hour.

Most metallic equipment can be made of living metal for double its normal cost.

Body Armor and Protective Gear

The armor tables follow the same format as those in the ***GURPS Basic Set***; see p. B282 for an explanation of abbreviations and location coverage. Some items have special features or restrictions; these are detailed in the item's description.

Threat Protection

High DR doesn't provide much defense against chemical weapons, great heat, microbes, and so on. These dangers demand specialized protection that corresponds to particular advantages. Below are several common classes of "threat protection" used in descriptions of protective gear:

Climate Control: The equipment provides protection against climatic extremes equivalent to the Temperature Tolerance advantage. Climate control systems remove waste heat as well as providing insulation and air conditioning. They extend the wearer's comfort zone to the range noted. If the suit is not sealed, treat as if it were merely air conditioned and insulated. If the wearer's own comfort zone is greater, the equipment may fail before its user does!

Air Supply: The equipment provides air for the wearer. The air supply times listed are an approximation (different people use air at different rates), and assume an external pressure of one atmosphere or less. For game purposes, assume that most adults use about the same amount of air per hour, and that children under 12 use half as much. It takes 10 seconds to hook up a tank and two seconds to jettison it. Air refills are $5 per hour, but most vehicles with life support systems incorporate air compressors that can top them up for free.

Glare-Resistant: The equipment screens out bright light. It is equivalent to Protected Vision (p. B78, and works against the deleterious effects of "dazzle," "flash," and "strobe" weapons.

Hearing Protection: The equipment screens out noise, and is equivalent to Protected Hearing (p. B78).

Radiation PF: The equipment has a radiation Protection Factor. Divide radiation by the PF before applying its effects, as if the user had Radiation Tolerance (p. B79).

Pressurized: The equipment is resistant to pressures greater than one atmosphere. Pressurized comes in three levels, each equivalent in effect to a level of Pressure Support (p. B77). This protects against crushing ocean depths and superdense atmospheres like those of Venus and Jupiter.

Sealed: Impervious to penetration by liquids and gases. This corresponds to the Sealed advantage (p. B82). It prevents all harm from noncorrosive bioweapons, chemicals, and nano, as well as ordinary rust and waterlogging.

Vacuum Support: Protects the wearer or occupants from the deleterious effects associated with vacuum and decompression (other than lack of air). This corresponds with the Vacuum Support advantage (p. B96).

Body Armor

These unpowered suits and armored garments require no special skill to use.

All body armor can come in any desired color, including camouflage patterns. It takes three seconds per piece to don or remove most body armor.

Body Armor Styles

Ultra-tech body armor is available in a variety of standard styles.

Bodysuit: This outfit covers the torso, groin, arms, and legs. The neck, head, or extremities are uncovered, making it easy to add customized boots, gloves, and helmets.

Gloves: A pair of armored gloves. They're made of thinner material than other armor types to avoid compromising the wearer's manual dexterity.

Jacket: This is a heavier outfit that covers the torso and arms. It zips up and has plenty of pockets.

Suit: This head-to-toe outfit includes a hood and face mask with eye slit. It's a useful exploration suit, supers costume, or ninja suit. It is also used as the basis for tailored armor (pp. 174-175).

Trousers: A pair of long pants, protecting the groin and legs (but not the feet). It is not obviously armor, and can pass for a normal pair of work pants or jeans.

Vest: A sleeveless t-shirt covering the torso.

All concealable armor styles can pass as normal clothing, although bodysuits and complete suits are likely to be conspicuous.

Additional styles can be created using the tailored armor (pp. 174-175) rules.

Ballistic Armor (TL9-11)

This armor uses flexible materials to resist high velocity projectile attacks as well as cutting blows. It's the ultra-tech successor to modern bulletproof vests. On a practical level, TL9+ ballistic armor's major advance is that it can provide full protection for areas other than the torso without sacrificing mobility.

Since bullets are among the most effective ways to deal damage at TL9-10, ballistic armor is widespread at these tech levels. At TL11+ it often declines in popularity, superseded by armor optimized against beam weapons.

Ballistic armor is flexible with a split DR: it provides full protection against piercing and cutting attacks, and uses its reduced DR against all other types of damage.

As material technology advances, ballistic armor continually improves. Examples of progressively-better ballistic armor types are reflex, nanoweave, and monocrys armor.

Reflex (TL9): This ballistic armor is a fabric woven from para-aramid fibers (such as Kevlar), polyethylene, or synthetics inspired by the molecular structure of spider silk. It is soaked in a "shear thickening fluid" of hard ceramic nanoparticles suspended in liquid. During normal handling, the armor is very flexible, but when a bullet or fragment strikes it, it becomes a rigid material.

Nanoweave (TL10): This armor is similar to reflex armor, but is reinforced for extra strength by woven carbon nanotubes. Nanoweave armor can be fitted with various accessories, using "smart" properties that can be engineered into it.

Monocrys (TL11): This is a single-crystal weave of synthetic diamondoid fibers, also called "nanocrystal." It is very light, but diamondoid materials melt at high temperatures, which means that monocrys is not particularly useful against beam weapons.

For heavier, non-concealable versions of reflex, nanoweave, and monocrys, see the descriptions of tactical vests (p. 173) and tactical suits (p. 178).

Concealable Ballistic Armor Table

TL	*Armor*	*Location*	*DR*	*Cost*	*Weight*	*LC*	*Notes*
9	Reflex Bodysuit	body, limbs	12/4*	$900	6	3	
9	Reflex Gloves	hands	6/2*	$30	neg.	4	
9	Reflex Jacket	arms, torso	12/4*	$450	3	3	
9	Reflex Suit	all	12/4*	$1,200	8	3	
9	Reflex Trousers	groin, legs	12/4*	$280	2.8	3	
9	Reflex Vest	torso	12/4*	$300	2	3	
10	Nanoweave Bodysuit	body, limbs	18/6*	$900	6	3	
10	Nanoweave Gloves	hands	9/3*	$30	neg.	4	
10	Nanoweave Jacket	arms, torso	18/6*	$450	3	3	
10	Nanoweave Suit	all	18/6*	$1,200	8	3	
10	Nanoweave Trousers	groin, legs	18/6*	$280	2.8	3	
10	Nanoweave Vest	torso	18/6*	$300	2	3	
11	Monocrys Bodysuit	body, limbs	24/8*	$900	6	3	
11	Monocrys Gloves	hands	12/4*	$30	neg.	4	
11	Monocrys Jacket	arms, torso	24/8*	$450	3	3	
11	Monocrys Suit	all	24/8*	$1,200	8	4	
11	Monocrys Trousers	groin, legs	24/8*	$280	2.8	3	
11	Monocrys Vest	torso	24/8*	$300	2	3	

* Flexible.

Tactical Vest (TL9-11)

This thick, sleeveless, jacket-like vest covers the torso and groin, with front and back pockets for inserting rigid ceramic or alloy plates.

A tactical vest is made of similar materials to concealable body armor, but is heavier, and is obviously body armor. It provides full protection against cutting and piercing damage, and reduced protection against all other attacks. Its trauma plates provide full protection against all damage types. It takes three seconds to insert or remove the plates.

Tactical Vest Table

TL	*Armor*	*Location*	*DR*	*Cost*	*Weight*	*LC*	*Notes*
9	Reflex Tactical Vest	torso, groin	18/7*	$900	9	2	
	trauma plates	torso	+34	+$600	+9	2	
10	Nanoweave Tactical Vest	torso, groin	24/10*	$900	9	2	
	trauma plates	torso	+46	+$600	+9	2	
11	Monocrys Tactical Vest	torso, groin	36/15*	$900	9	2	
	trauma plates	torso	+69	$600	+9	2	

* Flexible.

Assault Boots (TL9-12)

These armored boots add metal or ceramic inserts to the sole of a ballistic fiber. At TL9-11 they provide their full DR against attacks to the underside of the foot (e.g., stepping on a stake, a contact-detonation mine, etc.) but half DR against attacks from other angles. TL12 boots provide full protection from all angles.

Hiking: Ultra-tech combat boots incorporate smart-matter responsive fabrics and biomaterials that treat or prevent blistering from long marches. They count as the best quality equipment and add +TL/2 to Hiking skill.

Assault Boots Table

TL	*Armor*	*Location*	*DR*	*Cost*	*Weight*	*LC*	*Notes*
9	Assault Boots	feet	12/6	$150	3	4	
10	Assault Boots	feet	18/9	$150	3	4	
11	Assault Boots	feet	30/15	$150	3	4	
12	Assault Boots	feet	50	$150	3	4	

Laser-Resistant Body Armor (TL9-11)

Ultra-tech lasers are capable weapons at TL9 and become common at TL10, resulting in the development of flexible body armor optimized to counter them.

Ablative Armor (TL9)

This is similar to reflex armor, but made of plastic fabric designed to vaporize when struck by a laser beam. Since the armor is damaged by the attack, ablative armor is more useful against a single assassin than it is in a lengthy combat mission!

Ablative armor has a split DR. Its full DR is used against the burning or crushing explosive damage inflicted by any type of laser (including X-ray and graser models). This DR is also semi-ablative: For every 10 points of basic laser damage rolled, remove one point of DR from the location struck, regardless of whether the attack penetrated or not.

Its lower DR is used against all other attacks, and is not ablative.

Reflec (TL9)

Reflec is a light, highly-reflective armor of polished metallic fibers that reflects laser fire. It is useless against other attacks, but can be worn over other armor. Reflec has a split DR: It gets its full DR against microwaves and lasers (but not X-ray or gamma-ray lasers), but provides no protection against other weapons.

Reflec is an excellent radar reflector: any stealth benefits against radar are negated, and add +1 (+2 if wearing a full suit) to rolls to detect its wearer.

Reflec is not superscience, but is a cinematic technology. Realistically, mirrored material is not very effective against laser weapons, although it will function against microwave beams.

Any rigid helmet can be made reflective for $50. It gains +20 DR vs. lasers and microwaves.

Ablative Nanoplas (TL10)

This is advanced ablative armor made of tailored carbon nanotubes. It has higher DR, but it is otherwise equivalent to TL9 ablative armor.

Retro-Reflective Armor (TL11^)

This superscience reflec armor is embedded with polished, metallic fibers covered with millions of tiny spherical lenses. The micro-mirrors reflect laser fire *back at the attacker.* The armor "bounces back" half the damage from visible-light or near-infrared lasers that the DR actually *resisted*. The remaining damage affects the wearer normally.

If he wasn't suspecting the reflection, the attacker doesn't get an active defense against the first attack reflected back at him. He gets his usual defenses against subsequent reflected attacks, or if he knew the armor would be retro-reflective. Retro-reflec only works against direct hits!

Laser-Resistant Armor Table

TL	*Armor*	*Location*	*DR*	*Cost*	*Weight*	*LC*
9	Ablative Jacket	arms, torso	24/4*	$450	3	3
9	Ablative Suit	all	24/4*	$1,200	8	3
9	Ablative Trousers	groin, legs	24/4*	$280	2.8	3
9	Reflec Helmet	head	20/0*	$25	0.5	4
9	Reflec Jacket	torso, arms	20/0*	$150	1	4
9	Reflec Suit	all	20/0*	$300	2	4
10	Ablative Nanoplas Jacket	arms, torso	36/6*	$450	3	3
10	Ablative Nanoplas Suit	all	36/6*	$1,200	8	3
10	Ablative Nanoplas Trousers	groin, legs	36/6*	$280	2.8	3
11^	Retro-Reflective Helmet	head	40/0*	$250	0.5	4
11^	Retro-Reflective Jacket	torso, arms	40/0*	$1,500	1	4
11^	Retro-Reflective Suit	all	40/0*	$3,000	2	4

* Flexible.

Bioplas Armor (TL10)

Bioplas is a strong, pseudo-alive smart matter material that is light and comfortable to wear – see *Smart Bioplastic* (p. 171). Flexible armored suits and clothing are made out of this material. Like other bioplastic equipment, it can heal rips and tears if it has access to moisture and heat, such as sweat and body heat. Bioplas is also a popular material for swimwear and other sports clothing.

Bioplas is flexible armor with a split DR. Unlike ballistic body armor, bioplas provides its full DR against burning and piercing damage, but gets only one-third DR vs. other damage types. Thus, it's very effective against a bullet or most energy beams, but not that much use against a powerful blow or a vat of acid.

See *Space Biosuit* (p. 179) for a sealed environmental suit version.

Bioplas Armor Table

TL	*Armor*	*Location*	*DR*	*Cost*	*Weight*	*LC*
10	Bioplas Bodysuit	body, limbs	15/5*	$1,800	3	3
10	Bioplas Gloves	hands	15/5*	$60	neg.	4
10	Bioplas Suit	all	15/5*	$2,400	4	3

* Flexible.

Transparent Bioplas (TL10)

This is an option for any bioplas outfit and the space biosuit (p. 179). It does not protect against laser fire, but otherwise is the same as any other bioplas vest or suit. The suit adjusts around the user's body, and is almost invisible when worn. (A Vision roll from a yard or less will spot it, and anyone touching the wearer will notice it.) Transparent bioplas also comes in translucent colors; by covering up strategic areas, a wearer of a tinted bodysuit can look as if he or she is wearing a swimsuit while protecting the entire body. Transparent bioplas costs twice as much as ordinary bioplas, but is otherwise identical.

Energy Cloth (TL12)

This light and easily-concealed armor is an ultra-tech ballistic fiber similar to monocrys. Its hyperdense "fabric" is resistant to nearly all forms of attack. It is flexible, but gets its full DR against *all* damage types.

Energy Cloth Table

TL	*Armor*	*Location*	*DR*	*Cost*	*Weight*	*LC*
12	Energy Cloth Bodysuit	body, limbs	30*	$2,000	6	3
12	Energy Cloth Gloves	hands	15*	$50	neg.	4
12	Energy Cloth Jacket	arms, torso	30*	$1,500	3	3
12	Energy Cloth Suit	all	30*	$4,000	8	4
12	Energy Cloth Trousers	groin, legs	30*	$1,400	2.8	3
12	Energy Cloth Vest	torso	30*	$1,000	2	3

* Flexible.

Tailoring Armor

Individuals as concerned with fashion sense as personal safety may wear flexible armor in styles other than those described on the armor tables. This option enables executives, politicians, secret agents, celebrities and bodyguards to rely on discreet protection while appearing to be unarmored; it also works well for armored supers costumes. Specialty shops may design tailored armor to order using computerized manufacturing systems such as fabricators or nanofacs.

Example: A few months after a terrorist attack on the Emperor's Ball, Captain Alice Iwakura is asked to attend another formal affair. This time she plans to be better prepared. Arriving in a ballistic nanoweave jacket and trousers won't cut it. What to wear?

Armor Type

Select ballistic (p. 172), reflec (p. 173), ablative (p. 173), bioplas (p. 171), or energy (p. 174) body armor. Record the statistics of the suit version of that armor type. Its DR, cost, weight, and LC will be used as the basis of the rest of the outfit.

Example: We choose a TL10 tailored nanoweave bodysuit (p. 172) as the basis of our outfit. To start with, it has DR 18/6, covers all locations, and is $1,200, 8 lbs. and LC3.

Coverage

Choose the locations that are covered by the outfit. Each location has its own multiplier; add the multipliers for all locations covered. This will give the "coverage multiplier" of the entire outfit. The numbers add up to 1 (all locations covered).

Coverage Table

Multiplier	*Location*
0.05	skull
0.05	face and eyes
0.025	neck
0.125	both arms
0.05	both hands
0.25	torso
0.10	groin
0.25	both legs
0.10	both feet

Outfits may be designed that only protect a location (other than eyes or face) from the front (such as a low-cut dress) or the back (such as a cape). Halve the multiplier.

Outfits can be designed to protect only part of a location. For example, a miniskirt protects just part of the legs; a bikini bottom provides skimpy coverage to the groin. Halve the coverage multiplier for *half-coverage*; multiply by 0.25 for *skimpy* coverage (about 25% of the area). If a partly-covered location is struck, make an activation roll (see p. B116) using 3d to see if the protected area was struck. This is an 11 or less for armor with half-coverage, or 8 or less for skimpy coverage. Any armor on the upper torso *always* protects the vitals, and any armor on the face always protects the eyes.

Example: Alice considers nanoweave evening dresses. Her final selection is cut low in front and backless. It covers half the front torso (0.25 × 0.5 × 0.5 = 0.0625), the groin, (0.10) and half her legs (0.25 × 0.50 = 0.125) for a total multiplier of 0.0625 + 0.10 + 0.125 = 0.2875. We multiply the armor's weight and cost by the total multiplier to get $345 and 2.3 lbs. Her chosen outfit will protect the front of her torso (if she rolls 11-) from the front only, her groin, and her legs (if she rolls 11-).

Style

Now that the coverage has been selected, decide whether the clothing is heavy, normal, light, or diaphanous. This will multiply DR, cost, and weight, and may affect LC.

Heavy: Trench coats, winter clothing, etc. If it's supposed to be anything else, it's easily recognized as a protective outfit. Multiply weight, cost, and DR by 1.5. Reduce LC by 1.

Normal: The outfit can pass as typical civilian attire, such as shirts, jackets, skirts, and trousers. Use the base values.

Light: This is typical of T-shirts, evening wear, summer wear, and many undergarments. It can be easily worn *under* clothing. Multiply weight, cost, and DR by 2/3. Increase LC by 1.

Diaphanous: This is typical of wispy lingerie or swimsuits. It doesn't look like armor at all, and can be worn under other outfits. Multiply weight, cost, and DR by 1/2. Increase LC by 1.

Example: We decide Alice's evening dress is Light, which multiplies weight, cost and DR by 2/3. It now has DR 18/6 × 2/3 = DR 12/4, costs $345 × 2/3 = $230, and weighs 2.3 lbs. × 2/3 = 1.53 lbs. It is LC3 + 1 = LC4.

Cut

Finally, decide whether the outfit is of average cut (no extra cost), stylish (four times cost) or a fashion original (20 times cost). These multipliers are cumulative with all others, including accessories that were added to the outfit, except power supply costs.

Example: It's an exclusive party, so Alice orders a fashion original: 20 × $230 = $4,600. She is now dressed to kill, with an evening gown that has DR 12/4 over half her front torso, the groin, and half her legs, costs $4,600, weighs 1.53 lbs. and is LC4.

Accessories

Any appropriate accessories or clothing options (e.g., buzz fabric) may be added at the usual cost.

Rigid Body Armor

These are non-flexible pieces of non-sealed armor used to protect particular body parts.

Headgear (TL9-12)

This armor protects the head or eyes. It is made of rigid armor plastic or composites.

Armored Shades (TL9-12)

Sunglasses with armored lenses are available. They are glare-resistant and can be built into any of the video glasses described in Chapter 3.

Light Infantry Helmet (TL9-12)

These helmets resemble those used by 20th-century soldiers. They have no built-in electronics, and are often worn with armored shades (above) or an optional visor attachment. The visor is glare-resistant, and is often fitted with a HUD (p. 24), although this is not standard.

Rigid Body Armor Table

TL	*Type*	*Location*	*DR*	*Cost*	*Weight*	*LC*
9	Armored Shades	eyes	10	$100	+0.1	4
9	Light Infantry Helmet	skull	18	$250	3	3
	+ *Visor*	eyes, face	15	+$100	+3	3
10	Armored Shades	eyes	15	$100	+0.1	4
10	Light Infantry Helmet	skull	24	$250	3	3
	+ *Visor*	eyes, face	20	+$100	+3	3
11	Armored Shades	eyes	20	$100	+0.1	4
11	Light Infantry Helmet	skull	36	$250	3	3
	+ *Visor*	eyes, face	30	+$100	+3	3
12	Armored Shades	eyes	30	$100	+0.1	4
12	Light Infantry Helmet	skull	48	$250	3	3
	+ *Visor*	eyes, face	40	+$100	+3	3

Clamshell Armor (TL9-12)

This hinged cuirass consists of sloped, molded composite laminate reinforced by an inner layer of flexible armor. It is favored by soldiers who don't want to carry around the weight of a full suit of armor, but do want plenty of protection where it counts.

Clamshell Armor Table

TL	*Type*	*Location*	*DR*	*Cost*	*Weight*	*LC*
9	Heavy Clamshell	torso	45	$900	18	2
9	Light Clamshell	torso	30	$600	12	2
10	Heavy Clamshell	torso	60	$900	18	2
10	Light Clamshell	torso	45	$600	12	2
11	Heavy Clamshell	torso	90	$900	18	2
11	Light Clamshell	torso	60	$600	12	2

Environmental Gear and Suits

These masks and suits are designed to protect the user from the environment as well as from injury. Environmental suit styles vary widely; civilians often paint suits in garish colors for easy recognition, but outfits worn for combat, stealth, or hunting are usually camouflaged.

Air Masks and Breathing Gear (TL9-10)

These are used when a fully-equipped suit is unavailable or inappropriate. Each mask covers the entire face, providing the Protected Vision and Protected Smell advantages.

All masks take three seconds to put on, one second to remove. In all instances, a warning light blinks when power (or air, or filtration) capacity is 90% gone. All systems contain microcommunicators (p. 43) for presenting remaining capacity on a HUD.

Air Mask (TL9)

This mask is used in environments with an unbreathable but otherwise harmless atmosphere. It requires air tanks (below) or a filter (below). It takes two seconds to put on and one to take off.

Air Tanks (TL9-12)

Lightweight tanks that store pressurized air mixtures for breathing. Higher-TL systems use lighter tanks and higher pressurizations, increasing the duration of use. All

durations assume the use of rebreather systems that recycle and reuse air.

Large Tank: Holds 24 hours (TL9), 36 hours (TL10), two days (TL11),or three days (TL12) of air. $200, 10 lbs.

Medium Tank: Holds 12 hours (TL9), 18 hours (TL10), 24 hours (TL11), or 36 hours (TL12) of air. $80, 4 lbs. LC4.

Mini Tank: Holds 10 minutes (TL9), 15 minutes (TL10), 20 minutes (TL11) or 30 minutes (TL12) of air. $50, 0.5 lbs. LC4.

Small Tank: Holds four hours (TL9), six hours (TL10), eight hours (TL11), or 12 hours (TL12) of air. $60, 2 lbs. LC4.

Artificial Gill (TL9-12)

An artificial gill extracts oxygen from water and mixes it with buffer gases, allowing the user to breathe normally while submerged in any body of water that contains dissolved air. This includes most terrestrial seas, but not polar waters and some freshwater bodies. The gill is backpack-mounted, and includes a mask, an intake system, and a device for separating dissolved air from the water. It takes three seconds to put on and one to take off. At higher TLs, a gill uses nanocatalytic systems to reduce weight and improve efficiency. It runs on a D cell; endurance is eight hours (TL9), 24 hours (TL10), three days (TL11), or 10 days (TL12).

Filter Mask (TL9)

This mask can filter out ordinary contaminants such as dust, pollen, smoke, and even tear gas. It is only effective against nerve gas or other contact agents if combined with a Sealed outfit. The filter medium must be replaced periodically; cost varies from a $10 cartridge (to filter heavy dust or pollen) to replacing the whole mask (in a chemical-warfare environment). It takes two seconds to put on and one to take off.

Respirator (TL9)

This makes thin or low-oxygen atmospheres breathable by concentrating the oxygen. It includes goggles to protect the eyes from the effects of thin air. It takes three seconds to put on and one to take off. It runs on a B cell for one day (TL9), three days (TL10), 10 days, (TL11) or a month (TL12).

Reducing Respirator (TL10)

This mask makes dense or very dense oxygen atmospheres breathable by chemically reducing the partial pressure of oxygen. It includes glare-resistant goggles to protect the eyes from the burning effects of too much oxygen. It requires power and a monthly chemical recharge ($50, 1 lb.). It takes three seconds to put on and one to take off. It runs on a C cell for three days (TL10), 10 days (TL11), or a month (TL12).

Filter Skin (TL11)

A spray-on smart symbiotic nanoskin that covers the entire body, which is effectively sealed. However, it allows the skin to "breathe" by selectively passing air molecules in and sweat out. It's often worn with a filter mask. One spray lasts for 24 hours (TL11) or a week (TL12).

Environmental Gear Table

TL	*Type*	*Location*	*DR*	*Cost*	*Weight*	*LC*
9	Air Mask	eyes, face	10	$100	1	4
9	Artificial Gill	eyes, face	10	$2,000	25	4
9	Filter Mask	eyes, face	10	$100	3	4
9	Respirator	eyes, face	10	$300	3	4
10	Reducing Respirator	eyes, face	10	$500	5	4
11	Filter Skin	all	0	$20	1	4

Civilian Survival Suits (TL9-10)

These are flexible, multi-environmental, and fully-insulated survival suits, including gloves and a hood with clear plastic visor. The suits are light and comfortable. With the hood sealed and the addition of an air mask or respirator, they protect against atmospheric pollutants or chemical or biological contamination; use NBC Suit skill, but there is no DX penalty.

These suits are popular with natives of hostile regions, survey teams, and rangers; while not armor, their compound-fiber fabric is resistant to damage. The suits are generally legal, but people may frown upon individuals wandering about with the mask sealed. The suits don't protect the face when the mask is mask rolled up.

Survival suits are often equipped with programmable camouflage (p. 99) for safari or tactical purposes. At TL11+, biosuits (p. 179) or life support belts (p. 194) replace survival suits.

Desert Environmental Suit (TL9)

This full-body survival suit insulates the wearer from the extremes of desert heat and cold. It provides climate control (-20°F to 120°F). It also recycles 90% of the wearer's body fluids, collecting pure water in a reservoir from which the wearer may drink; the user can survive on one-tenth as much water as normal. The water recycling system also acts as part of the suit's cooling system. If the suit is out of power, it can't recycle.

Drysuit (TL9)

A one-piece, light underwater survival suit that is sealed and insulated. It is useful for diving in cold or toxic water. It covers the user's entire body except the face. With an aqualung or gill mask, the suit is sealed and provides climate control (-50°F to 90°F).

Heatsuit (TL9)

A heated suit for survival in freezing conditions, including a mask to protect the face. It provides climate control (-250°F to 100°F). With a respirator (above), it's useful at very high altitudes or on some alien worlds. If the heatsuit runs out of power, it still provides some benefit due to its insulation: climate control is -50°F to 90°F.

Protective Suit (TL9)

A simple sealed suit, with a fireproof and chemical-retardant coating but no other features. Cargo handlers, hazmat teams, hangar-bay crews, and some industrial workers often wear them, usually in white or a bright color such as orange or yellow. A rip in the suit causes the smart fabric to change color at the rip. It is sealed with the addition of an air mask (p. 176).

Expedition Suit (TL10)

This suit uses nanocatalytic filtration systems and transistor thermocouples woven into the fabric for heating, cooling, and recycling liquid waste. It recycles 95% of the user's body fluids and provides climate control (-120°F to 120°F). It prevents heat exhaustion with micropores which enable it to "breathe." These pores can also seal shut in hostile environments. Worn with an air mask (p. 176), it is sealed. If the suit runs out of power, it provides climate control (-50°F to 90°F) and cannot recycle.

Gill Suit (TL10)

This full-body suit is identical to the drysuit (p. 177) in all respects, except that its surface absorbs oxygen from water. This allows the user to breathe underwater as long as the power supply lasts. It includes a belt-mounted power pack.

Civilian Survival Suits Table

TL	*Type*	*Location*	*DR*	*Cost*	*Weight*	*Power*	*LC*
9	Desert Environment Suit	all	2*	$1,000	10	C/1 wk.	4
9	Drysuit	all	2*	$200	5	–	4
9	Heatsuit	all	2*	$500	10	C/24 hr.	4
9	Protective Suit	all	2*	$50	3	–	4
10	Expedition Suit	all	5*	$1,500	6	2C/1 wk.	4
10	Gill Suit	all	5*	$2,000	10	D/24 hr.	4

* Flexible.

Flexible Sealed Combat Suits (TL9-12)

These are sealed suits made of flexible armored fabric. All come with pockets, attachment points, and harnesses for weapons or gadgets.

Reflex, Nanoweave, and Monocrys Tacsuits (TL9-11)

These tactical suits are chemically-coated, contamination-proof coveralls made of flexible ballistic fabric: reflex armor at TL9, nanoweave at TL10, or monocrys at TL11. The suit has a split DR: it provides full DR against cutting and piercing damage, and half DR against other damage types. NBC Suit skill is used to get in or out of the suit quickly or gauge its state of repair, but a tactical suit does not limit DX. In fact, the suit is very comfortable to wear, thanks to its internal microclimate control system.

Tacsuits incorporate biomedical sensors (p. 187). With an air mask (p. 176) or combat infantry helmet (p. 180), the suit is sealed and provides climate control (-40°F to 120°F).

Energy Tacsuit (TL12)

This is identical to the ballistic tacsuit, except that it is made of energy cloth with a self-sealing nanogel layer. It is flexible armor providing full DR against all damage types.

Tacsuit Table

TL	*Type*	*Location*	*DR*	*Cost*	*Weight*	*Power*	*LC*
9	Reflex Tacsuit	all	20/10*	$3,000	15	C/12 hr.	2
10	Nanoweave Tacsuit	all	30/15*	$3,000	15	C/18 hr.	2
11	Monocrys Tacsuit	all	40/20*	$3,000	15	C/24 hr.	2
12	Energy Tacsuit	all	50*	$6,000	15	C/36 hr.	2

* Flexible. See above for the split DR explanation.

Counterpressure Vacc Suits (TL9-12)

These suits come in reflex, nanoweave, and monocrys versions. They get full DR against cutting or piercing damage, and use their reduced DR vs. other attacks.

These vacc suits do not inflate. They incorporate a mechanical counter-pressure (MCP) system which uses elastic layers in direct contact with the skin to prevent the expansion of gases and water vapor in blood vessels and tissues. This is more flexible and comfortable than the pressurized suits used at TL7-8.

Several types are available. All require Vacc Suit skill to use.

Skinsuit (TL10-11)

A form-fitting elastic garment resembling a body stocking, with a rigid collar ring for attaching a helmet. A skinsuit is much thinner than a conventional vacc suit (see below), omitting radiation shielding and heavy-duty climate control. It is often worn as normal day-to-day clothing by space crews who done a full suit only for extravehicular excursions. It is also worn on worlds with poisonous atmospheres but moderate climates. The suit does not include air tanks (p. 176), which must be provided separately. With the addition of a vacc suit helmet (p. 180), it is sealed, providing climate control (-50°F to 150°F) and vacuum support.

Vacc Suit (TL9-11)

A vacc suit covers the whole body, including a rigid, removable helmet and life support pack. It's usually festooned with exterior pockets, sticky patches, straps, and hooks for access to equipment, plus at least two lifeline hooks for safety when outside a vessel. The suit has a back-mounted life-support pack (LSP), which provides heat regulation, cooling, and energy for the suit's systems. It also includes an air tank with a 12-hour air supply.

The suit has built-in biomedical sensors (p. 187). It is sealed with the addition of a vacc suit helmet (p. 180), providing climate control (-459°F to 250°F) (p. 171), pressure support (p. 171) up to 10 atmospheres, radiation protection (PF 2) (p. 171), and vacuum support (p. 171). A vacc suit takes 30 seconds to put on or take off, though this time can be halved with a successful Vacc Suit skill roll.

Different vacc suit models are available:

Civilian Vacc Suit (TL9): An ordinary vacc suit worn by most spacers at TL9 and TL10.

Reflex, Nanoweave, and Monocrys Vacc Suit (TL9-11): A heavy-duty tactical vacc suit reinforced with impact-resistant ballistic armor. It has a split DR: Use the higher DR against piercing and cutting damage, and the lower DR against all other damage types.

Smart Vacc Suit (TL10): An improved civilian vacc suit design using advanced nano-catalytic systems to reduce the life support system's bulk.

Energy Vacc Suit (TL11): A tactical vacc suit made of energy cloth armor. Its DR protects against all types of attacks.

Space Biosuit (TL10)

This flexible "living" counterpressure vacc suit resembles a form-fitting jumpsuit. Made of smart bioplastic, it absorbs sunlight and recycles waste, giving it an extended air supply (some wastage occurs, but the suit provides full life support for six weeks as long as its power supply can be charged). A small belt pack contains the air needed for recycling and a power pack to supplement the solar power system.

The space biosuit is self-sealing for punctures up to an inch in diameter, and more extensive damage is slowly repaired. It is powered by the user's body heat and lives off his waste products. The suit also includes flexible bioplas gloves and a transparent hood-helmet, which are stored in the belt pack when not in use. These meld seamlessly with the suit when worn. No clothing or armor can be worn under a space biosuit.

The suit is sealed with the hood on, providing climate control (-459°F to 250°F), pressure support up to 10 atmospheres, and vacuum support. Like bioplas, the biosuit has a split DR: use its higher DR vs. most attacks, but its lower DR against corrosion, crushing, and toxic damage. The suit is also a small computer (p. 22) with the "printed" option for flexibility.

Counterpressure Vacc Suit Table

TL	*Type*	*Location*	*DR*	*Cost*	*Weight*	*Power*	*LC*
9	Civilian Vacc Suit	all	6*	$10,000	25	2C/24 hr.	4
9	Reflex Vacc Suit	all	20/10*	$12,000	30	2C/24 hr.	2
9	Skinsuit	all	2*	$1,500	4	–	3
10	Smart Vacc Suit	all	6*	$5,000	15	2C/36 hr.	4
10	Space Biosuit	all	15/3*	$10,000	5	2C/6 wk.	3
10	Nanoweave Vacc Suit	all	30/15*	$12,000	30	2C/36 hr.	2
11	Monocrys Vacc Suit	all	40/20*	$12,000	30	2C/48 hr.	2
12	Energy Vacc Suit	all	50*	$20,000	30	2C/72 hr.	2

* Flexible.

Sealed Combat Armor (TL9)

These enclosed suits of rigid combat armor are designed to resist ultra-tech rifle fire as well as explosive and biochemical munitions. Thanks to advances in micro-climate control systems and power supplies, they are comfortable to wear, but more expensive than flexible armor. They may be issued to regular infantry soldiers operating in high-threat environments, or limited to special units such as SWAT or hostage-rescue teams. Descriptions of various types are given below.

Combat Hardsuit (TL9-12)

This is a sealed suit of combat armor designed for operations in a terrestrial environment. It is heaviest over the torso, but articulated plates and molded pieces also protect the rest of the body. An anti-radiation layer provides radiation PF 2.

It incorporates an inner garment including biomedical sensors (p. 187), a waste relief system (p. 187), and a micro-climate control system (p. 171). The back of the torso clamshells open so the user can step into the armor (it takes three seconds to step in or out). The helmet is *not* included. When worn with either a combat infantry helmet (p. 180) or space helmet (p. 180) the suit is sealed, with climate control (-140°F to 140°F) and radiation protection (PF 5).

A hardsuit isn't pressurized and can't operate in vacuum, but with air tanks and a mask or appropriate helmet, it can operate in areas with unbreathable or contaminated air.

Space Armor (TL9-12)

This complete suit of articulated and pressurized plate armor enables its wearer to operate in almost any environment. It could be the standard "space marine" combat armor. Other space crews may also suit up before entering a battle or visiting a hostile environment, and engineering crews may wear it for dangerous damage control tasks – the suit provides good protection against radiation and explosions.

The suit includes biomedical sensors (p. 187) and a climate control system. It is sealed if worn with a space helmet (below), providing climate control (-459°F to 250°F), pressure support (10 atm.), radiation protection (PF 10) and vacuum support. Each suit has a split DR: use its higher DR for attacks to the torso, and its lower DR for attacks to other areas.

Sealed Combat Armor Table

TL	Armor	Location	DR	Cost	Weight	LC
9	Combat Hardsuit	all	50/30	$10,000	30	2
9	Space Armor	all	50/30	$20,000	45	2
10	Combat Hardsuit	all	75/45	$10,000	30	2
10	Space Armor	all	75/45	$20,000	45	2
11	Combat Hardsuit	all	100/60	$10,000	30	2
11	Space Armor	all	100/60	$20,000	45	2
12	Combat Hardsuit	all	150/90	$10,000	30	2
12	Space Armor	all	150/90	$20,000	45	2

Sealed Helmets

These helmets protect the entire head. They take three seconds to attach or remove. Each helmet has a split DR: use its higher DR for attacks to the skull, and its lower DR for attacks to the face and the eyes.

Combat Infantry Helmet (TL9-11)

This rigid full-face visored helmet is usually worn with either the combat hardsuit (p. 179) or a tacsuit (p. 178). It has built-in GPS (p. 74), hearing protection (p. 171), a small radio (p. 44), and an infrared visor (p. 61). Filter masks (see p. 177) are built into the cheek pieces. With the visor locked into place, the helmet provides an airtight seal to hardsuits and tacsuits.

Space Helmet (TL9-12)

These enclosed helmets are designed to be worn with suits that are sealed or provide vacuum support. There are three styles:

Bubble Helmet (TL9-12): A fishbowl helmet made of rigid transparent plastic or diamondoid. The user should wear his own vision and communication gear.

Space Combat Helmet (TL9-12): A heavily-armored combat helmet often worn in conjunction with space armor (pp. 179-180). It has hearing protection (p. 171), a small radio (p. 44), and an infrared visor (p. 61).

Visored Space Helmet (TL9-12): An enclosed helmet with a transparent faceplate. This incorporates a small radio (p. 44), an infrared visor (p. 61), and hearing protection (p. 171).

Flexible Space Helmet (TL10-12): Essentially a pressurized bag, this is made of light, flexible plastic, inflated by a puff of air from the suit. It can be rolled up and stored in a pocket; the user must wear his own communications and vision gear.

Sealed Helmets Table

TL	Type	Location	DR	Cost	Weight	Power	LC
9	Bubble Helmet	head	6	$2,000	5	B/24 hr.	4
9	Combat Infantry Helmet	head	18/12	$2,000	5	B/12 hr.	2
9	Space Combat Helmet	head	40/30	$3,000	7	B/24 hr.	2
9	Visored Space Helmet	head	20/15	$2,000	4	B/24 hr.	3
10	Bubble Helmet	head	9	$2,000	5	B/36 hr.	4
10	Combat Infantry Helmet	head	27/18	$2,000	5	B/18 hr.	2
10	Flexible Space Helmet	head	5*	$500	0.5	–	4
10	Space Combat Helmet	head	60/45	$3,000	7	B/36 hr.	2
10	Visored Space Helmet	head	30/22	$2,000	4	B/36 hr.	3
11	Bubble Helmet	head	20	$3,000	5	B/36 hr.	4
11	Combat Infantry Helmet	head	36/24	$2,000	5	B/24 hr.	2
11	Flexible Space Helmet	head	8*	$500	0.5	–	4
11	Space Combat Helmet	head	80/60	$3,000	7	B/48 hr.	2
11	Visored Space Helmet	head	40/30	$2,000	4	B/48 hr.	3
12	Bubble Helmet	head	30	$3,000	5	B/36 hr.	4
12	Combat Infantry Helmet	head	54/36	$2,000	5	B/36 hr.	2
12	Flexible Space Helmet	head	10*	$500	0.5	–	4
12	Space Combat Helmet	head	100/60	$3,000	7	B/48 hr.	2
12	Visored Space Helmet	head	60/45	$2,000	4	B/48 hr.	3

Second Skin (TL11)

This genetically-engineered symbiont is often used by scouts and rangers, as well as colonists who wish to live a normal life on marginally-habitable planets. It covers the user's entire body, forming a transparent membrane over the eyes and a self-regenerating filter for the lungs. It lives off body wastes and heat, and can regenerate itself to heal tears or replace its filtering membranes. While it is worn, the user must drink slightly more fluids than usual. It is warmer to the touch than normal flesh, but otherwise appears normal.

Second skin protects the user against ultraviolet radiation and mild atmospheric irritants (sulfur trioxide, for example, or industrial pollutants), but not against extremely corrosive atmospheres. The mouth and nose membranes filter out pollutants and provide some protection against both respiratory and contact agents such as nerve gas: +3 on HT to resist. This bonus is cumulative with modifiers for the Resistant advantage.

In combat, second skin serves as ablative armor. It has DR 4 (ablative) against burning or corrosion damage. Each point of DR lost also reduces the lifespan of the skin by two months. The skin breaks down after eight months of normal wear; time spent in a polluted atmosphere counts double. Growing a skin around a person costs $3,000 and takes three hours using an adult-sized biofab (p. 204). LC4.

Powered Suits

Powered suits enhance the wearer's strength and mobility. They come in two styles: open *exoskeletons* and enclosed *battlesuits*. Most powered suits provide a bonus to Lifting ST (p. B65) and Striking ST (p. B88).

Exoskeletons

A powered exoskeleton (or "exo") is an open framework of artificial "muscles." When the user moves, the sensors in the suit react to and match his movements. The wearer uses the physical attributes of the exoskeleton rather than his own.

Exoskeletons provide little protection, but unless noted, they may be worn over clothing or any flexible armor.

Full-Body Exoskeletons

These are attached to the body and limbs. They provide a bonus to Lifting ST and Striking ST. Battlesuit skill limits DX and DX-based skills; see p. B192. With the power on, a full-body exoskeleton's weight is *not* counted toward encumbrance.

Heavy Exoskeleton (TL9)

A rugged, heavy-duty exoskeleton designed for cargo loading and construction work. It's often used as a substitute for a fork-lift truck or construction robot. It is very strong, but the oversized arms are not suited for fine work.

It stands eight feet tall (SM +1). The wearer gains Lifting ST+12 and Striking ST+8. In addition to any penalties for low skill, the wearer is Ham-Fisted (-3 DX).

The exoskeleton has a built-in laser torch (p. 80), a mini tool kit (p. 82) for Mechanic skill, and a fire extinguisher tube (p. 87).

Light Exoskeleton (TL9)

This is a lower-powered but less bulky exoskeleton. It grants the wearer Lifting ST+10 and Striking ST+6.

Ranger Exoskeleton (TL10)

Basically a battlesuit without the armor, this light but powerful exoskeleton is used for military or paramilitary operations. Its leg braces and motors boost the wearer's agility as well as his strength. It grants Lifting ST+12, Striking ST+12, and Super Jump 2.

Stealth Exoskeleton (TL10)

This lightweight exoskeleton can be concealed under heavy clothing, such as a jacket or trousers. It can only be worn over skimpy clothing. It's useful for covert operations, and visitors or first-generation colonists may wear stealth exoskeletons as normal clothing on high-gravity worlds. It's also useful for natives of low-gravity worlds visiting a planet like Earth. The stealth exoskeleton gives Lifting ST+4 and Striking ST+4.

Lower-Body Exoskeleton (TL9)

Lower-body exoskeletons are worn by porters, soldiers, and anyone else who needs to carry heavy loads without straining. They include an exo-supported backpack capable of carrying up to a 70-pound Payload; when the power is on, this load is *not* counted toward encumbrance. Battlesuit skill only limits DX and skills for tasks that require lower-body agility, such as melee attacks or jumping.

Power Sleeve (TL9)

A bulky "power glove" and arm brace that enhances gripping power. The glove can also be set on "auto-grip," which makes it "freeze" in any desired position; the user can then slip his hand out of the glove and leave it clamped onto something. It gives Arm ST+6 for crushing, gripping, and holding to the arm it is worn on (the user can wear one glove on each arm, if desired). It requires Battlesuit skill, but this only limits DX and skills for tasks involving the power-sleeved arm.

Exofield Belt (TL12^)

This belt projects an invisible force field around the user that not only protects him, but also follows his movements and enhances his physical strength and mobility. The exofield belt gives Lifting ST+20 and Striking ST+20, as well as Super Jump 3. It is operated using Battlesuit skill. Its weight *is* counted toward encumbrance. The field provides no DR or enhancement when the power is turned off.

Powered Exoskeleton Table

TL	Armor	Location	DR	Cost	Weight	Power	LC
9	Heavy Exoskeleton	all	20/0	$50,000	200	E/24 hr.	3
9	Light Exoskeleton	body, limbs	10/0	$25,000	50	D/12 hr.	3
9	Lower Body Exoskeleton	groin, legs	8/0	$12,000	30	2D/24 hr.	4
9	Power Sleeve	one arm and hand	8/0	$2,000	2	C/12 hr.	4
10	Ranger Exoskeleton	body, limbs	20/0	$50,000	50	D/12 hr.	3
10	Stealth Exoskeleton	body, limbs	12/0	$10,000	10	2C/8 hr.	4
12^	Exofield Belt	body, limbs	50	$100,000	1	C/1 hr.	3

If an exoskeleton has a split DR, use the higher DR against any *swinging* melee attacks, falls, or collisions. Use the lower DR against *all other damage types*.

Battlesuits

A battlesuit is an armored exoskeleton. Its strength-amplifying feature lets a battlesuit trooper carry squad-support weapons like heavy machine guns or semi-portable blasters. Many battlesuits have built-in tactical systems such as sensors or weapon mounts, and are designed for hostile environments.

Battlesuits are much more expensive than ordinary combat armor, and require more training to use, but they greatly increase effectiveness. A single battlesuit trooper with heavy weapons can be as effective as an entire squad, and nearly as mobile as an armored vehicle. Gadgeteers also love to build futuristic battlesuits: an ultra-tech suit in the modern world lets even a normal person become a super-powered hero or villain.

Battlesuits do not run any faster, since the user's speed is limited by the length of his legs, but suits with strong leg muscles can move quickly by using a series of jumps, which may provide both the Super Jump advantage and an increase in Basic Move. Wearing a suit is not fatiguing; except for the helmet, the armor's weight does not count as encumbrance while powered up. If the suit loses power, the wearer can still move (unless he's in a combat walker), but he must use his own ST to carry the weight!

Unless otherwise noted, a battlesuit opens at the waist so that the user can easily step in or out. This takes three seconds, plus another three to screw on the separate helmet, if there is one. However, it takes 30 seconds to do this *and* perform all the subsystem checks, power everything up, and connect all features (such as the waste relief and biomedical telemetry). This time is halved on a successful Battlesuit skill roll. It's also possible to omit the check-out procedure and just start moving, but if so, the GM should feel free to have internal systems fail ("due to your rush, the suit filter wasn't properly locked down – looks like that nerve gas will affect you after all").

At TL9-10, most battlesuits should be fitted to the wearer. Refitting takes two hours and requires an Armoury (Body Armor)+2 roll. Failure means another attempt is required. Critical failure damages the suit, which will need minor repairs before it is usable, or suffer a fault that will not be apparent until it is used in action. It is possible to use an unfitted suit, provided the user is the same size, shape, and sex as the last wearer (height/weight should be no more than 2% off). However, the wearer will suffer a -1 penalty to DX and all DX-based skills.

At TL11+, nanogel systems based on smart bioplastic layers are routinely built into all battlesuits. A nanogel system fits like a glove and adjusts itself to conform to any wearer within 10% of the weight and height of whatever average it was built for.

Flying Battlesuits

Many battlesuits are used with flight systems, since the suit's strength amplification makes it easy to carry extra gear. For maximum flexibility, these systems are not included in the suit designs, but are usually worn as external packs or belts. See *Flight Pack* (pp. 230-231) for various options. Flight systems interface with battlesuits, allowing the suit's own navigation displays to be used for flight control.

Underwater Battlesuits

Units operating underwater will use an aquatic propulsion pack (p. 228) or a contragrav belt (p. 231) for submerged mobility. A few suits have integral aquatic propulsion.

Combat Walkers (TL9)

These early designs have a barrel-shaped torso that blends into the head. There is no neck or waist articulation; the user must rely on sensors to see behind him and cannot twist his torso around. The suit's hands are also crude (but very strong) grippers. Combat walkers built for humans stand eight feet tall (SM +2).

A combat walker is more mobile than a tank, but its agility remains limited. The suit can sit or kneel, but the user cannot crawl, get up from a prone position, jump, or swim. On the other hand, the walker is covered with depleted uranium composite laminate over high hardness steel alloy, and can shrug off fire from light anti-tank weapons.

The suit's exoskeleton provides Lifting ST+20 and Striking ST+20. Due to its longer legs, it also adds +1 to Basic Move. While wearing the suit, the wearer suffers Bad Grip 2 (p. B123). The entire suit's weight is ignored for encumbrance. However, if the combat walker loses power, the wearer is effectively paralyzed until he leaves the suit.

The suit has several standard accessories: a GPS (p. 74), hearing protection (p. 171), biomedical sensors (p. 187), and a waste relief system (p. 187). Its helmet electronics include a hyperspectral visor (p. 61), a medium radio (p. 44), and a small laser comm (p. 44). The helmet has audio sensors so the user can hear outside the suit, but it lacks olfactory sensors; unless the hatch is opened, the

user suffers from No Sense of Smell/Taste (p. B146) when dealing with the outside world. The suit's surface has a tactical ESM (p. 62), and incorporates infrared cloaking (p. 99) and radar stealth (p. 100).

A combat walker is slightly more roomy than most other battlesuits. This means that it is a "one size fits all" suit that does not require special fitting to each user. It has a hatch at the back that the user must climb into; due to its height, the suit should be in a kneeling posture to enter, or it takes an extra second to clamber into it. Entry and exit are otherwise similar to most battlesuits.

Different variations of combat walker are described below. Combat walkers become obsolete at TL10+, and are replaced with heavy battlesuits (p. 184).

Infantry Combat Walker (TL9)

This is the standard model, designed for operations in terrestrial conditions. It is sealed (p. 171), with a filter mask (p. 177), climate control (-20°F to 140°F) (p. 171), and radiation protection (PF 10) (p. 171). It can be equipped with air tanks (pp. 176-177), but these add to its weight.

Marine Combat Walker (TL9)

This model can swim underwater using ballast tanks and a waterjet propulsion system. It has Water Move 4, and a built-in small sonar (p. 65). It is sealed, and provides climate control (-20°F to 150°F), pressure support (10 atm.), and radiation protection (PF 10). It has a large air tank, giving a it a 24-hour air supply at TL9.

Space Combat Walker (TL9)

This battlesuit is designed for operations on hostile alien worlds. It can walk underwater, but cannot float or swim. It has vacuum support, and can operate underwater or in superdense atmospheres. It is sealed, and provides climate control (-459°F to 300°F), pressure support (30 atm.), radiation protection (PF 10), and vacuum support. It has two large air tanks, giving a it a 48 hour air supply at TL9.

Powered Combat Armor (TL9)

This is a standard medium-weight combat battlesuit. It is seven feet tall, made of articulated plates of metal-matrix composites with an inner layer of reflex armor. Powered combat armor is intended to resist rifles or light machine guns, but can't stand up to anti-tank weapons. It is small enough to fit through ordinary doors, making it a superb tool for house-to-house fighting, urban warfare, and boarding actions. It may be assigned to elite forces or every soldier, depending on resources and doctrine.

Powered combat armor gives +10 to Lifting and Striking ST and Super Jump 1. Biomedical sensors (p. 187) and a waste relief system (p. 187) are standard features. The suit's surface has a tactical ESM (p. 62).

The helmet comes with a filter mask (p. 177), a GPS (p. 74), hearing protection (p. 171), a small radio (p. 44), a small laser comm (p. 44), and a hyperspectral sensor array (p. 61). The helmet has olfactory and audio sensors so the user can hear and smell outside the suit.

With the helmet on, the suit is sealed. It provides climate control (-459°F to 250°F), pressure support (10 atm.), radiation protection (PF 10), and vacuum support. It has a large air tank with 24 hours of air at TL9. In a contaminated but breathable atmosphere, it can operate using the standard filter mask.

Powered combat armor incorporates infrared cloaking (p. 99). Chameleon surfaces (pp. 98-99) are common but not standard.

Note: This suit is similar to the Battlesuit on p. B285.

Zero-G Worksuit (TL9)

This suit is more like a miniature spaceship than a vacc suit. It is a rigid pressurized cylinder with a transparent helmet dome; the whole thing is slightly larger than a man. It has no legs, but is propelled by an integral thruster pack mounted in the base. The suit's thrusters accelerate or decelerate it at up to three yards/second^2, with enough fuel for 300 seconds of acceleration. A Piloting (High-Performance Spacecraft) roll is required to quickly change direction.

In addition to its normal suit sleeves, it has three ST 15 waldoes – remote-controlled arms – for heavy duty work; they can be used as normal arms but at a -3 DX penalty. Any two waldoes may be used at once. One waldo also mounts an integral laser torch (p. 80). A waldo's grip can be power-locked onto a structure (e.g., a ship's hull) to hold the suit steady while the other limbs are used for work.

It is sealed, providing climate control (-459°F to 300°F), radiation protection (PF 10), and vacuum support. It has two weeks of air. A small (eight-inch diameter) airlock in its side is used to transfer small items (such as tools, food, or air) without breaking suit integrity. It has a built-in medium radio (p. 44). The suit is powered by an E cell, and has sockets for a second cell.

Like a combat walker (p. 182), a zero-G worksuit does not need to be specially fitted to each user.

Commando Battlesuit (TL10)

This is a lightweight, agile, form-fitting powered armor suit. It may be popular with commandos, SWAT teams, or costumed heroes.

Its exoskeleton gives +15 to Lifting and Striking ST and Super Jump 2. Biomedical sensors (p. 187) and a waste relief system (p. 187) are standard features. The suit's surface has infrared cloaking (p. 99), radar stealth (p. 100), and a tactical ESM (p. 62).

The helmet comes with a filter mask (p. 177), an inertial compass (p. 74), hearing protection (p. 171), a small radio (p. 44), a small laser comm (p. 44), and a hyperspectral visor (p. 61). The helmet has olfactory and audio sensors so the user can hear and smell outside the suit.

With the helmet locked down the suit is sealed, providing climate control (absolute zero to 500°F), pressure support (20 atm.), radiation protection (PF 10), and vacuum support. It has a large air tank (p. 176) with 36 hours of air at TL10. In a contaminated but breathable atmosphere, it can operate using the filter mask.

Heavy Battlesuit (TL10)

These highly-mobile suits can fight in almost any environment. They have enough life support to keep the user alive for days in a contaminated war zone. They are smaller than TL9 combat walkers, but still stand seven feet tall and are bulky (SM +1).

The armor is a thick shell of laminated nanocomposites and ceramic armor over an inner layer of shock-absorbing liquid armor. This gives torso protection equal to at least three inches of steel plate. It also has integral superconductor-based electromagnetic armor, which doubles the suit's DR against shaped-charge warheads and plasma bolts. The electromagnetic armor operates off a separate D cell and is good for 10 uses.

A powered exoskeleton amplifies the user's muscles and ground speed (see below). Except for the helmet, the armor's weight does not count as encumbrance while powered up. It is powered by an integral radiothermal generator which operates it for up to 10 years.

The suit's helmet includes a filter mask (p. 177), an inertial compass (p. 74), hearing protection (p. 171), a hyperspectral visor (p. 61), a small laser comm (p. 44), and a medium radio (p. 44). The suit's body incorporates biomedical sensors (p. 187), trauma maintenance (p. 189), a provisions dispenser (p. 187) with a week's provisions, tactical ESM (p. 62), and a waste relief system (p. 187). The suit also has infrared cloaking (p. 99) and radar stealth (p. 100).

With its helmet on, it is sealed, and has climate control (-459°F to 500°F), pressure support (10 atm.), radiation protection (PF 5), and vacuum support. It has two large air tanks with a 72-hour air supply at TL10.

The suit's exoskeleton grants Lifting and Striking ST+20. It has Basic Move +2 and Super Jump 1.

Command Battlesuit and Scout Battlesuit

These variations have almost identical statistics.

Command Battlesuit (TL10): A suit designed for officers, not quite as strong as a heavy battlesuit, but with equivalent armor and greater mobility. It includes a medium laser comm (p. 44) and a large radio (p. 44). Its exoskeleton grants Lifting and Striking ST+18, Basic Move +3, and Super Jump 2.

Scout Battlesuit (TL10): A variation on the command battlesuit for reconnaissance and special ops units. It has a chemsniffer (p. 61), and a deceptive radar jammer (p. 99). The helmet has a small genius computer (p. 22). Its exoskeleton is less strong but faster: it grants Lifting and Striking ST+16, Basic Move +4, and Super Jump 3.

HEX Suit (TL10)

The Hostile Environment eXosuit is a suit of powered space armor reinforced for operations in extremely dangerous environments, such as the hellish surfaces of Mercury or Venus. The HEX is most often used by explorers and workers, but might be issued to military forces.

The suit is eight feet tall (SM +1). Its bulbous, heavily-armored body is reinforced and shielded to resist extremes of pressure, temperature and radiation, and it has a heavy-duty life support system. It is sealed, providing climate control (-459°F to 800°F), pressure support (50 atm.), radiation protection (PF 100), and vacuum support. It has 120 hours of air and water.

Its exoskeleton provides Lifting ST+8 and Striking ST+4, and cancels the weight of the suit for encumbrance. Unlike most other battlesuits, it does not otherwise increase the wearer's mobility. The suit requires 60 seconds to put on or take off.

Standard accessories include a waste relief system (p. 187), a provisions dispenser (p. 187) with a week's water and rations, and an automatic backscratcher. The helmet has hyperspectral goggles (p. 61), a small multi-mode radar (p. 65), and a medium radio (p. 44).

Battlesuit skill is used to operate the suit, and *does* limit DX and skill use (see p. B192). Unlike most ultra-tech suits, the HEX suit is nearly as clumsy as a TL7 vacc suit.

Cybersuit (TL11)

An advanced form of "smart" body armor, the cybersuit resembles a skin-tight vacc suit with a small backpack. Its armor is a multi-layered, three-dimensional molecular weave of diamond-based fibers with microscopic computer-controlled electric motors. The fabric of the suit acts like artificial muscle, reading the wearer's every movement with pressure sensors, then duplicating each movement instantly and without resistance. More pressure sensors covering the suit's surface feel the shape of whatever the user touches and transmit it through the suit.

The suit's muscles are normally programmed to match the user's normal strength and running or jumping ability, but the user can set it to amplify ST and mobility instead. If the user lacks Battlesuit skill, he may choose to deactivate the suit's strength-augmentation feature (removing the ST enhancement and Super Jump). If so, no DX penalties are applied for lack of skill. Even without strength augmentation, suit weight does not count toward encumbrance.

Cybersuits incorporate a built-in responsive clothing (p. 39) feature, and can perform minor fitting adjustments so that "one size fits all." It takes only three seconds to don and one second to remove. The suit incorporates a dynamic chameleon surface (pp. 98-99) that automatically changes color, pattern and infrared signature to blend in with its surroundings. If the wearer desires, he can use voice control to override the suit chameleon circuits. Civilian spacers often use this feature to decorate their suits with garish colors or designs.

Its built-in systems include a filter mask (p. 177), hearing protection (p. 171), a hyperspectral visor (p. 61), a small radio (p. 44), infrared cloaking (p. 99), radar stealth (p. 100), and a tactical ESM (p. 62). It is sealed and provides vacuum support. The suit itself is also a standard computer (p. 22) with the printed option. Like the space biosuit, the cybersuit absorbs sunlight and recycles waste and exhaled carbon dioxide, giving it an extended air and water supply. The suit's backpack also includes a D cell, good for a day of operation without sunlight, and a week's supply of concentrated rations.

Any cybersuit may also incorporate smartsuit options (pp. 189-190).

Cybersuit (TL11-12)

This is the standard cybersuit. In some TL11 societies, cybersuits might be the most common form of light military armor; they might also be worn by space explorers, belters, and traders. The suit's augmentation grants the wearer Lifting and Striking ST+5 (+8 at TL12), Basic Move +1, and Super Jump 1. The suit provides climate control (-459°F to 250°F), pressure support (30 atm.), and radiation protection (PF 5).

Military Cybersuit (TL11)

A tougher, thicker cybersuit with greater strength augmentation and tougher armor made of flexible sapphiroid-diamondoid material. It takes three seconds to put on and one second to remove. The entire suit acts as artificial muscle, granting its user Lifting and Striking ST+10, Basic Move +1, and Super Jump 2.

The suit adds tactical ESM (p. 62), infrared cloaking (p. 99), and radar stealth (p. 100) to the features of the civilian model. Its flexible printed computer is also upgraded from standard to microframe (p. 22).

The suit is sealed and provides vacuum support, powered by a small radiothermal generator for up to 10 years. The suit provides climate control (-459°F to 1,000°F), pressure support (100 atm.), and radiation protection (PF 10).

Dreadnought Battlesuits (TL11)

These heavily-armored battlesuits incorporate portable nuclear fusion reactors, giving them unsurpassed endurance compared to earlier powered armor. A single suit can support its operator for months or even years, although he'd probably go crazy if he were stuck in there all the time.

A dreadnought battlesuit is about the size of a heavy battlesuit (SM +1; about eight feet tall), but has more mass. Its armor is composed of titanium carbide-diamondoid nanolaminate over inner shock- and radiation-absorbing layers of liquid armor, stabilized metallic hydrogen, and bioplas.

A dreadnought suit's laminated armor gets doubled DR vs. shaped charge warheads (including HEMP). Like the heavy battlesuit, it also has integral superconductor-based electromagnetic armor: this increases the suit's protection to triple DR against any shaped-charge warheads or plasma bolts. The electromagnetic armor operates off a separate D cell and is good for 20 uses.

The suit has a full regenerative life support system, which provides continued temperature, air, and water (but not food). It is designed for operations in a wide variety of hostile environments. With its helmet on, it is sealed, and has climate control (-459°F to 1,000°F), pressure support (100 atm.), radiation protection (PF 20), and vacuum support.

Its helmet includes a filter mask (p. 177), an inertial compass (p. 74), hearing protection (p. 171), a hyperspectral visor (p. 61), a medium laser comm (p. 44) and a medium radio (p. 44).

The suit's body incorporates biomedical sensors (p. 187), trauma maintenance (p. 189), a provisions dispenser (p. 187) with two weeks of provisions, and a waste relief system (p. 187). There are olfactory and audio sensors so the user can hear and smell outside the suit. The suit's surface has a tactical ESM (p. 62).

Its powerful amplified muscles give it Lifting and Striking ST+30, Basic Move +3, and Super Jump 3.

The suit has radar stealth (p. 100) and infrared cloaking (p. 99), but the latter capability is nullified while the nuclear reactor is operating. (This also affects any added chameleon systems, which will not provide any Stealth bonus vs. hyperspectral or infrared vision.) To avoid this problem, a backup power cell system can operate the suit for 12 hours. The reactor needs an hour to cool off after being shut down.

Nanosuit (TL12)

This appears to be a thick belt or collar, but on the wearer's mental command, it flows over the body like a liquid, spreading into a thin but extremely strong coating that envelops his entire body. It is made of active titanium carbide living metal.

A neural interface (p. 48) is required to control the suit, which is a flexible distributed microframe. Battlesuit skill (p. B192) is required to operate it properly, but the suit gives a +2 skill bonus.

The nanosuit layer mimics and amplifies the user's movements, to provide Lifting ST +10, Striking ST+10, Enhanced Move (Ground) 1 and Super Jump 2. In addition to functioning as body armor, the suit can be given various smartsuit options (pp. 189-190).

The nanosuit is sealed, with climate control (-400°F to 500°F), pressure support (10 atm.), radiation protection (PF 10), and vacuum support. It can absorb oxygen from water and air, acting as a filter mask (p. 177) and a TL12 artificial gill (p. 177). It does not have an integral air supply – the user needs an air tank or some other source of oxygen to operate in space or on airless worlds. The nanosuit's surface is a tactical ESM (p. 62), and it uses a printed power cell.

Warsuit (TL12)

A warsuit is armored with living metal laminate armor reinforced by an outer layer of hyperdense collapsium. It absorbs shock and radiation with inner layers of liquid armor, stabilized metallic hydrogen, and bioplas. Its DR has Hardened 3 (p. B47) against shape-charge warheads and plasma bolts, and Hardened 1 against other attacks.

Its portable antimatter reactor can power it for five years. The suit has a full regenerative life support system, which provides temperature control, air, and water (but not food). It is designed for operations in a wide variety of hostile environments. With its helmet on, it is sealed and has climate control (absolute zero to 10,000°F), pressure support (1,000 atm.), radiation protection (PF 100), and vacuum support.

The helmet includes a filter mask (p. 177), an inertial compass (p. 74), hearing protection (p. 171), a hyperspectral visor (p. 61), a medium laser comm (p. 44), and a medium radio (p. 44). The suit's body incorporates biomedical sensors (p. 187), trauma maintenance (p. 189), a provisions dispenser (p. 187) with two weeks of provisions, and a waste relief system (p. 187). There are olfactory and audio sensors so the user can hear and smell outside the suit. Its surface has a tactical ESM (p. 62).

The suit's powerful amplified muscles give it Lifting and Striking ST+40, Basic Move +3, and Super Jump 4. It has radar stealth (p. 100) and infrared cloaking (p. 99), but the latter capability is nullified while the antimatter reactor is operating. (This also affects any added chameleon systems, which will not provide any Stealth bonus vs. hyperspectral or infrared vision.) To avoid this problem, a backup power cell system can operate the suit for 12 hours. The reactor needs an hour to cool off after being shut down.

Battlesuit Table

TL	*Armor*	*Location*	*DR*	*Cost*	*Weight*	*Power*	*LC*
9	Combat Walker	all	200/120	$300,000	800	E/24 hr.	1
9	Marine Combat Walker	all	200/120	$320,000	900	E/24 hr.	1
9	Powered Combat Armor	all	70/50	$80,000	150	E/18 hr.	1
	+ *Helmet*	head	70/50	+$10,000	15	C/18 hr.	1
9	Space Combat Walker	all	200/120	$330,000	950	2E/48 hr.	1
9	Zero-G Worksuit	all	40	$60,000	150	E/48 hr.	3
10	Commando Battlesuit	all	105/75	$80,000	150	E/24 hr.	1
	+ *Helmet*	head	105/75	+$10,000	15	C/24 hr.	1
10	Heavy Battlesuit	all	150/100	$200,000	480	10 yr.	1
	+ *Helmet*	head	150/100	+$10,000	20	10 yr.	1
10	HEX Suit	all	140	$200,000	2,000	2E/1 wk.	3
11	Cybersuit	all	40*	$35,000	30	D/1 wk.	3
11	Military Cybersuit	all	80*	$50,000	50	10 yr.	2
11	Dreadnought Battlesuit	all	200/150	$200,000	500	10 yr.	1
	+ *Helmet*	head	200/150	+$10,000	15	10 yr.	1
12	Nanosuit	all	100*	$70,000	20	D/4 wk.	2
12	Warsuit	all	300	$500,000	500	5 yr.	1

Battlesuits with split DR use the higher DR against attacks to the torso (and skull, for helmets or suits that cover all locations); the lower DR protects other locations.

* Flexible.

Typical Armor by TL

There are many different types of armor; these are simply guidelines as to who might be using them. "Paramilitary" refers to corporate security forces, second-line troops, terrorists, and riot police. "Mechanized infantry" are soldiers who ride into battle in armored personnel carriers.

TL9

Civilian and Police: Reflex jacket, trousers, vest or tailored armor. For spacers, a civilian vacc suit or zero-G worksuit.

Light Infantry or Paramilitary: Reflex tactical suit or vest; light infantry helmet.

Mechanized Infantry or SWAT: Combat hardsuit (or space armor), or powered combat armor.

Heavy Powered Infantry: Combat walker.

TL10

Civilian and Police: Nanoweave jacket, trousers, vest or tailored armor. For spacers, a skinsuit or nanoweave vacc suit.

Light Infantry or Paramilitary: Nanoweave tactical suit or vest; light infantry helmet.

Mechanized Infantry or SWAT: Combat hardsuit, space armor, or commando battlesuit.

Heavy Powered Infantry: Heavy battlesuit.

TL11

Civilian and Police: Bioplas or monocrys jackets, trousers, vests, and tailored armor. For spacers, a bioplas space suit.

Light Infantry and Paramilitary: Bioplas or monocrys tactical suits, or a cybersuit.

Mechanized Infantry or SWAT: Military cybersuit.

Heavy Powered Infantry: Dreadnought battlesuit.

TL12

Civilian and Police: Energy cloth jackets, trousers, vests, and tailored armor. In superscience settings, a force screen belt.

Light Infantry and Paramilitary: Energy cloth tactical suits or a nanosuit. In superscience settings, a force screen pack.

Heavy Powered Infantry: Warsuit.

Defense Systems

There is more to defense than just heavy armor. These are a variety of specialized systems, some designed to be integrated into suits, others for use on their own.

Miscellaneous Accessories

Magnetized Plates (TL9): These can be put on the soles of any boots. They let the wearer walk along metallic bulkheads and ship hulls in microgravity or zero-G. Move is normal with Vacc Suit skill and halved without. $100, 0.5 lbs. LC4.

Provisions Dispenser (TL9): A sealed helmet or suit that covers the head can be equipped with a concentrated food and water supply in a handy helmet-mounted dispenser. The provisions can be consumed "hands-free" without taking off the helmet. Built into many suits; if bought separately, $50, 1 lb.

*Waste-Relief System (*TL9): The suit collects and packages the wearer's waste products in a hygienic manner. Worth every penny if the suit is worn for more than a few hours! Built into many suits; if bought separately, $1,000, 2 lbs.

Other Defenses

These are miscellaneous protective systems, designed to deal with specific hazards rather than general damage. If the system is included in a suit as a standard feature, there is no extra cost or weight, and the system runs off the suit's power supply.

Ablative Foam (TL9)

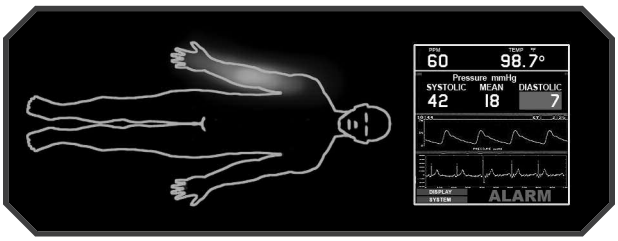
Ablative foam can be applied to skin or to body armor. It is a half-inch-thick layer of sticky foam, available in a variety of camouflage colors. It gives DR 8 vs. burning damage only, and is treated as Hardened 1 (p. B47) against laser attacks. It ablates more rapidly than ablative body armor, losing 1 DR for every point of damage inflicted to a location.

A spray can covers one person or a square yard; a spray tank covers a car-sized vehicle or up to 10 square yards. Only one layer of foam can be used on a person, while up to three layers can be applied to vehicle armor. Application takes three seconds per square yard or person. The foam is also radar absorbent; -3 for radar to detect anything covered with it, not cumulative with other modifiers for radar stealth systems. $100, 2 lbs. for a can; $500, 10 lbs. for a tank. LC4.

Armor Without Faceplates (TL9)

Any helmet or armor that covers the entire head can be built with no faceplate. All the sensor information is presented on a display inside the helmet. It includes a 360-degree scan, so that the user has Peripheral Vision. The sensor suite costs $1,000 and includes a basic HUD, audio microphones, and a simple (and unjammable) low-light optical-circuit TV camera.

Any critical hit to the "eyes" location by an beam weapon will burn out the TV scanner on a roll of 10 or less on three dice. Many prefer to make do with old-fashioned visors, which are fairly sophisticated anyway.



Biomedical Sensors (TL9)

These embedded sensors monitor cardiopulmonary function, blood pressure, oxygen saturation, posture, and activity level. The sensors also note the location and size of any penetrations into the armor. This permits remote monitoring of physiological status over a communications system; the patient data can also be encrypted and stored in a built-in storage device. This data gives medics a +1 (quality) bonus to Diagnosis when examining the wearer in person, or allows Diagnosis skill to be attempted without the wearer being present at a -2 penalty. $200, 0.2 lbs., A/24 hr. LC4.

Electromagnetic Armor (EMA) (TL9-10)

This armor upgrade is designed to dissipate the penetrator jet created when a shaped-charge warhead hits the exterior. When the round hits, embedded sensors trigger an electromagnetic pulse in the armor that disrupts the stream. Electromagnetic armor effectively doubles the armor DR vs. shaped-charge warheads and plasma bolts. Laminate armor with the EMA upgrade has triple the armor DR against shaped-charge warheads and plasma bolts.

EMA requires power and is limited in the number of times it may be used, a "use" being any penetration of the armor that is blocked only thanks to the doubling (or tripling) of DR. It draws on the suit or vehicle's power plant or energy banks; the number of uses is specified in the descriptions of vehicles equipped with it.

Vehicular EMA (TL9): This is integrated into layered armor in vehicles such as tanks (p. 226).

Battlesuit EMA (TL10): This uses superconductor technology to integrate the armor into battlesuits. A minimum thickness of armor is required to insulate the suit, so EMA is only available for the heavy battlesuit (p. 184), dreadnought battlesuit, and warsuit (p. 185).

EMA is an integral feature rather than an add-on; its presence is noted in particular vehicle and armor designs.

IFF Comm (TL9)

This software upgrade can be used with any directional communicator. It allows the user to send an "Identify Friend or Foe" signal and sets up an automatic response to any valid friendly IFF signal. IFF comms are compatible with the IFF interrogators (p. 151).

An IFF signal is an encrypted interrogation code. If the target has IFF comm software activated, and if it has the proper codes, its communicator will automatically reply with its own coded "friend" response. Once an IFF comm has identified a friendly target, it will pass this data to any navigational, sensor, or targeting displays it is linked to. If the target fails to respond, or any information does not match the IFF comm's database, it will be indicated as potentially hostile.

IFF comm software is Complexity 2, $500. LC3.

Life Jacket (TL9)

This small life jacket inflates automatically if totally submerged. Once activated, it reduces Swimming skill by 3, but the wearer won't sink even if he wants to. One jacket will support 200 pounds × (TL-7) in water. $20, 2 lbs.

Nasal Filter Plugs (TL9)

This pair of chemical-biological filter plugs fits in the wearer's nostrils. They do not provide full protection against gas, but as long as the wearer keeps his mouth closed and breathes only through his nose, the plugs add a +5 bonus to HT to protect against breathed gas (such as sleep gas), strong odors, or avoid infection from airborne microorganisms. They provide no protection against agents absorbed through skin.

Inserting the plugs takes three seconds if in hand. A DX roll can cut this to two seconds, but critical failure means the user drops one of the plugs instead of inserting it.

In a surprise gas attack, the user must make an IQ roll to close his mouth and insert the plugs before breathing a whiff of gas. Combat Reflexes adds +6 to IQ for this purpose, and Hazardous Materials skill (p. B199) can substitute for IQ if it is higher.

The filters only work perfectly for about four hours of continuous use. The HT bonus then declines by -1 every two hours; after 10 hours the plugs offer no protection at all. $100, neg. weight. LC4.

Near Miss Indicator (TL9)

This miniature acoustic sensor can attach to any combat helmet. It only works in conjunction with a HUD (p. 24), and does not function in vacuum. The NMI's sensor detects the flight path of projectiles (but not energy beams) as they pass across the user's field of vision, then displays them as visible traces. This gives a +2 to Vision rolls to locate the source of enemy fire. $1,000, neg. weight, A/24 hr. LC4.

Personal Radar/Laser Detector (TL9)

This alerts the user if he's in the path of a radar or ladar beam at up to twice that beam's range (1.5 times normal range for LPI radars, see p. 63). It cannot detect radars of a higher TL than its own. TL9+ soldiers often carry radar detectors built into combat helmets. $50, 0.5 lbs., A/10 days. LC4.

Psionic Mind Shield (TL9^)

This psychotronic device generates a telepathic mind shield that warns the user of mental attacks and defends against them. Add the shield's TL-6 to IQ or Will whenever the user resists an advantage with the Telepathic limitation. The shield also resists attempts to locate the user's mind using psionic abilities. Such abilities must win a Quick Contest against the wearer's Will + the shield's (TL-6) to find him.

At the GM's option, an artificial mind shield may protect against spells listed under *Communication and Empathy Spells* (p. B245) or *Mind Control Spells* (p. B250).

Mind Shield Helmet (TL9^): The shield circuits warn the wearer when a telepath fails to penetrate the shields, but provide no warning if the telepath succeeded. The warning can take the form of a beeper, a silent signal, or a message in the user's HUD. Lightweight caps (DR 1, cover only the skull) are $1,000, 1 lb., 2B/100 hr. LC3.

Mind Shield Circuitry (TL9^): This can be built into any type of helmet: $1,000, 0.5 lbs., 2B/100 hr. LC3.

Telepathic Barrier (TL9^): This psionic stealth coating can be used to shield vehicle crews, building occupants, or even entire cities from telepathic detection and manipulation. It uses external power. $1,000, 0.5 lbs. per square foot. Sealing a 10' cube requires an area of 600 square feet; a typical civilian vehicle is about 300 square feet.

Mind Shield Headband (TL10^): A more compact version of the standard telepathic mind shield, worn as a headband or tiara. $1,000, 0.1 lb. B/100 hr. LC3.

Radiation Badge (TL9)

This is a tiny device (often worn on the wrist) that detects the local radiation level; it includes a touch-sensitive display and micro-communicator. It can provide the actual radiation level or be set to trigger an alarm if the radiation exceeds a specified amount. The same unit may be built into a helmet visor or connected to a HUD. $100, neg. weight, AA/1 month. LC4.

Riot Shield (TL9)

Police on riot-control duty often use this large, rectangular shield of transparent armorplas. It has DB 3 and DR 30/HP 60. It does not impair the user's vision, but lasers ignore its DR. $100, 4 lbs., LC4.

Suit Patches (TL9)

Environment suits and sealed battlesuits usually have a front pocket containing 10 sticky emergency patches. Damage that penetrates the suit can be patched manually. This requires three seconds and a Vacc Suit skill roll. If the first attempt fails, each further attempt is at a cumulative -1. Every three seconds of delay or failed attempt means a loss of 10 minutes' worth of air. Extra packets of suit patches are $10, 0.1 lb.

Trauma Maintenance (TL9)

This medical system is available for any battlesuit or flexible powered suit with biomedical sensors (p. 187). It includes an auto-injector and 10 doses of drugs. The user can manually trigger it, or it can be preset to inject a specific drug if vital signs warrant it; e.g., a painkiller if injured or a stimulant if fatigued. The injector might also be remotely controlled by a superior officer, or loaded with non-medical drugs; e.g., to trigger berserker rage. It has its own power supply to make it independent of suit power loss. $2,000, neg. weight, A/1 year. LC4.

Desert Environment System (TL10)

This recycling system can be added to any sealed suit, giving it the same water recycling capabilities as a desert environment suit (p. 177). $1,000, 2 lbs. LC4.

Microbot Arteries (TL10)

These may be added to any armor. Microbot arteries contain room for one square yard of microbots *inside* the suit, allowing them to travel to any location covered by the armor. Suits with microbot arteries usually carry paramedical swarms (p. 201) or repair swarms (p. 87) to heal the user or repair damage to the suit. A battlesuit may have two different sets of microbot arteries. $500, neg. weight. LC4.

Reactive Armor Paste (TL10)

This sensor-embedded directional-explosive paste comes in tubes and can be lathered onto armor or flesh. It explodes outward to disrupt impacts and beam-weapon strikes.

Reactive armor paste will only detonate if struck by a high-velocity attack such as a bullet, beam, or explosion. It reduces the damage from attacks *before* armor DR. It is especially effective against crushing damage from a direct hit by an explosive shaped charge, such as a HEMP or HEAT warhead. One detonation protects against all hits from a rapid-fire attack.

Each time the paste detonates, the wearer takes 1d crushing damage with the explosive modifier. Reactive armor paste is normally placed on armor, which will protect against this damage.

Reactive armor paste is only good for a limited number of uses. If it's already protected a location once, then roll 1d each time a successive attack strikes the same location. Subtract 1 for every prior attack that resulted in a detonation. If the result is 0 or less, an unprotected area has been hit and the paste has no effect.

Reactive armor paste typically provides DR 20 (DR 200 vs. shaped charges). Multiply DR by 1.5 at TL11, and double it at TL12. Enough paste to cover a full-body suit is 4 lbs. and $200. Use the tailored armor rules for partial coverage. LC 2.

Smartsuit Options (TL10-11)

These options are available for smart vacc suits (p. 179), energy vacc suits(p. 179), space biosuits (p. 179), cybersuits (p. 184), and nanosuits (pp. 184-185). They make full use of the mutable capabilities of smart matter materials. Some of the possible suit features are:

Interphase (TL10)

This "smartsuit-built-for-two" feature allows two or more suits in physical contact to merge into a single, larger suit – like a big bioplastic sleeping bag – that contains all the original occupants. This takes 10 seconds and requires that all parties be cooperative, restrained, or unconscious. Once the suits are interphased, everyone within shares life support and can interact in ways that are difficult or impossible in separate suits; such skills as First Aid and Erotic Art are at only -1. A lone user can use First Aid on *himself* (still at -1) without opening his suit by activating interphase and causing his suit to balloon. It's impossible to walk while wearing a sack, but the occupants can hop or roll at Move 1. Separating the suits takes 10 seconds; any suit wearer can initiate his suit's separation. $1,000 for a biosuit or nanosuit; $5,000 for a smartsuit or cybersuit. LC4.

Rainbow (TL10)

The suit can change its color on request, or even become transparent (though not invisible). This lets the suit mimic different kinds of clothing – for example, the user could make arms, head, and legs transparent to create the illusion of swimwear. The helmet's colors and transparency can also be adjusted.

The rainbow option is not as effective as a chameleon suit, but does allow the user to don a camouflage pattern (-2 to be spotted) if desired. It can also give the suit a chrome pattern, for the equivalent of a reflec armor surface (p. 173). $400 for biosuit or nanosuit; $2,000 for a smartsuit or cybersuit. LC4.

Morphwear (TL10)

The suit can reconfigure itself to mimic normal clothing, with the hood retracting into the body and the legs, torso, and sleeves separating and billowing as necessary to duplicate anything from a formal suit to a cocktail dress. A large library of outfits can be programmed; in combination with the Rainbow setting, the suit can duplicate most types of full clothing, and create the illusion of skimpy outfits by becoming selectively transparent.

While it is activated, the morphwear function compromises the suit's ability to protect against hostile environments and halves DR. The suit can change back to its protective form in two seconds. $1,000 for a biosuit or nanosuit, $5,000 for a smartsuit or cybersuit.

Smartcloak (TL11)

The suit can split open, then re-configure itself into a cloak with a hood. This takes one second. It can be used in combat exactly like a heavy cloak (p. B287), with the exception that it weighs the same as the suit and has the suit's DR.

If a person is nude but wearing a biosuit in smartcloak mode, it can be commanded to flow around the wearer and enclose him in the biosuit. This takes one second. To pressurize the suit, the user should then don the belt pack. $1,000 for a biosuit or nanosuit, $5,000 for a cybersuit. LC3.

Beam-Adaptive Armor (TL11)

This type of armor reconfigures itself to optimize against particular beam weapon types. The optimization is against a specific sub-type of beam weapon, such as a blue-green laser, neural disruptor, or charged particle beam. Adaptive armor has triple normal DR against that particular type of beam, and normal DR against all other attacks.

Beam-adaptive armor reconfigures *automatically* to adapt one second after a beam attack of a known type penetrates the armor, or does more than half the damage needed to penetrate DR. If struck by several beam types in a single turn, the armor reconfigures against the most powerful attack. It can also be manually adjusted.

Adaptive armor can be used with any TL11-12 armor. It costs $1,000 per pound of armor weight. More expensive versions may optimize against two ($4,000 per pound), three ($9,000 per pound), or four ($16,000 per pound) beam types at a time.

This option is also available for swarmbots (pp. 35-37). Add $1,000 to the cost of the swarmbot chassis.

Living Metal Armor (TL12)

Combat hardsuits, space armor, battlesuits, and cybersuits may be made of living metal (p. 171). The armor incorporates a composite structure, with layers or cells filled with nanoassemblers and channels for feedstock. When damaged, the nanoassemblers attempt to fix it, using materials provided in the feedstock or cannibalizing the surrounding area for the required substances. These structures can seal a hole within two seconds, or repair one HP or point of DR per hour. Routine maintenance is also performed.

Bodyguards

The job of a bodyguard is to protect his principal . . . with his own life, if necessary. Not all bodyguard jobs are equally hazardous. The minions of a hated dictator are in daily danger. The guards of a businessman trying to operate in a failed nation must be constantly alert for kidnapping attempts. The wealthy and famous are mobbed by paparazzi more often than they are actually menaced. Even the leader of a democracy at peace may become a target for random maniacs, but it won't happen often. Of course, some leaders and some wealthy men, flaunt their guards as a status symbol, whether they're needed or not.

Some bodyguards deter violence with their threatening presence. Others may blend into the background until they're needed, or be disguised as personal assistants, domestic staff, chauffeurs, lovers, pets, or even children.

Robots are the most common ultra-tech bodyguards. Combat androids (p. 167), nanomorphs (p. 111), and petbots (p. 41) are especially useful. Trained animals can be useful bodyguards, especially if upgraded with neural uplift (pp. 218-219), or controlled via puppet implants (p. 218) and biopresence software.

A person's *clothing* can be an effective bodyguard – see swarmwear (p. 40).

A good bodyguard is often trained and equipped for medical emergencies involving his charges – see *Medical Equipment* (pp. 196-206). A bodyguard team may incorporate medics: see the combat medic lenses for the Nursebot (p. 202) and Medical Bushbot (p. 203).

Force Fields

These superscience devices generate a protective energy field. Some force fields are effective against many types of attack, while others are more specialized.

Force Screens

A force screen is a general-purpose defensive field that can stop both solid objects and energy beams. Force screens may be related to gravitic or space-warp technology. They allow individuals, vehicles, or habitats to look unprotected while resisting enemy fire or hostile environments. A discreet shield belt is more elegant than a bulky armored suit, but may offer the same protection. Similarly, a Tudor mansion, complete with gardens, could sit on the Moon or the hellish surface of Venus.

A force screen provides DR that protects the user (or vehicle's) entire body, including the eyes. Its effects are applied *before* armor DR. Effects that rely on touch only affect someone protected by a force screen if carried by an attack that penetrates the screen's DR.

A force screen's Damage Resistance is semi-ablative: every 10 points of basic damage rolled removes one point of DR, regardless of whether the attack penetrates DR. A partially-ablated screen regenerates 1 DR per second for every 10 DR the field started with (minimum 1 DR). Thus, a DR 50-59 screen regenerates DR 5 per second.

A force screen does not normally impede the user's ability to attack, communicate, reach, or see out of the screen. This could represent either a one-way screen, or the user's ability to selectively open portals through it.

A force screen is normally sealed, and provides total pressure and vacuum support. It also provides a radiation PF equal to its DR. Since gases cannot pass through the screen, life support will be needed to avoid suffocation.

(These advantages and limitations are ignored if the screen has the velocity or energy options.)

It takes a Ready maneuver to turn a force screen on or off. A force screen only provides DR when it is on. However, it may regenerate DR while it is off.

Barrier Screens (TL11^)

A barrier screen is a hemispherical or spherical shell that surrounds a screen generator rather than conforming to the user's shape. It's used by spacecraft, flying grav vehicles, or ground bases. Unless it is an energy or velocity screen, it won't form if something solid is in the way.

A barrier screen is effectively a solid object with a Size Modifier based on the screen's diameter (+2 since it's a sphere or hemisphere; see p. B19). The screen will function as cover and block movement into or out of it.

When targeting something protected by a barrier screen, use the normal SM of the target. If an attack misses by a margin of failure that is equal to or less than the difference between the target's SM and that of the screen, the shot hits the screen. Any penetrating damage that gets through will not strike the target unless the attack affects an area. On the other hand, this damage will reduce the screen's semi-ablative DR, and if there are multiple occupants spread about inside the screened area (e.g., a force screen around a campsite) someone else could still be hit. Use the *Occupant Hit Table* on p. B555.

Heavy Force Screen (TL11^): A powerful barrier screen, used to protect fortified strong points, tanks, or warships. The standard field diameter is 15 yards (SM +7), but larger fields are possible at increased weight, cost, and power consumption; see below.

Medium Force Screen (TL11^): This screen is used by light armored vehicles, to defend secure buildings, and by combat or exploration vessels. The minimum field diameter is 10 yards (SM +6), but other sizes are possible.

Light Force Screen (TL11^): This screen is small enough to be (barely) man-portable, and is often used to protect light vehicles, such as grav cars, or to generate a hemispherical field suitable for campsite perimeter defense. The minimum field diameter is five yards (SM +4), but other sizes are possible.

Screen statistics are shown on the *Force Screen Table*. They may be adjusted for screen options.

Force Screen Table

TL	Screen	DR	Cost	Weight	LC
11^	Heavy Force Screen	4,000	$1,500,000	1,500	1
11^	Medium Force Screen	1,000	$250,000	250	2
11^	Light Force Screen	200	$25,000	25	3

The light, medium, and heavy force screens are barrier screens based on a sphere that is five, 10, or 15 yards in diameter, respectively; all use external power. For larger areas, multiply the weight and cost by the ratio of change. For example, increasing a medium force screen's coverage from 10 to 30 yards triples the weight and cost.

If the screen size is increased, recalculate its Size Modifier using the diameter of the screen and the guidelines on p. B19, i.e., use the *Size Modifier Table* but at +2 to SM due to the spherical or hemispherical shape. Thus, a 30-yard screen is SM +9.

Conformal Force Screens (TL12)

A conformal screen is somewhat form-fitting: it follows the user's contours, but can be adjusted to flow over and protect worn or carried equipment, up to a maximum of extra-heavy encumbrance. (Once the screen is on, if the user picks up anything else, it will take a Ready maneuver to adjust the screen to cover it.) Conformal screens have the same SM as their intended wearer, or the object they are built to protect.

Personal Force Screen (TL12^): A belt-mounted screen, also built into some suits, robots, and small vehicles. Its power cell lasts for 15 minutes of continuous use.

Tactical Force Screen (TL12^): A powerful man-portable screen, often carried in a backpack or built into a robot. Its power cell lasts for an hour of continuous use.

Conformal Force Screen Table

TL	Screen	DR	Cost	Weight	Power	LC
12^	Personal Force Screen	60	$8,000	2.5	C/15 min.	3
12^	Tactical Force Screen	150	$20,000	10	D/1 hr.	2

Force Screen Variants

Numerous types of force screen are possible; some examples are given below, and others can be created by the GM. It's possible that one of these variants might be the *only* type of screen available to a particular technology path.

Options can be combined, except where noted. Modifiers are cumulative.

Adjustable

The user can opt to reinforce half the screen, increasing its DR by 50%, at the expense of the other half (reducing its DR by 50%). For example, if the front half of the screen is reinforced, this multiplies its current DR by 1.5 against front attacks, but halves the screen's DR against attacks from the right, left, and back; see p. B388 for a facing diagram. It takes a Ready maneuver to adjust the screen. +100% to cost.

Cloaking

Has the same effect as a TL12 invisibility surface (p. 100), except that the user is also invisible to active sensors such as ultra-scan, sonar, radar, and ladar. +100% to cost, and halves the operating duration due to excessive power drain.

Energy

This only affects energy attacks (beams, force swords, electrical attacks, energy explosions, fire, etc.). The screen is not sealed and provides no pressure or vacuum support. If energy screens are the only type available, guns will have an advantage over beam weapons. -50% to cost.

Kinetic

This screen only affects solid, liquid, or gaseous matter (bullets, fragments, punches, acid, falls, etc.), not energy attacks (see above). It does not protect against radiation, and may not be combined with an energy screen. If kinetic screens are the only type available, beam weapons will have an advantage over projectile weapons; -50% to cost.

Opaque

The screen is *not* transparent from the outside, although the occupants can see through it. Senses and sensors cannot detect anything in the screen unless they are only blocked by reality stabilizers and/or stasis fields. Its sensor-absorbing properties make it invisible to active sensors such as radar and ladar. The screen itself is a non-reflective black, which counts as camouflage in space or at night; it occludes other bodies, and is therefore not invisible. The screen does not block the other emissions of its user, so passive sensors are unaffected. In the case of an opaque barrier screen, there is no penalty to target the center of the screen, but other occupants cannot be deliberately attacked. They may be struck at random, as described in the barrier screen rules above. No extra cost.

Permeable

The screen is configured to allow air to pass through. This lets the user breathe, but removes the sealed advantage. It can be turned on or off with a Ready maneuver. +50% to cost; there's no need for this option if the screen has the velocity or energy options.

Reality-Stabilized

This type of force screen includes the effect of a reality stabilizer (pp. 194-195), allowing it to block matter transmission and reality disruption attacks that would enter the screen. (It's still possible to use these effects from within the screen, or against targets outside it.) Reality-stabilized screens may be a standard capability for force screens in settings where matter transmitters and reality-disintegrating weapons are common. +100% to cost.

Safety Switch

A force screen may be fitted with a safety switch; it will detect any incoming attack slower than the speed of light and turn on the belt to protect the wearer. This conserves power, and helps protect against sneak attacks. It cannot react to beam attacks (other than sonic or plasma weapons) in time to stop them, but it switches on automatically after a beam attack is fired at the user, whether he is hit or not. +10% to cost.

Velocity

This screen only blocks fast-moving attacks, such as bullets, explosions, fragments, or energy beams. It won't resist anything moving slower than 100 mph. In particular, it won't protect against melee attacks, thrown weapons, or falls and collisions under Move 50. It *will* stop arrows, sling stones, crossbow bolts, bullets, and almost all explosions. (An explosion detonated in contact with the body will penetrate the screen – if a hand grenade goes off a few feet away, the user will be protected, but a limpet mine would still be effective.) The screen is not sealed and provides no pressure or vacuum support, but there's no need to worry about suffocation. Velocity screens are a useful "swashbuckler option" for GMs who wish to combine swordplay and ultra-tech weapons. -10% to cost.

Force Screen Habitats

By generating a field over a city, it may be possible to dispense with solid domes or underground dwellings – and you won't have to worry about bad weather, either. A homesteader could buy a smaller field generator and power plant and set up on the asteroid of his choice. With a sufficiently powerful force screen and contragrav generator (p. 223), a research station could be built deep within a gas giant's crushing atmosphere, or even within a star. The engineering problems would be immense, but think of the view!

Force Shields

These rigid energy barriers feel like a solid wall, but exist only as long as the power is maintained. A force shield is normally transparent, but its outlines may be visible if struck by an attack. Gas or liquid will not pass through a force shield – if it encloses the subject, it's effectively sealed. This may lead to suffocation if there is no air supply.

Force shields are effective against all physical attacks: energy beams will be absorbed, melee attacks will hit an apparently solid wall, and any projectile failing to penetrate loses its kinetic energy and falls to the ground. An object or beam that strikes a force shield and inflicts enough damage to penetrate its DR will pass through it, but the field will reform as long as power remains.

Force Shield Bracelet (TL11^)

This is a solid bracelet worn on the wrist (leaving the hand free). The bracelet generates a flat, circular force shield. The size of a large shield, this grants DB 3 and has DR 100 with Hardened 1 (p. B47).

The force shield serves the same purpose as a medieval shield – to physically block attacks. Duelists might use one of these in conjunction with a force sword. Its advantage is that the shield vanishes when the generator is turned off, and the wrist-generator itself is light, giving it the agility of a buckler with the protective qualities of a large shield. Use Shield (Force) Skill. $1,500, 0.5 lbs., B/30 min. LC3.

Reflective Force Shield (TL12^)

As above, but a successful block roll against a ranged beam attack lets the defender attempt a separate DX roll to

return the blocked damage to the attacker! $3,000, 0.5 lbs. B/30 min. LC2.

Force Ward (TL11^)

These stationary devices project a two-dimensional force shield barrier that has DR 100 with Hardened 1. A typical ward generator casts a field two yards high and a yard wide, sufficient to block a doorway or narrow corridor. Larger or smaller wards are also possible. Multiple ward generators can be linked together to create a wider barrier. If the ward is used as a fence, half this field will be underground.

The generator and control unit is mounted on one side of the ward, and cannot be reached without passing through the field. Permanent wards built into doorways or airlocks are often linked to security scanners. $10,000, 25 lbs., D/24 hr. LC3.

Nuclear Dampers

A nuclear damper manipulates nuclear force over a distance in order to control radioactive decay and suppress nuclear fission explosions.

Dampers neutralize nuclear warheads within their radius of effect. They can prevent the nuclear detonation of fission warheads, as well as fusion warheads that use fission triggers, such as the hydrogen bombs typical of TL7-9. A damper field doesn't affect "clean fusion" weapons that use lasers or antimatter to trigger fusion.

Fission and fission-fusion bombs generally have chemical explosive triggers, and these will still explode normally. Thus, a nuclear warhead that is set off within a damper field will usually be destroyed, but fail to produce a nuclear explosion.

Nuclear Damper Projector (TL10^)

This device projects a spherical nuclear damper field with a radius of 100 yards. The field can be generated at a range of up to five miles, but must be focused on a particular target area. Use Gunner (Beams) skill to quickly focus it (e.g., to intercept a nuclear missile in flight). It has Acc 24 and RoF 1 when used in this fashion.

The large area of effect means even a "miss" may still catch the target (see *Attacking An Area,* p. B414). If the damper engages a flying target, the attack roll would have to miss by 10 or more for the field to fail to envelop the target. $10 million, 2,000 lbs., external power. LC1.

Portable Nuclear Damper Projector (TL10^)

This is a small, short-range damper. It has an area of effect of only two yards and a range of only 200 yards. It is used for nuclear bomb disposal, and is typically mounted on a tripod. As a ranged weapon, it has Acc 18, RoF 1. $200,000, 50 lbs., 2D/24 hours. LC2.

Nuclear Damper Field (TL11^)

A portable nuclear damper field prevents any nuclear fission or fission-triggered fusion explosion from occurring within a 10-mile radius around the damper field generator. It does not interfere with controlled release of nuclear energy (e.g., in a power plant). It will not prevent the detonation of ultra-tech fusion warheads that are triggered by means other than a fission explosion.

A nuclear weapon exploding outside the area of effect of the damper may still damage anything within the damper field; the field prevents detonation, but does not provide a shield against blast or radiation. This is a portable damper field, capable of being installed in a small installation or mounted in a large vehicle or trailer. Larger or smaller fields may also exist! $20 million, 4,000 lbs., external power. LC1.

> *A world without nuclear weapons would be less stable and more dangerous for all of us.*
>
> *– Margaret Thatcher*

Nuclear Jammers (TL11^)

These are nuclear dampers that *also* affect nuclear fission reactors and radiothermal generators. A fission reactor will cease to function if targeted by a nuclear damper projector or if within a nuclear damper field.

It will resume functioning afterward, but the interruption may disturb its normal operation – roll vs. the reactor or generator's HT, with failure indicating a malfunction (in a fission reactor, this could lead to a nuclear accident). A successful Mechanic (Power Plant) roll will diagnose any problems and reveal whether it is safe to restart, or whether further repairs are needed.

Nuclear jammers are otherwise identical to nuclear dampers; they have the same cost, weight and power requirements. In some settings, all nuclear dampers may also be nuclear jammers. *Tunable* nuclear jammers that can be set to affect or not affect fission reactors are double normal cost. LC1.

Stasis Webs

Stasis is an induced state in which almost no time passes. Several types of stasis-web generator are available, but their operation is similar. The duration of the web can be set for any length of time between five minutes (the minimum) and a billion years; an atomic clock registers how much relative time has passed within the web, and deactivates the field when the time is up.

Something protected by a stasis web is effectively outside the normal space-time continuum, and cannot be affected by anything within it. It could fall through the heart of a star or survive for a billion years. One second of time in the field equates with the passage of roughly 30 trillion years. Since only (relative) microseconds or nanoseconds will pass for the occupants of a stasis web, they cannot take any action while within the web.

The standard web has a damage divisor of 10,000,000; that is, divide any damage passing through the field by that value. In effect, it's invulnerable. (This equates with a high level of cosmic Injury Tolerance (Damage Reduction), see ***GURPS Powers***). If there are other fields with different strengths, the time ratio is equal to the cube of the damage divisor.

The stasis generator is always within the web itself. Viewed from the outside, an object encased in a stasis web is inside a perfectly reflecting mirror, and no sensors of any type can penetrate into it. The only way to deactivate a stasis web from outside it is a reality stabilizer (below). Anything only partially in a stasis web (e.g., an arm or leg) will be sheared off when the web is activated. Velocities are retained while in stasis, so a falling object will continue to fall, a spacecraft will continue on course, etc.

Stasis Cube (TL11^)

A stasis cube is a box which generates a stasis web around itself. It takes two seconds to set the duration, and one more to activate the cube, which is then surrounded by the web. It holds as much as a backpack (about 40 pounds of equipment). $40,000, 5 lbs., C/10 uses. LC3.

Stasis Chamber (TL12^)

This is a stasis cube the size of a large coffin, used as a suspended animation chamber, a vault, or a prison. It is essential to make sure it has the right time setting. Once activated, there is no way, short of a reality stabilizer, to turn it off until the duration expires. It can hold one person in a suit with equipment, or two with no equipment, or 10 cubic feet of cargo. The generator is designed to be activated from outside the chamber, but a timer is included so that the user can set the web duration, then climb into it. $200,000, 20 lbs., 2D/10 uses. LC3.

Stasis Grid (TL12^)

This is a stasis web generator built into a storage unit, building, or vehicle. The grid must completely enclose the object, covering all its sides. The stasis web is often designed to be triggered from within a vehicle or building as a last-ditch defensive measure. It may also be built to be activated externally, which is common for safes and medical stasis units. Like other stasis webs, a timer must be set and only a reality stabilizer can deactivate the stasis web until that time has passed. A stasis grid costs $2,000, weighs 0.2 lbs. and runs off vehicle or building power. Thus, a stasis web generator covering a coffin-sized 6' × 3' × 2' box (72 square feet) is $144,000, 14 lbs. LC2.

Stasis Belt (TL12^)

This device generates a stasis web around the user and anything he is carrying. The duration of the web depends on how long it was set for. It takes two seconds to change the duration setting on an inactive stasis web, and one second to turn it on. $20,000, 3.5 lbs., C/10 uses. LC2.

Other Force Fields

These are exotic force fields designed for special purposes.

Life Support Field (TL11^)

This low-powered force screen gives DR 5 vs. energy attacks, divides radiation dosage by 10, and adds 60 degrees to the "hot" end of the user's comfort zone. It can hold in air and heat, and will block gas or liquids from penetrating or escaping, provided the pressure differential is less than two atmospheres. A life support field will keep out anything with less than ST 1 (such as insects), and also deflect rain, snow, and normal hail.

A life support field can also be adjusted to make it *breathe*; it takes one second to change the setting. This lets gas molecules pass through it (so the user won't suffocate), but will continue to keep out liquid droplets, insects, rain, hail, and so on.

A life support field is easily breached by any application of strength. Walking or reaching through it meets only slight resistance, like pushing through mud.

Life-Support Belt (TL11^)

This device projects a conformal life support field around the wearer, extending out a few inches. Unless the wearer has an air supply or the field is set to breathe, the air begins to go bad within 15 minutes – start rolling for suffocation. Heat is lost more slowly, at two degrees per minute.

Activating the belt requires one turn, or it may be activated instantly by voice. An optional safety module ($100) will also activate it the instant pressure drops. It takes one turn for the field to form. $1,000, 0.25 lbs., B/12 hr. LC4.

Umbrella Field (TL11^)

A large life support field generator that is useful for camping (no need to stake a tent), holding outdoor events, or picnicking. Large versions can cover stadiums or even cities! It protects a 10-yard radius. $100,000, 25 lbs., D/24 hr. LC4.

Umbrella Shield (TL11^)

This generates a parasol-shaped life support field that keeps off rain and pests. It may be handheld, or built into a hat, disguised as a hair ornament, etc. The field has a one-yard radius, like a horizontal force shield bracelet. $100, 0.1 lb., B/24 hr. LC4.

Reality Stabilizer (TL11^)

A reality stabilizer creates an interference zone of spatial-temporal inertia that will block the functioning of certain superscience technologies.

No temporal and parachronic superscience devices will function within a reality stabilizer other than the stabilizer itself. Stasis fields will collapse, tau fields won't work, time portals cannot open, etc. This also applies to parachronic tech such as conveyers and projectors (p. B529). Faster-than-light and teleportation superscience technologies that are based on interdimensional travel, hyperspace, or wormhole effects are ineffective, although teleportation based on matter-energy conversion will still work. Pocket universes will continue to exist, but access to them through wormholes will be blocked. The interference applies to devices operating within the reality stabilizer field, and to external devices trying to penetrate, transport, or scan into its area of effect.

It is up to the GM whether the Jumper or Warp advantage and related non-technological abilities such as planar summoning or travel spells will function inside a reality stabilizer. In general, they'll probably fail if they have a high-tech origin. Otherwise, they'll ignore the field, or suffer a penalty equal to the field's TL.

Reality stabilizer fields are normally invisible, but failed attempts to penetrate them may result in side effects such as flickering auras around the field perimeter.

Local Reality Stabilizer (TL11^): This generates a field that covers a 200-yard radius, sufficient to stabilize space-time around an installation or spacecraft. $2 million, 400 lbs., external power. LC3.

Portable Reality Stabilizer (TL11^): This pack-sized unit generates a field that covers a five-yard radius. This can protect several people against portable space-time weapons, or ward a room against unwanted teleporters, timescanners, and other exotic intrusions. $50,000, 20 lbs., D/12 hr. LC3.

Individual Reality Stabilizer (TL11^): This belt-sized unit generates a field that protects a single person, or two individuals huddled close together. It covers a one-yard radius. $10,000, 2 lbs., C/12 hr. LC3.

Hypertime Fields (TL12^)

A hypertime field is a bubble of *hyper-accelerated time* – a sort of reverse stasis web. From the perspective of those within the area of effect, everything *outside* the field appears to stop, frozen in time, while they are free to act.

No energy or matter within the hypertime field can leave its boundaries. It is impossible for someone inside the field to take any action that will affect someone outside of it; from within the field, the edge resembles a stasis field (a silver mirror) and is just as impenetrable. If the generator is deactivated, runs out of energy or is destroyed, the field collapses, and time resumes its normal course.

A hypertime field allows those within it to "step out of time." This has numerous applications – for example, someone could get work done, heal rapidly, or study, all while within the field and "outside of time." There are also tactical applications. For example, suppose someone carrying a hypertime generator is surrounded by a few dozen foes, but only one is within range of the generator. The field is activated; time freezes outside the field, while within it the two fight. After a fierce close-range duel with force swords, one of them kills the other but is wounded. He will then have several subjective minutes to perform first aid. When the generator is deactivated, it will appear to those outside the field that the loser suddenly dropped dead from a dozen wounds, and the wounded victor has materialized in a different position.

Hypertime field power drain and duration are based on subjective time *within* the field. The power supply must always be inside the field along with the hypertime field generator.

Hypertime fields are miraculous tech that could be unbalancing if widely used. GMs may wish to limit their use to bizarre alien artifacts, sinister villains, and so on.

Any hypertime generator can also function as a tau-shield generator at double normal cost.

Local Hypertime Field Generator (TL12^)

This creates a hypertime bubble that covers up to a 10-yard radius, suitable for protecting a building or base camp. These make excellent hospitals, repair bases, science labs, nurseries, or schools. If powered by a fusion generator, the generator may operate for years of subjective time. $1,000,000, 100 lbs., external power. LC1.

Personal Hypertime Field Generator (TL12^)

This is a man-portable hypertime generator. It could be worn as a backpack, but is also often a feature of a single autodoc, diagnostic bed, or study. It covers a one- to four-yard radius around the generator; the area of effect is adjustable when the field is turned on, but can't be changed until it is deactivated. $400,000, 50 lbs., 2D/8 hr. LC1.

Tau-Shield (TL12^)

This circuitry can be incorporated into any sealed full-body armor or vacc suit, or into a force screen. It generates a tactical chronowarp with two settings: tactical and infinity. The user can change the setting at the start of his turn.

On tactical setting, the tau-shield speeds up the wearer as if he had up to nine levels of Altered Time Rate (p. B38). While the suit is on this setting, the wearer seems to shimmer, as if covered in liquid crystal. The first level lets the wearer experience time *twice* as fast as a normal – that is, experience two subjective seconds for each real second that passes. Each level past the first increases this ratio by one: three times as fast at the second level, four times as fast at the third level, and so on. Each level lets the wearer take one additional maneuver on his turn in combat, allowing him to run very fast by taking multiple Move maneuvers, make multiple All-Out Attacks, etc. The wearer's turn doesn't come any sooner, however!

On infinity setting, the tau-shield functions much like a stasis belt (see p. 194), freezing the wearer in space-time. He becomes an invulnerable mirror statue for whatever duration he preset before activating this function (anything from a second to several billion years). While in this state, the user enjoys total immunity to most attacks (see *Stasis Web*, pp. 193-194) but he cannot do anything until the duration runs out, since he is frozen in time.

The tau-shield's D cell can maintain the tactical setting for up to 180 minutes divided by (levels of Altered Time Rate). Each use of infinity consumes 18 minutes of power. $500,000, 2 lbs., C/180 min. (see above). LC2.

Chapter Eight

Medical and Biotech

Adrienne Volkova had undergone updates before, once every year or so, when she got around to it. But this time, waking up from the procedure seemed to take forever. Maybe she shouldn't have stayed up all night partying, she reflected. She still had her exams to finish. Of course, the local college guys were ***so*** *lame – that's why she preferred the spaceport bars.*

"Adrienne Volkova-Morrigan? Can you hear me?"

Adrienne ***what****? She opened her eyes. Something that looked like a giant mechanical thorn bush was leaning over her. Some sort of high-end medical robot.*

"Uh . . . you aren't my regular doctor, are you? Anyway, my name's not Morrigan, it's Volkova."

"Ah, I see. I'm Dr. Gilbert," the bush robot said. It had a nice, fatherly voice. "How are you feeling, Adrienne?"

"Uh, okay. A bit dizzy." She looked around. She was in some sort of recovery room. The walls were a soft pink, and there was a big bouquet of flowers beside the bed – violets and roses, her favorites. This wasn't the room she'd been in before! "What's going on?"

"You had a temporarily fatal accident. I can assure you that you are now in perfect health. You are about to be released from hospital into the care of your husband. He's waiting outside."

"My ***husband****?"*

"Ah, I see. At Imperial General, we do strongly recommend ***weekly*** *updates of mind uploads. Perhaps we can interest you and your children in our family medical plan?"*

This chapter describes the equipment and technologies used to heal or modify living things . . . including replacement of some or all of their biological parts with machines.

Biomedical Equipment

To the average citizen, better medicine and biotechnology can be the most important technological advances in an ultra-tech society.

Medical Gear

These devices are useful for first aid, diagnosis, surgery, and long-term patient care. This section also describes static medical robots and microbots, which are treated as equipment. For mobile machines, see *Medical Robots* (pp. 202-203).

When determining physiology modifiers (p. B181), automeds, smart bandages, robots, and similar gear are treated as specialized for the designer's species. Versions optimized for treating different species (including animals) may be available, usually at double normal cost.

Anti-Toxin Kit (TL9)

This is an antidote for one specific non-nanotech toxin; 10 uses. $25, 0.5 lb. LC4.

Automed (TL9)

This is a coffin-sized trauma pod. A single patient enters it, and the lid is shut. The pod can treat the patient on its own, or be controlled remotely.

The automed is equipped with robot arms, surgical tools, and diagnostic sensors. Its dedicated computer can treat its patient with Diagnosis-12, Electronics Operation (Medical)-12, First Aid-13, Physician-11, and Surgery-13 (all increasing at +2 per TL after introduction). It has no imagination, so new diseases or strange problems may stump it – in which case it does its best to sustain the patient and call for help.

An automed may also be used to diagnose or treat patients by manual or remote control. Used this way, it can function as a crash kit (p. 198), as diagnostic probes (below), and as a portable surgery (p. 200); however, do not add their equipment modifiers when the automed uses its own skills. It's common for automeds to be teleoperated by AIs rather than living doctors.

An automed can sustain patients on life support, as a transport ESU (p. 198). It has 100 uses of bandage spray (below) and an internal pharmacy with room for 200 doses of drugs. The drugs are chosen and stocked by the automed's owners, and can be dispensed as needed. There is also a medium-range radio (p. 44) connected to the medical sensors, an internal camera, and a speaker. $100,000, 250 lbs., E/200 hr. LC4.

Bandage Spray (TL9)

This spray-on antiseptic bandage seals and disinfects minor wounds while acting as an analgesic. It comes in flesh-tone, colored, and transparent versions. First Aid using bandage spray receives a +2 (quality) bonus to skill.

One-Use Bandage Spray (TL9): One use. $3, 0.1 lbs. LC4.

Bandage Spray Can (TL9): Six applications. $15, 0.5 lbs. LC4.

At TL9, the spray can stop bleeding and restore 1 HP in 10 seconds. It works more rapidly at higher TLs as anticoagulants, wound-cleaning, and cell-repair nano are incorporated, taking five seconds at TL10, three seconds at TL11, and two seconds at TL12.

Biomonitor (TL9)

A non-invasive monitor that records basic vital signs: pulse, heartbeat, blood pressure, etc. It has a small display, and stores its data internally on a standard disk so that a doctor can review the patient's medical history.

Biomonitor Bracelet (TL9): A doctor consulting or monitoring it receives a +1 (quality) bonus to Diagnosis skill for the wearer. $50, 0.1 lb., A/100 hr. LC4.

Biomonitor Autoinjector (TL9): As above, but incorporates a hypo or patch with 10 doses of drugs. It injects a programmed drug when a specific physical or stress-related psychological condition occurs, e.g., unconsciousness, heart attack, Bad Temper or Berserk disadvantage, transforming into a werewolf, etc. If an appropriate drug is available, the device can serve as a Mitigator (see p. B112) for such conditions. $200 (plus drug dosage), 0.15 lb., A/100 hr. LC4.

Diagnostic Sensors (TL9): A "doc in a box" that connects to a set of sensors which must be attached over the body. It gives readouts on the patient's vital signs, including pulse, electrocardiogram, blood pressure, and respiratory rate. This provides a +2 (quality) bonus to Diagnosis. $500, 0.5 lb., 2B/1,000 hr. LC4.

Diagnostic Bed (TL9)

An examination table equipped with a full range of biological and medical scanners, including a CAT scan, a PET scan, T-rays, ultrasound, and X-rays. The patient lies on the table and scan results are projected onto an overhead screen.

Diagnostic Bed (TL9): Provides a +3 (quality) bonus to Diagnosis skill for most medical conditions, save those requiring detailed and non-invasive brain imaging (see *HyMRI*), (p. 198). If the imaging results from a diagnostic bed is combined with diagnostic probes (below) or laboratory tests, the total bonus to skill is +TL/2.

$25,000, 250 lbs., E/100 hr. LC4.

Diagnostic Web (TL11): This system always adds +TL/2 to skill. It extends a web of molecular sensors that painlessly penetrate the subject's body, performing lab testing without diagnostic probes (below). $30,000, 150 lbs., E/100 hr. LC4.

Diagnostic Probes (TL9)

A solution of tiny medical biosensors which can be injected into a patient as part of a diagnostic procedure. Injecting them requires only a hypo, but retrieval requires an automed, diagnostic bed, chrysalis machine, or ESU. If they've had at least two hours to circulate, their data gives a +3 (quality) bonus to Diagnosis skill. If the data is combined with readings from an imaging scan performed by a diagnostic bed (above) or HyMRI (p. 198), the total quality bonus to skill is +TL/2.

At TL10+ a diagnostic bed can communicate with the probes without removal being required. If not removed, they'll work for a month and then degrade harmlessly. $200 per dose. LC4.

Disposable Hypo (TL9)

A tiny one-use syringe, no longer than a fingernail. It is preloaded with a dose of a drug, poison, or metabolic nanoagent in injectable form. If the drug costs $5 or more, the hypo is included at no additional cost. Otherwise, $0.50 plus the cost of the drug, 0.01 lb. LC4.

Disposable Test Kit (TL9)

This tests for a specific disease, toxin, drug, or condition (e.g., pregnancy or malnutrition). No skill is required; the kit produces a color change to indicate a positive result. Available in versions that test urine or blood. $5, 0.1 lb. LC4.

Emergency Support Unit (TL9)

This is a life support system for patients who can no longer sustain their own bodily functions. See *Mortal Wounds* (p. B423) for the effect of trauma maintenance: the patient rolls to survive each day rather than each half-hour, and may use the higher of his Physician's skill or his HT.

Attaching a mortally-injured patient to an ESU requires an Electronics Operation (Medical) roll; each attempt takes 10 seconds. The system also includes diagnostic biosensors (p. 197). An ESU can function as a Mitigator (-60%, see p. B112) for any Terminal Illness disadvantage caused by organ failure or similar problems.

An ESU can maintain the biological functions of someone who is dead (unless they're at -5 × HP or worse), preserving the body intact for later use. It can also perform whole-blood transfusions. A "blood-wash" to remove toxins or nanomachines takes two hours.

Hospital ESU (TL9): A standard trauma maintenance unit, usually integrated into a hospital bed (the bed is not included). It provides a +2 (quality) bonus to Physician skill or HT rolls for trauma maintenance. $15,000, 120 lbs., 4D/200 hr. LC4.

Transport ESU (TL9): A lightweight but shock-resistant and stabilized version of the hospital ESU, attached to a stretcher or installed in a vehicle. It is used for safe transport of critically injured patients. It provides a +1 (quality) bonus to Physician skill or HT rolls for trauma maintenance. $10,000, 60 lbs., 2D/100 hr. LC4.

Wearable Life Support Unit (TL9): Takes over the function of a specific failed organ, such as the heart or kidneys. It is only useful as a Mitigator for terminal illness caused by organ failure. $2,000, 4 lbs., 4C/100 hr. LC4.

Suitcase ESU (TL10): A lightweight system that can be attached to a prone patient. It is often used by paramedics or built into robots. $5,000, 12 lbs., D/50 hr. LC4.

First Aid Kits (TL9)

These kits contain basic medical instruments appropriate to the TL.

First Aid Kit (TL9): Contains a bandage spray can (p. 197), ointments, etc. It gives a +1 (quality) bonus to First Aid skill, or +2 when using the bandage spray to treat bleeding. $50, 2 lbs. LC4.

Crash Kit (TL9): Contains a defibrillator, an oxygen mask, sutures, a bandage spray can, and no-shock drugs. It provides a +2 (quality) bonus to First Aid skill and counts as improvised equipment (-5) for Surgery skill. $200, 10 lbs. LC4.

Hibernation Chamber (TL9)

This chamber slows down a living subject's metabolic activity through chemical means. It reduces oxygen consumption, body temperature, food and water consumption. It is the lowest-TL means of achieving "suspended animation."

It takes an hour to reduce the subject to a hibernation state, after which he is unconscious and his life support requirements drop by a factor of 10. He also "ages" at roughly one-tenth the usual rate. The subject may be kept unconscious indefinitely if the chamber is equipped to provide for life support. Once the chamber is opened, the subject will be at 0 FP (or his current total, if less). He can recover FP normally, although stimulants may also be used.

Hibernation is used to give critically ill patients awaiting organ transplants more time, to keep patients suffering severe blood loss alive long enough for surgery, and to reduce life support requirements during long voyages.

Hibernation Chamber (TL9): Houses a single person. It is equipped with life support systems to keep the patient alive at his low metabolic rate, stimulate muscles, etc. These must be connected to an external life support source, but the occupant uses up one-tenth the normal life support requirement. $20,000, 200 lbs., external power. LC3.

Suspended Animation Tube (TL10): Has a self-contained regenerative life system that maintains all needs for as long as the power holds out. It will auto-revive if power is about to fail. $50,000, 750 lbs., 5E/10 years (or indefinite with external power). LC3.

Hibernation Case (TL10): A compact unit that fits inside a trunk. Designed mostly for storing organs and pets, but a child, dwarf, or small teenager (SM -1) could fit inside. It will auto-revive if power is about to fail. $10,000, 125 lbs., 5D/1 month. LC3.

Hibernation chambers are specific to classes of species (e.g., mammals) and may not work on some races.

HyMRI Scanner (TL9)

A conventional magnetic resonance imaging (MRI) scanner uses powerful electromagnets to stimulate the protons in the patient's body into emitting radio energy, which is used to produce a non-invasive image. HyMRI augments this with an inhaled laser-polarized inert gas such as an isotope of xenon or helium. This increases the resolution, especially in the lungs and nearby heart and brain.

Use Diagnosis skill to operate the scanner. It is basic equipment for the noninvasive diagnosis of brain and spinal disorders, as well as for mind emulation (p. 220), and provides a +TL/2 (quality) bonus for diagnosing heart-lung problems.

An MRI is not safely usable on anyone with magnetic or ferrous material in their body, e.g., cybernetics or fragments. If in doubt, a diagnostic scan should precede its use.

Hospital HyMRI (TL9): A large device that the patient must lie inside. $250,000, 500 lbs., 2E/10 hr (or external power). LC3.

Portable HyMRI (TL10): A helmet-sized device clamped over the patient. This is only usable for imaging the head. $25,000, 50 lbs., 2D/1 hr. LC3.

At TL11+, diagnostic beds incorporate the equivalent of a HyMRI at no extra cost.

Plasti-Skin (TL9)

This antiseptic and hemostatic patch can serve as a pressure bandage or a tourniquet. When the flesh beneath it heals, the patch falls off. It reduces the time required for bandaging (p. B424) from 60 seconds to 20 seconds, and the hemostatic proteins incorporated into it stop bleeding immediately after successful application.

Plasti-skin is normally a different color than flesh (so the bandage can be easily identified). However, versions that assume the color of the underlying skin are available to

cover tattoos and scars – these are useful as disguises. A field dressing pack with four applications is $2, 1/8 lb. LC4.

Pneumohypo (TL9)

This hypo injects drugs with a charge of compressed air. It must be touching the patient to inject its drug. If used as a weapon, it can penetrate DR 1, or normal clothing, has Reach C, cannot parry, and uses Knife skill (or DX-4). Its vial holds one dose of a drug.

These devices are about the size of a penlight, and are included in all medical kits at no extra cost. Air cartridges providing 100 charges of compressed air are $10. It takes three seconds to remove an empty drug vial or air cartridge and replace a new one. $20, 0.1 lb. LC4.

During the first week out, the senior surgeon announced that any who wished could avail themselves of cold-sleep. Within a day or two the bunkroom was half deserted, the missing passengers having been drugged and chilled and stowed in sleep tanks aft, there to dream away the long weeks ahead.

– Robert A. Heinlein, ***Between Planets***

Physician's Equipment (TL9-12)

Anyone under the care of a competent physician (Physician skill 12+) who has a stock of drugs and medical supplies gets +1 on all rolls for natural recovery. The *healer* may also make a Physician roll to cure the patient. Only one physician may roll per patient, but a single physician can care for many patients.

The exact number of patients a physician can attend to and the frequency with which he may roll to cure them depend on the TL of his Physician skill; see the *Medical Help Table,* below. On a success, the patient recovers 1 HP; on a critical success, he recovers 2 HP. This is in addition to natural healing. However, a critical failure *costs* the patient 1 HP!

Medical Supplies (TL9): Drugs and other disposable supplies sufficient for 50 patient-days of Physician treatment (TL9-10), 100 patient-days (TL11), or 200 patient-days (TL12). Gives a +1 (quality) bonus. Without this gear, the doctor operates as if at the TL6 level. $500, 5 lbs. LC4.

Medical Bed (TL9): A robotic nursing bed with built-in instruments, waste-relief systems, and an automated programmable drug dispensary for treating one patient. Adds +3 (quality) to Physician skill; allows two Medical Care rolls daily at TL9, three at TL10, four at TL11, or five at TL12. $10,000, 100 lbs., D/100 hr. LC4.

Biomonitor (TL9): If a patient has been wearing a biomonitor bracelet (p. 197) for at least a day, its accumulated data makes it easier to treat him. This gives +1 to Physician skill. $50, 0.1 lb., A/100 hr. LC4.

Suit Doc (TL10): An array of intelligent diagnostic sensors and general-purpose medical drug injectors that can be built into any sealed suit. It can perform ongoing Medical Care (p. B424-425) on the wearer as if he were under the care of a doctor operating at its TL who has Physician-10. A suit doc's drug pack is good for five days (TL10), 10 days (TL11), or 20 days (TL12). Extra suit doc drug packs are $50 and 0.5 lbs. $5,000, 5 lbs., C/100 hr. LC3.

Medical Help Table

Medical TL	*Frequency of Rolls*	*Patients per Doctor*
9	2 × daily	50
10	3 × daily	50
11	4 × daily	100
12+	5 × daily	200

Diagnostic Smart Bandage (TL9)

This is a sensor-equipped hemostatic plasti-skin bandage containing smart drug patches. A diagnostic smart bandage is manually applied; this takes 20 seconds, but otherwise use normal Bandaging rules (p. B424). It adds +2 (quality) bonus to skill when performing Bandaging, and its hemostatic proteins always stop bleeding.

After its application, the bandage will begin treating the patient for shock (p. B424), delivering a cocktail of drugs that help keep him calm, warm, and comfortable. After 10 minutes of this treatment, the bandage gets a First Aid-12 roll to determine its success. This is not quite as effective as a human medic: success restores only 1d HP rather than 1d+1, and there is no special result on a critical success. As usual, a critical failure results in a 2 HP loss.

Diagnostic Smart Bandage (TL9): Described above; four applications are $20, 0.4 lbs. LC4.

Diagnostic Smart Bandage Spray (TL10): Takes only three seconds to apply; uses a smart aerosol. One application is $5, 0.1 lb. LC4.

Surgical Equipment (TL9)

A complete set of surgical equipment provides a +(TL-6) bonus to Surgery skill rolls in *addition* to the equipment quality modifiers described below. See *Surgery* (p. B223 and p. B424).

Surgical Instruments (TL9): A complete set of surgical tools, including laser scalpels, forceps, bio-glue, sonic probe, and sutures. (This is also included in the crash kit, p. 198.) It is basic equipment for the Surgery skill. $300, 15 lbs., 5B/20 hr. LC4.

Operating Theater (TL9): An entire room full of specialized equipment. Its instruments include manipulators that can be controlled via virtual reality gloves and an augmented reality interface; the surgeon still needs steady hands, but he's not putting them inside the patient. As a result, smaller incisions are needed and recovery times are halved.

It provides a +2 (quality) bonus to Surgery skill. $200,000, 1,000 lbs., 20C/40 hr. or external power. LC4.

Portable Surgery (TL9): A complete set of equipment that fits in the back of a utility vehicle, a trailer, or a hospital cart. This equipment is favored by "street docs" and military units. Its capabilities are the same as that of an operating theater, but it gives a +1 (quality) bonus to Surgery skill and +2 (quality) bonus to First Aid. A portable surgery takes five minutes to pack or unpack. $50,000, 250 lbs., 5C/40 hr. (or external power). LC4.

Specialized Operating Theater (TL9): Dedicated to a particular Surgery specialization. It gives a +TL/2 (quality) Surgery bonus in that specialization, but is only basic equipment otherwise. $1,000,000, 1,000 lbs., 20C/40 hr. or external power. LC4.

Specialized Portable Surgery (TL9): As above, but dedicated to a particular Surgery specialization, such as brain surgery or cybernetics. It provides a +2 (quality) bonus to Surgery skill in that specialization, but is only useful as basic equipment for other types of surgery. $100,000, 250 lbs., 5C/40 hr. or external power. LC4.

Pocket Medic (TL9)

This is a static robot the size of a paperback book. If clamped onto a wounded area, it will treat injuries. It has a hypo, anesthetic spray gun, and small surgical arms. It dispenses bandage spray (p. 197), then treats for shock with First Aid-12 (+1 per TL after TL9). After it is finished, it signals for removal. If its sensors indicate that first aid has failed, or that the patient is not responding to treatment, it calls for a physician. It has a built-in short-range radio (p. 44). $1,200, 2 lbs., B/10 hr. LC4.

Medscanner (TL10^)

This multi-purpose medical scanner can detect internal injuries, genetic problems, diseases, implants, and more. No space opera medic should be without one!

Medscanner (TL10^): A pocket-sized device with a one-yard range. It gives a +3 (quality) bonus to Diagnosis skill. $1,000, 0.25 lbs., B/10 hr. LC4.

Diagnostic beds built at TL11^ or TL12^ can be assumed to use medscanners; the main advantage is that no instruments need be physically attached to the patient and they may also perform as a HyMRI (p. 198). Otherwise, see *Diagnostic Bed* (p. 197).

Nanostasis (TL10)

This is a means of safely shutting down a person's metabolism, putting him into a state of permanent suspended animation, in which no special preservation tank is needed. It uses nanomachines to install protective scaffolding and fixatives around and within every cell in the patient's body. Once placed in stasis, an organism does not require any oxygen or food, and cannot age or deteriorate, although it remains vulnerable to physical damage. Reversal of nanostasis requires similar bio-nanotech to remove the preservatives and restart bodily functions.

A living being placed into nanostasis is not dead. However, it is inanimate and unconscious, with IQ 0 and the Immunity to Metabolic Hazards, Injury Tolerance (Unliving), and Unaging advantages.

Nanostasis can also replace the need for anesthesia during TL10+ surgery.

Nanostasis is safe, but the subject will be disoriented for hours (sometimes days) afterward. Upon revival, the process supervisor makes a Physician roll. Critical failure means the patient has the Confused (9) disadvantage for 20-HT hours, and Amnesia (Partial) for at least a week; roll vs. HT weekly to recover. Failure produces the same effects, but roll vs. HT daily to regain memory. On a success, Confused lasts only (20-HT)/2 hours and there is no memory loss. Critical success means immediate recovery.

Nanostasis Tank (TL10): A growth tank (p. 204) modified to place someone into nanostasis, or to revive him. It takes five hours for the process to slow and then completely stop

the patient's metabolism. Afterward, he can be safely removed. Reviving a patient takes eight hours. The tank uses up one package of nanomachines ($5,000, 0.1 lbs.) per patient. $300,000, 250 lbs., E/200 hours. LC3.

Nanostasis Pod (TL10): An armored and radiation-shielded (DR 50, PF 100) pod that contains a nanostasis tank and automatic suspension and revival equipment (Physician-14 for this purpose only). It powers down when not in use; it is designed to keep someone preserved for centuries. It can revive its occupant at a pre-set date. $500,000, 500 lbs., E/200 hours (when not powered down). LC3.

At TL11, see *Chrysalis Machine* (below).

Neural Inhibitor (TL10)

A two-inch-wide disk with adhesive bonding material on one side. When applied to the bare skin of a living being with an approximately terrestrial vertebrate nervous system, it cuts off nerve impulses.

Its effects depend on where it is placed. If a neural inhibitor were attached to a person's forearm, his hand would be paralyzed, but he'd feel no pain from a hand or forearm injury, and surgery could be performed without anesthesia. If it were placed near the neck over the spinal cord, he would be paralyzed from the neck down. Use on the skull induces unconsciousness until removed. If the subject is not cooperating, treat these effects as a HT-6 affliction attack; the victim may roll to resist each second in contact.

A neural inhibitor gives a +1 (quality) bonus to First Aid to treat shock (p. B424). $200, 0.1 lb., A/10 hr. LC 3.

Paramedical Swarm (TL10)

This swarm of microbots is designed for autonomous patient care. It is made up of teams of specialized microbots. Some taste blood and perform diagnosis, some cut away damaged tissue, clean wounds, sew up cuts, and inject drugs, and some enter the body to perform internal repairs or diagnosis.

The swarm may perform First Aid, cleaning and repairing damaged tissue and injecting no-shock drugs. Each square yard of swarm can treat one person at a time. A paramedical swarm has Diagnosis-10 and First Aid-10; add +1 skill per TL after introduction. It provides its own basic equipment for both skills, but it cannot benefit from other types of medical equipment. Paramedical swarms can't treat somebody in a sealed suit, but a swarm can be housed in microbot arteries (p. 189). $6,000/square yard; see *Swarmbots* (pp. 35-37) for additional microbot swarm rules and options. LC3.

Regeneration Tank (TL10)

A regeneration tank is a biofab (p. 204) optimized for rapid whole-body cell repair. The tank contains mechanisms for controlling nanomachines as they permeate the user's body, instructing and assisting every viable cell in what repairs to make. Nonviable cells are programmed to self-destruct, or are removed and replaced with clones of healthy cells.

A Physician roll is required to supervise the procedure. Success means it works normally; failure takes twice as long as usual. It can heal everything up to permanent crippling injuries, at 1 HP per 12 hours, or radiation at 10 rads per day. Missing limbs and organs regrow in six weeks. $500,000, 600 lbs., 2E/200 hr. LC3. A regeneration tank requires nanomachines and feedstock: a week's supply is $1,000, 1 lb.

Rejuvenation Tank (TL10)

This specialized regeneration tank reverses the aging process. Its nanomachines reset cellular clocks, killing senescent or dying cells and replacing them with healthy ones.

Rejuvenation requires three months of treatment (TL10), six weeks of treatment (TL11) or a week (TL12), after which the subject's body is restored to young adulthood and full health. All age-related disadvantages and attribute losses are removed, as are any crippling injuries.

Rejuvenation is a risky procedure. The process supervisor must make a Physician roll. On a critical success, the patient is rejuvenated and fully recovered. Success means that the patient is rejuvenated but suffers Confused (9) (p. B129) for 1d days as he adjusts to his rejuvenated body. Failure means the structures of his memory were permanently disrupted: he has Partial Amnesia (p. B123). A critical failure results in either a messy death (such as being turned into a mass of cancer cells) or revival with no mind at all. Rejuvenation treatments may also have other limits, such as sterility or a set limit on the number of rejuvenations one can sustain.

A rejuvenation tank can also function as a regeneration tank. $1,000,000, 600 lbs., 2E/200 hr. LC2.

Suitcase Doc (TL10)

This device must be placed atop a patient's torso or other injured part (this takes a Ready maneuver). After that, it is autonomous. It unfolds, extruding surgical manipulators, anesthesia and life support tubes, and diagnostic sensors as necessary. It uses its manipulators to cut away clothing and treats the patient using Diagnosis-10, First Aid-12, Physician-10, and Surgery-10 (+2 per TL after TL10). It incorporates diagnostic probes (p. 197), suitcase ESU (p. 198), and a crash kit (p. 198).

If the doc encounters a problem it can't handle, it calls for help on its short-range radio. It also carries 10 uses of bandage spray and an internal pharmacy with up to 20 doses of drugs. $10,000, 20 lbs., 2C/10 hr. LC3.

Chrysalis Machine (TL11)

A chrysalis machine is a pod that spins a life-support web around the patient, completely enfolding him. Each cell is surrounded with biological repair and support machinery, which take over control from the patient's own DNA. The machine instructs the cells to begin self-repair procedures, and if necessary, takes apart the patient cell by cell and rebuilds him in accordance with its own programming.

A chrysalis machine can function as a high-speed regeneration tank, healing injury at 1 HP per hour. Crippled limbs or organs are restored when the lost HP are recovered. A chrysalis machine can also function as a nanostasis tank (p. 200) and rejuvenation tank (p. 201); it does so at 12 times normal speed.

A chrysalis machine can revive the dead, provided the body was not totally destroyed (-10 × HT or worse). Roll against Physician skill to do so, at -2 for every hour the subject has been dead. Success restores the patient to life. Failure by 1 or 2 restores the patient with personality intact, but with substantial memory loss (treat as Partial Amnesia). Failure by 3 or more restores the body with no mind or personality, although downloading (p. 220) could potentially fix that.

As long as there are some traces of genetic material remaining (the body may be crushed or burned, but not disintegrated) the chrysalis can clone the original using genetic reconstruction. Unless a mind emulation (p. 220) is available, the result will be a blank-minded clone.

A chrysalis machine can direct itself using its own dedicated computer's Physician-13 skill (15 at TL12), or be controlled by an operator. $500,000, 600 lbs., 2E/200 hr. LC2.

Implant Seed (TL11)

A pill-sized device that contains a swarm of nanomachines. Once inside the body, it uses the patient's biomass as building materials to grow a cybernetic implant. This could be benign – a neural interface, for instance – or something unwanted, such as a hostile puppet implant.

An implant seed can only grow cybernetic implants that require minor or simple operations (at TL11). Other implants, such as cybernetic arms, are either too complex or too large to be assembled.

Each seed is designed to grow into a particular type of cybernetic. Construction time is one hour per $50 cost. The seed may be programmed to lie dormant for a period of time before beginning construction.

Halfway through the growth process, an implant seed will be large enough to appear on scans performed using a diagnostic bed (p. 197) or medscanner (p. 200). At that point, it can be detected and removed before it starts functioning. See *Detecting and Removing Cybernetics*, p. 208.

An implant seed costs twice as much as a normal cybernetic implant at its TL; it has the same LC.

Pocket Regenerator (TL12^)

Regeneration fields are precision energy fields used to stimulate cell regrowth in living tissue. They may be related to hypertime (p. 195) or neural disruptor (p. 121) technology. The pocket regenerator is a pen-sized device with a regeneration field that can close wounds quickly. It has a range of one inch, and can be used through light clothing. Each use of a pocket regenerator combines the effects of bandaging and treating shock (p. B424) into a single treatment that only takes a minute. It requires either an Electronics Operation (Medical) or First Aid roll. $1,000, 0.5 lbs., B/15 min. LC4.

Regeneration Ray (TL12^)

This is a bed or chamber equipped with a powerful regeneration field. The patient lies inside and is bathed in the energy, which restores cellular function. A regeneration ray can heal injuries and repair the ravages of age. It does not cure poison or disease, but it can restore HP lost to them.

A regeneration ray can be used as a pocket regenerator with a +2 (quality) bonus to the user's skill. Short treatments can be used as part of TL12 Medical Care (p. B424): the regeneration ray gives a +6 (quality) bonus to Physician skill.

In addition to these minor applications, a regeneration ray can be used at high power levels. This takes an hour to set up, followed by an hour of treatment. High-power use requires a Physician roll. Success heals *all* damage sustained by the patient. Any attribute points lost to age or prior mortal wounds are restored, and any lasting crippling injuries are cured. Permanent crippling injuries are not restored immediately, but missing body parts will grow back as if the user had the Regrowth advantage. Critical success usually has no extra effect, but in a cinematic game it might trigger some favorable mutation, justifying spending character points on improved attributes or advantages.

Failure means something goes wrong: the subject takes 3d toxic damage, and no further regeneration ray or pocket regenerator treatments are possible for 1d weeks. Critical failure *seems* to work, but an unfavorable side effect appears 1d weeks later, such as the unexpected growth of tissue or a body part (an Unnatural Feature), cellular damage (a level of Slow Healing), or a bizarre mutation. All side effects also change the genetic code – any clones made from tissue sampled after the treatment will also possess them.

Regeneration rays are large, bulky devices. $1,000,000, 2,000 lbs., E/20 hr. LC3.

Medical Robots

Most medical robots are static equipment or tiny microbots (both covered under *Medical Equipment*). However, the need for cheap nursing assistance for an aging population may lead to the development of mobile medical robots.

Nursebot (TL9-12)

209 points

This man-shaped robot caregiver can assist the elderly and disabled, both at home and in clinics and hospitals. Its long, dextrous fingers have retractable surgical instruments, which can function as claws if used in combat. Its oversized head contains infrared and sonar systems for patient imaging.

Some nursebots can pass as human, although a sculpted humanoid version is more common.

Attribute Modifiers: ST+3 [30]; HT+2 [20].
Secondary Characteristic Modifiers: HP+7 [14].
Advantages: Absolute Direction [5]; Ambidexterity [5]; Discriminatory Taste (Profiling, +50%) [15]; Doesn't Breathe [20]; DR 2 [10]; High Manual Dexterity 2 [10];

Infravision [10]; Machine [25]; Microscopic Vision 2 [10]; Penetrating Vision 1 (Blockable, Dense Substances, -30%) [7]; Radio (Burst, +30%, Secure, +20%, Video, +40%) [19]; Sealed [15]; Sensitive Touch [10]; Sharp Claws (Switchable, +10%) [6]; Vacuum Support [5].

Perks: Accessories (Personal computer; surgical instruments) [2]; Sanitized Metabolism [1].

Disadvantages: Electrical [-20]; Restricted Diet (Very Common, power cells) [-10].

Lenses

Select one of these model lenses, then combine it with a machine intelligence lens (pp. 27-28) and a biomorphic lens (p. 28).

TL9 Model (-5 points): Add Maintenance (one person, weekly) [-5]. $150,000, 150 lbs., 2D/8 hr. LC4.

TL10 Model (+1 point): Add Maintenance (one person, biweekly) [-3], Reduced Consumption 2 [4]. $100,000, 150 lbs., 2D/24 hr. LC4.

TL11 Model (+4 points): Add Maintenance (one person, monthly) [-2] and Reduced Consumption 3 [6]. $70,000, 150 lbs., 4D/1 week. LC4.

TL12 Model (+8 points): Add Reduced Consumption 4 [8]. $50,000, 150 lbs., 4D/1 month. LC4.

Medical Bush Robot (TL11-12)

475 points

This is a mobile "robot bush" equipped with branching manipulators and sensors. It is a variant of the technical bush robot (p. 86). A "medical bush" can perform the most delicate forms of surgery without any additional tools.

Attribute Modifiers: HT+4 [40].

Secondary Characteristic Modifiers: HP+7 [14]; Per+2 [10].

Advantages: 360° Vision [25]; Absolute Direction [5]; Ambidexterity [5]; Chameleon 1 [5]; Discriminatory Taste [10]; Doesn't Breathe [20]; Double-Jointed [15]; DR 10 (Can't Wear Armor, -40%) [30]; Enhanced Tracking 2 [10]; Extra Arms 4 (Extra Flexible, +50%) [60]; Extra Mouth 5 [25]; Extra Attack 2 [50]; High Manual Dexterity 4 [20]; Hyperspectral Vision [25]; Injury Tolerance (No Brain, No Eyes) [10]; Machine [25]; Microscopic Vision 6 [30]; Penetrating Vision 1 (Flesh only -40%; Sense-Based: Touch, -20%) [4]; Protected Vision [5]; Radio (Burst +30%, Secure, +20%, Video, +40%) [19]; Sealed [15]; Sensitive Touch [10]; Sharp Teeth [1];Vacuum Support [5]; Vibration Sense [10].

Perks: Accessories (Microframe computer; surgical instruments) [2].

Disadvantages: Electrical [-20]; Restricted Diet (Very Common, power cells) [-10].

Lenses

Select a TL model lens and combine it with any machine intelligence lens (pp. 27-28) except a cyborg brain. Consider the optional lenses.

TL11 Model (+4 points): Add Maintenance (one person, monthly) [-2] and Reduced Consumption 3 [6]. $220,000, 75 lbs., 3D/1 week. LC4.

TL12 Model (+8 points): Add Reduced Consumption 4 [8]. $120,000, 50 lbs., 3D/1 month. LC4.

Optional Lenses

Budding (+21 points/copy) (TL12): Some bushbots can bud off smaller copies of themselves. Take up to five copies with Duplication (Duplicate is -1 SM, +0%; Shared Resources, -40%) [21/copy]. $20,000 per copy.

Combat Medic (+177 points) (TL11): An armored "thorn bush." Upgrade DR to DR 60 (Can't Wear Armor, -40%) [180] and Chameleon to Chameleon 4 (Extended, Infravision, Radar, and Ultravision, +60%) [32]. +20% cost and weight.

Psychiatric Equipment

This equipment is for monitoring and manipulating the mind.

Brainscanner (TL9)

A brainscanner observes the human brain by the mind's electrical activity. A high-resolution 3D structural scan of the subject's brain is assembled using a HyMRI or similar system. Other real-time electrical recording technologies such as magnetoencephalography (MEG) or electroencephalography (EEG) are used to record the firing of individual brain cells and map those impulses to the scan.

Brainscanners can also be used to create a "persona map," a model of the way a person thinks. The subject must be conscious, but cooperation is not required. Roll against Electronics Operation (Medical); one roll is allowed each day. Updates are performed at +1 and generally take a few hours.

Careful study of a recent persona map can reveal a person's main mental advantages, disadvantages, and quirks. It requires two hours and a successful Psychology skill roll, which provides a +2 bonus to Psychology and +1 to other social skills when dealing with that individual.

Scanning Net (TL9): This is a network of electrodes, superconducting quantum-interference devices (SQUID), and other sensors that must be attached to the subject's head. It must be used in conjunction with a prior HyMRI scan. $6,000, 4 lbs. LC4.

Implant Net (TL9): A neural interface (p. 48) or biomonitor implant (p. 208) allows brain scans without the use of a scanning net. This provides +1 to all tasks that require a brainscan.

Deep Brainscanning (TL10)

This is an *interactive* brainscan. The person running the scan must fit the subject with a neural interface (pp. 48-49), then stimulate the parts of the brain associated with memory recall. The subject is conscious but in a dreamlike state through most of the process. Roll every week rather than daily. Success provides data that gives triple the bonus of a brainscan, and which is sufficient to design a shadow mind emulation (p. 220).

Biotech Equipment

Equipment for growing life forms and for biotechnology research. Portable labs (pp. 66-67) for Biology skill are also useful.

Growth Tank (TL9)

An artificial womb that can be used to grow a life form to infancy or adulthood. It's no faster than natural growth. An organism developing in a growth tank has the same awareness as a baby in its womb. If kept past the fetal stage, it will not develop mentally beyond infancy unless additional stimulation (such as an educational dreamgame) is provided.

Incubator Growth Tank (TL9): Can carry a human infant to term. $10,000, 10 lbs., external power. LC3.

Adult Growth Tank (TL9): Big enough to allow a human to grow to adulthood inside it. $200,000, 200 lbs., external power. LC3.

Larger and smaller tanks are $1,000 and 1 lb. for each pound of body weight they can support.

Biofab (TL10)

This is a specialized wet nanofactory that can assemble organs or even a complete life form. A biofabricator can assemble living things rapidly (about a year of growth every week). It can grow an adult human in about 18-20 weeks.

Incubator Biofab (TL10): Can carry a human infant to term. $200,000, 50 lbs., D/20 hr. (but usually runs on external power). LC2.

Adult Biofab (TL10): Big enough to allow a human to grow to adulthood inside it. $4,000,000, 1,000 lbs., E/20 hr. (but usually runs on building power). LC2.

Larger and smaller tanks are $20,000 and 5 lb. for each pound of body weight they can support.

Nanofacs and Replicators (TL11-12)

Nanofacs (p. 91) and replicators (p. 93) can also assemble living things. When calculating the speed of assembly, assume an adult human costs $100,000 and an embryo $25,000.

Drugs and Nano

Miraculous drugs are a staple of science-fiction medicine. See *Ultra-Tech Drugs*, p. B425, for guidelines on designing futuristic drugs. Drugs can also include nanomachines which perform specific medical, maintenance, or protective tasks.

A drug may be a pill, injection, aerosol, contact agent, or aerosol contact agent. Many drugs are available in multiple forms. Most pills require 30 minutes or more to take effect, but can be dissolved in drinks. Contact agents such as patches take at least five minutes, while aerosols and injections take effect almost immediately. Double cost for aerosols or contact agents, or multiply by 10 for aerosol contact agents.

Assume that each doubling of dosage gives an extra -1 to the roll to resist.

Analgine-Beta (TL9)

This drug masks pain for a period equal to half the user's HT in hours. Unfortunately, the user is also Numb for the same period. $50 per dose. LC3.

Antirad (TL9)

One dose halves the effective amount of rads from a new exposure; two doses will halve exposure again, and so on. Antirad is preventative; it does not heal radiation damage. It comes as an injection or pill for $150 per dose.

Hyperstim (TL9)

This drug *instantly* awakens an unconscious person, regardless of his HP or FP. Someone using this drug cannot fail a HT roll to avoid unconsciousness. After the drug wears off, roll vs. HT. Failure causes 1 HP damage, while critical failure also results in a heart attack. $100 per dose. LC2.

Morphazine (TL9)

This drug puts the patient into a deep, dreamless sleep. The user gets a HT-3 roll to resist; failure results in the user falling asleep for eight hours times the margin of failure. It is a reliable, powerful sleeping pill, often available only through prescription. If injected, it works in one second. $10 per dose. LC3.

Soothe (TL9)

Places the user in a dreamy state of euphoria. Roll HT-3; if the roll is failed, the drug causes the Euphoria irritating condition and High Pain Threshold advantage for five minutes times the margin of failure. The user has no memory of events that occur while under the drug's influence. $15 per dose. LC4.

Crediline (TL9)

A psychoactive drug designed for interrogations and drug-assisted psychotherapy. It is often abused by criminals. The subject becomes trusting and talkative. He must roll HT-3 or suffer the Gullibility (9) disadvantage for (25-HT) minutes. $240 per dose. LC2.

Ascepaline (TL10)

Accelerates cellular regeneration: anyone using it regenerates 1 HP every 4 hours. Each dose lasts a day, and a week should elapse before another dose is taken. If not, roll vs. HT+2 for the second dose, HT+1 for the third, etc. Failure means the user's natural ability to heal *without* the drug is permanently damaged: the user gains Unhealing (Partial) (p. B160). He may still use Ascepaline, however. $20 per dose. LC3.

Purge (TL10)

This cleanses the user's system of foreign biochemicals. If the user makes a HT roll, it neutralizes any active drugs (including recreational drugs and alcohol) within 2d minutes. Failure means that the dose had no effect; critical failure also nauseates the user (-3 DX for 1 hour). Purge will not counteract drug addiction or cure side effects that remain after the drug that caused them wears off. Purge has no effect on TL11+ drugs or most deadly poisons, but it will counteract sleep gas. $20 per dose. LC4.

Memory-Beta (TL10)

Stimulates the user's memory. After taking a dose of the drug, he can remember nearly anything that has happened to him that he concentrates on recalling. An IQ roll is required to focus on something specific, and some stimulus is required to recall buried memories. If the IQ roll fails, the user gets lost in his own memories, reliving bits and pieces of his life. A critical failure results in the user being captured by some especially strong memory, whether of joy, tragedy, terror or even birth. This may trigger buried phobias or other psychological traumas. $250 per dose. LC3.

Biomedical Nanomachines (TL10-12)

These travel through tissue examining, dismantling, and rebuilding damaged molecular structures. Early versions are the size of bacteria, and specialized to repair specific types of molecular damage. More advanced machines are the size of viruses, with onboard computers, manipulators, and motive systems.

These machines are powered by the same chemicals that power the body's own cells. Cell repair machines produce some heat, but the resulting rise in body temperature is no greater than that produced by ordinary exercise.

Tailored Immune Machines (TL10)

Ultra-tech medicine may use biomedical nanomachines to seek out and destroy disease-causing microorganisms or tumors. It's also possible to get expensive nano that wards off these problems and stays in the body for weeks or permanently; see ***GURPS Bio-Tech***. Alternatively, medics may use cheaper tailored nanomachines designed for a specific purpose. This requires successfully diagnosing the problem. After it is diagnosed, prescribing the correct treatment requires a successful Physician roll.

A dose of tailored nano specific to a particular disease is $50 per dose and LC4; pharmacies, automeds, and hospitals usually stock a large range. Tailored immune machines for exotic ailments such as a rare disease or biological weapon may be harder to find, and cost $500 per dose. Tailored immune machines for unknown diseases require a new invention (but see *Programmable Immune Machines*, below).

If the correct nano is taken (by injection or pill) it cures the patient in 3d hours at TL10 or 1d hours at TL11+. If it was incorrectly proscribed, it will have no effect; another try with a different selection may be possible. If one dose works, the GM may allow the same nano to work on any patient with an identical problem.

Programmable Immune Machines (TL11)

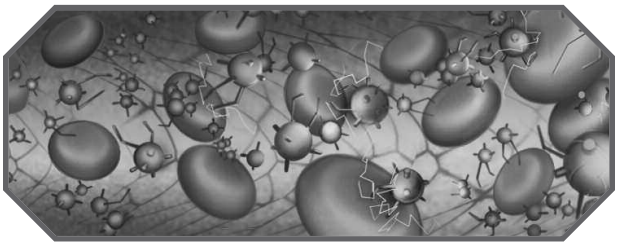
These general-purpose nanomachines are programmed to eradicate disease-causing microorganisms or tumors. They work like tailored immune machines, except that a successful diagnosis followed by a Physician roll lets the user program the nano dose to treat a specific disease. There's no need to buy or make new nanomachines for each illness. Programming usually takes an hour per attempt (apply a -2 penalty to skill for rare diseases). Programming a cure for a previously unknown disease takes a successful diagnosis and at least a day per attempt. The skill roll is at -4. $500 per dose. LC3.

Quickheal (TL11)

This is a topical application of nanomachines. It restores 1d HP of injury after an hour. The patient must also have received First Aid; Quickheal won't close a gaping wound. No more than one dose can be taken per hour. $100 per dose. LC4.

Critical Repair Nano (TL11)

These specialized treatments reset cellular control mechanisms. They can remove heart scarring and repair spinal or nervous system damage. A patient using critical repair nano can remove the Wounded disadvantage or regain the point of HT lost on a failed roll to recover from a mortal wound. $10,000 per dose. LC4.



Respirocytes (TL11)

These function like oxygen-carrying red blood cells, but with many times the transport capability. They store extra oxygen, transport it, and release it in response to need. They also extract carbon dioxide and absorbed nitrogen from muscle tissue, carrying it to the lungs for excretion.

Respirocytes provide +2 FP and Doesn't Breathe (Oxygen Storage × 25, -50%). They last until the oxygen has been used up or the user reaches 0 FP due to extra effort or exertion; then additional respirocytes are needed. $500 per dose. LC4.

Torpine (TL11)

This puts the user into a healing trance; he becomes unconscious for 24 hours. At the end of that time, *all* damage taken is totally healed. However, the user comes out of the trance at 1 FP. He is famished from the demands on his system, and must eat to recover lost FP. Torpine also speeds up the metabolism; treat each day on torpine as equivalent to 10 days for aging purposes. $250 per dose. LC3.

Fast Regeneration Nano (TL12)

These nanobots rush to any point of injury and begin performing repairs. They provide Regeneration (Fast) for one hour. However, each HP regenerated costs the subject 1 FP due to heat build up. Since the nano are not under the user's control, it's possible to be cooked by one's own nano if they are struggling to heal injuries. $500 per dose. LC3.

Aegis Nanobots (TL11)

This injection of "active shield" nanobots dwells permanently inside the user's body, patrolling his bloodstream and policing his cells to keep out unfriendly nanomachines. They are effective against both metabolic nanomachines and nanotech assaults that do not require a HT roll to resist, such as nanotracers (p. 161) and splatter (p. 162).

Biotech Techniques

These technologies are covered in detail in ***GURPS Bio-Tech***, but their capabilities are summarized here.

Human Cloning (TL9): Babies that are the genetic twins of humans (along with other animals) can be reliably created.

Bodysculpting (TL9): Cosmetic surgery can completely change a person's appearance.

Tissue-Engineering (TL9): Replacement organs and other body parts can be grown to order and grafted onto the body. These include specialized biomods that are the biotech equivalent of cybernetics.

Variant Races (TL9): Genetically-engineered subraces of humanity or other species can be created. These are treated as racial templates. Once the research is done, parents might acquire a genetically-engineered embryo, ready for transplant. A typical price is $25,000 for a racial template that does not have any traits a normal person could not have, or $50,000 (or more) for one that does; add an extra +$1,000 per character point the template costs over 0 points.

Biogenesis (TL10): Functional biological beings or devices can be assembled using bio-nanotechnology or nanomachines. These are "living robots" patterned on biological models.

Metamorphosis (TL11-12): A chrysalis machine or similar nanotechnology can make radical physical alterations, changing a person's racial template. At TL12, an injection or aerosol of nanomachines can trigger these changes.

Aegis confers immunity against all known types of intruding nanomachines, whether biological or not. The nanobots are programmed to recognize benign nanomachines and will not attack them. They do not confer immunity against new types unless updated (see below). However, if an unknown nanomachine allows a HT roll to resist, they give a +8 bonus to the resistance roll.

Against invading nano that do not give a HT roll to resist, Aegis nano engage in a contest of their skill against the intruder's skill to destroy it. Aegis nanobots have a skill of 15 vs. known nano and skill of 12 vs. unknown nano. See the description of Splatter and Shrike (p. 162) invasive nanomachines for examples of how this may work. If creating new nano, the GM should decide what effect Aegis will have on it.

Aegis nano can receive updates if the user has a neural interface. The cost is minimal: 1% per year for a subscription. Organizations such as police or military forces may provide this for free.

Aegis nano permanently grants Immunity to Known Nanomachines (Requires updates, -10%) [9] and Resistant to Unknown Nanomachines (+8) [5]. $5,000. LC3.

Cybernetics and Uploading

The earliest cybernetic systems were prostheses such as hearing-aid implants and pacemakers. Late in TL8, cybernetics that linked the user's nervous system with electronics were developed, allowing paralyzed individuals to control computers. This set the stage for bionic eyes and advanced limb replacements. In some settings, cybernetic limbs and organs may be unnecessary, thanks to easy-to-grow transplants. In others, cybernetic replacement may be much more common.

Cybernetics that *enhance* a person's abilities are a different matter. Many simple cybernetic implants are for convenience. An implanted, voice-activated communicator is easier to use than a pocket phone. Neural interfaces (p. 48) allow hands-free use of many gadgets, sometimes with greater efficiency. Combat implants can also provide a crucial edge. An opponent with a laser in his forearm, a battle computer in his brain, and armor under his skin is trouble.

Social Effect of Cybernetics

Cybernetic implants blur the line between a person and his gadgetry, making a man's abilities less important than his neurosurgeon's. Still, not everyone will want cybernetics. A spy may benefit from concealed armor and implanted claws, but it will take surgery to remove if they're spotted when he's walking through Customs. If he's captured and his captors find his implant communicator, they may be less than gentle about confiscating it.

Those who receive cybernetics will have to deal with their own differences – and with how others view them. Becoming a machine might be considered a Social Stigma in many societies. Cybernetics could also lead to reaction penalties in a society where Intolerance against robots or cyborgs exists.

Cybernetics are not always controversial. They might be a standard medical treatment or fashion choice, no more unusual than a prosthetic leg or plastic surgery is at TL8. If a lot of war veterans have bionic replacements, they could even be a mark of distinction: "Yes sir, got that leg after fighting in the Battle of Three Suns, back when I was a sergeant in the High Marines. No, never could afford to replace it with a transplant." In some societies, certain types of cybernetics, like neural interface implants, may mark the user as a member of an elite group (aerospace pilots, for example) or a particular subculture.

Statistics

Cybernetic modifications usually provide advantages or mitigate disadvantages; these traits are listed under *Statistics* along with the total point cost. The *Body Modification* (p. B294) rules apply, with the exception that the more detailed *Operations* rules below supersede the *Surgical Modifications* rules on p. B295.

Cybernetic advantages often have the limitation Temporary Disadvantage (Electrical, -20%), which means the advantage is vulnerable to electrical surges, power draining, etc. See *Electrical, p.* B134.

Cybernetic replacement parts for specific body locations are bought as a crippling disadvantage with the Mitigator (-70%) limitation. This limitation is assumed to include the effects of the Electrical, Maintenance (1 person, monthly) (p. B143), and Unhealing (p. B160) disadvantages for that body part.

Cybernetic implants generally supercede (or mitigate) existing natural or biological traits. Thus, if someone with Night Vision 1 gains a bionic eye that provides Night Vision 2, the levels don't stack together. Modify the character's point total accordingly; if paying character points for the advantage, base the cost on the net change (if positive).

Availability

Each modification specifies the type of procedure, the cost of the cybernetics, and the LC. Procedures are classified as simple, minor, complex, or radical – see below.

Procedure

Installing cybernetic modifications involves opening up the patient and, except for simple procedures, performing neurosurgery to connect the device to the user's nervous system.

Surgery skill is used to install cybernetics, and Surgery (Cybernetics) may be a common specialization at TL9. Most hospitals are reliable enough that no skill rolls are required for surgery the characters pay for (although cyber-surgery accidents or malpractice can be part of an adventure plot). If they do their own work, or a black-market surgeon is hired, the GM should require a Surgery skill roll (see p. B223).

The table below shows the procedures' difficulty modifiers (use the parenthetical value for brain or eye surgery), the time per attempt, and the injury caused by a failed roll (this is applied to the body part operated on). Success installs the modification, but it won't work until after the specified recovery period. The fee is the surgical fee charged at a clinic or hospital – ignore it for characters who do their own work.

Surgical Procedures Table

Procedure	Modifiers	Time	Injury	Recovery Period	Fee
Simple	+4 (+2)	15 min.	1 HP	1 hour	$100
Minor	+2 (+0)	1 hour	1d/2 HP	1 day	$1,000
Major	0 (-2)	2 hours	1d HP	1 week	$10,000
Radical	-3(-5)	4 hours	3d HP	4 weeks	$100,000

All damages and recovery times assume the surgeon is using robotic instruments; without them, double recovery time and damage. (Increase damage from a failed Simple procedure to 1d/2 HP.)

A modification is not functional until the recovery time has passed. If a disadvantage is mitigated by the modification – e.g., One Hand for a Bionic Hand – the patient will suffer the disadvantage until the recovery time is completed.

On a critical success, halve the recovery time. A critical failure may inflict double damage, or may result in the inadvertent installation of defective cybernetics. These may break down at a dramatically appropriate time, or cause an inconvenient disadvantage. Leaking toxic chemicals, bad installation, electrical faults, or infection might lead to Chronic Pain, Neurological Disorder, Unfit, Terminal Illness, or Wounded. A problem may also be specific to the attempted modification, such as a malfunctioning ear implant leading to Motion Sickness.

At TL10+, the recovery time of most cybernetic surgeries drops as advanced biotech and nanosurgical techniques simplify the procedures.

Biofabrication (TL10)

Some surface implants – notably skin coatings and dermal armor – can be grown by immersing the patient in a vat of micromachines inside a biofab, which assembles the implant as if it were a 3D printer. This technique is also used to add synthetic flesh and tactile sensors to robots and total cyborgs. Nanosurgeons make the neurological connections between skin and body.

This process requires a Physician roll (modified by the quality of the tank) and takes the specified number of hours. The patient is unconscious. On a failed Physician roll, the process must be repeated. On a critical failure, something goes gruesomely wrong, resulting in 1d corrosion damage for every 2 hours the process took.

Detecting and Removing Cybernetics

A diagnostic bed (p. 197), medscanner (p. 200), or X-ray scanner (p. 104) can detect concealed implants on a successful Electronics Operation (Medical) or Diagnosis roll.

Cybernetics can be safely removed in the same fashion they are installed, but the operation is easier: add +1 to Surgery rolls. If the parts don't need to be removed intact, add +2 and halve the time required.

Cybernetics may be rigged to cause unpleasant effects (e.g., see *Bomb Implant*, p. 210) if removal is attempted. A successful Traps-4 roll is required to notice a cyber-trap before it goes off; roll at no penalty if specifically looking for it. Disarming a booby trap requires an appropriate Traps roll prior to the surgery.

Second-Hand Cybernetics

Second-hand parts may be available, usually at 20-70% (1d+1 × 10%) of the cost of the cybernetics. This may or may not be a bargain, and there may be damage that is not immediately evident. Because of their value, bionics are rarely discarded until they are totally destroyed, giving new meaning to the phrase "loot the bodies." Salvaged cybernetics are usually worth 10-35% (1d+1 × 5%) of the original value depending on their condition.

> *His left eye was artificial and his face bore dozens of tiny, threadlike scars; for not even the marvelous plastic surgery of that age could repair entirely the ravages of space-combat.*
>
> *– E.E. "Doc" Smith,* ***Galactic Patrol***

Salvaging cybernetics from a corpse is much faster than installing them in a living person. It takes only one-third the procedure time and, if paying someone, costs 1/10th as much. A Mechanic (Robotics) skill roll can be substituted for surgery. Failing the roll means the parts require major repairs; critical failure destroys them.

Repairing Cybernetics

Use Mechanic (Robotics) skill to repair physical damage or malfunctioning cybernetics, or to diagnose second-hand parts to see if they have any hidden flaws. Minor damage to bionic body parts can be repaired from the outside, without surgery. For implants and major damage, the part must be completely removed before any repairs can take place.

Powering Cybernetics

Cybernetic devices are assumed to be powered by body heat and motion. Exceptions are noted in the descriptions. Bionic limbs require cell replacement or recharging on a monthly basis (this is part of the maintenance requirement subsumed in their Mitigator limitation).

Body Modifications

These include modifications to the body's limbs and organs, as well as implanted devices.

Biomonitor Implant (TL9)

This implant monitors vital signs: pulse, heartbeat, blood pressure, respiration, brainwaves, blood sugar, and alcohol levels, as well as the overall condition of the user's other cybernetics. It includes a small wrist display, and can connect to a neural interface (p. 48) or computer implant (p. 215). It gives a +2 bonus to any First Aid, Diagnosis or Physician rolls on the cyborg, as long as the medic can see the display. Halve the bonus if the user can see it but has to describe it to the medic. If the medic has a neural interface or a computer, he can jack it into a port beside the visual readout and monitor the cyborg directly.

Statistics: Accessory (Biomonitor) [1]. *1 point*.

Availability: Minor procedure (simple at TL10-12). $100. LC4.

Bionic Arm or Hand (TL9)

This is slightly stronger than the original, but constrained by the limits of the flesh-and-bone shoulder it is attached to.

One Bionic Arm (TL9)

Statistics: Arm ST+2 (One arm; Temporary Disadvantages, Electrical, -20%, and Maintenance, 1 person, weekly, -5%) [5]; DR 2 (One arm, -40%) [6]; One Arm (Mitigator, -70%) [-6]. *5 points*.

Availability: Major procedure. $12,000. LC4.

Two Bionic Arms (TL9)

Statistics: Arm ST+2 (Both arms; Temporary Disadvantages, Electrical, -20%, and Maintenance, 1 person, weekly, -5%) [8]; DR 2 (Arms, -20%) [8]; No Fine Manipulators (Mitigator, -70%) [-9]. *7 points*.

Availability: Two major procedures. $24,000. LC4.

If the recipient *already* has one existing bionic arm, use the Availability entry for one bionic arm.

Bionic Hand (TL9)

A cybernetic hand and wrist.

Statistics: Arm ST+1 (One arm, Temporary Disadvantage, Electrical, -20%) [3]; DR 2 (One hand, -80%) [2]; One Hand (Mitigator, -70%) [-4]. *1 point*.

Availability: Major procedure. $8,000. LC4.

Bionic Ears (TL9)

Crude cybernetic implants to repair damaged or lost hearing were available at TL8; these are much more advanced, providing some benefits over natural ears.

Bionic Ear (TL9)

Statistics: Hard of Hearing (Mitigator, -70%) [-3]. *-3 points*.

Operation: Minor procedure. $500. LC4.

Bionic Ears (TL9)

Statistics: Protected Hearing [5]; Deafness (Mitigator, -70%) [-6]. *-1 point*.

Operation: Two minor procedures. $1,000. LC4.

Advanced Bionic Ears (TL9)

These ears are connected to a computerized sound-profiling database.

Statistics: Discriminatory Hearing (Temporary Disadvantage, Electrical, -20%) [12]; Protected Hearing [5]; Deafness (Mitigator, -70%) [-6]. *11 points*.

Operation: Two minor procedures. $5,000. LC4.

Bionic Eyes (TL9)

The eye is a complex organ, but TL9 cybernetics may be able to replace it with something that works just as well or better than the original. Standard features are roughly equivalent to night vision contact lenses, including a video display option and low-light and telescopic (2×) optics.

One Bionic Eye (TL9)

Statistics: Accessory (Video Display) [1]; Nictitating Membrane 2 (One eye, -50%) [1]; Night Vision 2 (Temporary Disadvantages, Electrical and No Depth Perception, -35%) [2]; Telescopic Vision 1 (Temporary Disadvantages, Electrical and No Depth Perception, -35%) [4]; One Eye (Mitigator, -70%) [-4]. *4 points*.

Availability: Major eye procedure. $5,000. LC4.

Two Bionic Eyes (TL9)

Statistics: Accessory (Video Display) [1]; Nictitating Membrane 2 [2]; Night Vision 2 (Temporary Disadvantage, Electrical, -20%) [2]; Protected Vision [5]; Telescopic Vision 1 (Temporary Disadvantage, Electrical, -20%) [4]; Blindness (Mitigator, -70%) [-15]. *-1 points*.

Availability: Two major eye procedures. $10,000. LC4.

Bionic Leg (TL9)

A single cybernetic leg is limited by the capabilities of the remaining original leg. A pair of legs are more useful.

One Bionic Leg

Statistics: DR 3 (One leg, -40%) [9]; Missing Legs (Mitigator, -70%) [-6]. *3 points*.

Availability: Major procedure. $8,000. LC4.

Two Bionic Legs

Statistics: Basic Move +1 (Temporary Disadvantages, Electrical, -20%, and Maintenance, 1 person, weekly, -5%) [4]; Super Jump 1 (Temporary Disadvantages, Electrical, -20%, and Maintenance, 1 person, weekly, -5%) [8]; DR 3 (Legs, -20%) [12]; Legless (Mitigator, -70%) [-9]. *15 points*.

Availability: Two major procedures. $16,000. LC4.

Bionic Vital Organs (TL9)

Complete cybernetic replacement of the heart, lungs, or other vital organs is usually performed only to save a life. This may be combined with additional implants that improve on the original organ.

Bionic Organ Transplants (TL9)

One of the most common operations, this extends TL8 medicine with better pacemakers, artificial lungs, etc. The procedure is common, and therefore cheaper than most cybernetics.

Statistics: Hard to Kill (Temporary Disadvantage, Electrical, -20%) +2 [4]; Terminally Ill (Up to one month; Mitigator, -70%) [-30]. *-26 points*.

Availability: Major procedure (minor at TL11-12). $7,000. LC4.

Boosted Heart (TL10)

This combination of a cybernetic heart upgrade and arterial reinforcement allows the recipient to temporarily boost his metabolism beyond human norms. It can be added to either a healthy or a bionic heart.

Statistics: Basic Speed +1 (Costs Fatigue 1, -5%; Temporary Disadvantage, Electrical, -20%) [15]; Immunity to Heart Attack (Temporary Disadvantage, Electrical, -20%) [4]. *19 points*.

Availability: Major procedure (minor at TL11-12). $10,000. LC4.

Bionic Voicebox (TL9)

This implant replaces the recipient's voicebox, and may include an artificial tongue if the original was damaged. Someone with a damaged or recovering voicebox can croak or gurgle, but cannot actually speak. These implants can also be used to give animals the power of speech, although at IQ 5 or less, they can only parrot words.

Cybervoder (TL9)

Statistics: Cannot Speak (Mitigator, -70%) [-3]. *-3 points*.

Availability: Minor procedure. $1,000. LC4.

Silvertongue Implant (TL10)

Statistics: Cannot Speak (Mitigator, -70%) [-3]; Voice (Temporary Disadvantage, Electrical, -20%) [8]. *5 points*.

Availability: Minor procedure. $5,000. LC4.

Bomb Implant (TL9)

This explosive charge is attached to a timed or radio-triggered detonator and placed in the subject's head or torso. Implanted bombs could be suicide devices under the control of the implantee, or used to insure the loyalty of untrustworthy subordinates. Implanted bombs are often wired into other implants to prevent tampering – *see Detecting and Removing Cybernetics* (p. 208).

An ounce of TL9 explosive will inflict 6d crushing damage with the explosive modifier; wounding to the victim is tripled (as per a vital hit) for a torso charge in the vitals, or quadrupled (as per a skull injury) for one buried in the head. An exploding skull inflicts 1d-3 cutting fragmentation damage to anyone nearby.

A nasty variation on the implanted bomb is to place it under the control of a computer implant (pp. 215-216) which shares the victim's consciousness. Such a system is much harder to fool than a guard with a radio trigger!

Statistics: An implanted bomb may qualify as an Involuntary Duty.

Availability: Simple procedure. Use the cost and LC of a smart grenade (p. 146); a 25mm or 40mm can fit in the torso, a 15mm in a limb, 10mm elsewhere in the body.

Boosted Reflexes (TL9)

These implanted glands release chemicals on mental command, triggering a controlled adrenaline-like response.

Statistics: Basic Speed +1 (Costs Fatigue, 2 FP, -10%) [18]. *18 points*.

Availability: Major procedure (minor at TL10-12). $9,000. LC3.

Cyber Claws (TL9)

The recipient's hands or feet are equipped with ceramic or metal claws. The claws are retractable, triggered by muscle contractions.

Statistics: Sharp Claws (Switchable, +10%) [6].
Availability: Minor procedure. $6,000. LC3.
Halve the cost and treat as a simple procedure if adding these to a bionic hand or arm.

Filter Implant (TL9)

A self-regenerating particle-filtration system integrated into the recipient's lungs.

Statistics: Filter Lungs [5].
Availability: Minor procedure (simple at TL11-12). $2,500. LC4.

Flesh Pocket (TL9)

This is a surgically implanted pocket or pouch, sealed by a flap of skin. It can be used to smuggle small objects. A flesh pocket is normally installed in the torso; up to five levels are possible. Each level allows the pocket to hold up to Basic Lift/10 lbs. If placed elsewhere, a maximum of one level can be installed, and the amount of weight that can be carried is divided by 4 (leg), 8 (arm), or 16 (head or neck).

Statistics: Payload 1-5 [1/Level]. *1-5 points.*
Availability: Simple procedure. $200 per level. LC3.

Gyrobalance (TL9)

This is a miniature electronic gyroscope implanted in the inner ears (*both* ears – but treat as a single operation), and interfaced to improve the recipient's sense of balance.

Statistics: Klutz (Mitigator, -70%) [-2]; Perfect Balance (Temporary Disadvantage, Electrical, -20%) [12]. *10 points*.
Availability: Minor procedure. $7,000. LC4.

Hidden Compartments (TL9)

A cybernetic arm or leg may have a compartment large enough for any small object of up to Basic Lift/10 lbs. weight.

Statistics: Payload 1 [1].
Availability: Simple procedure. $500. No operation required if purchased with the limb. LC4.

Implant Radio (TL9)

This "implant communicator" is a radio (p. 44) with a range of one mile. It is spliced into the recipient's auditory nerve; the user may speak normally or subvocalize. A character with an implant radio can use it to subscribe to a cell phone or net service provider.

Statistics: Radio (Reduced Range, 1/10, -30%; Secure, +20%; Temporary Disadvantage, Electrical, -20%) [7]. *7 points*.
Availability: Simple procedure. $100. LC4.

Implant Video Comm (TL9)

This implanted radio communicator (p. 44) is spliced into the recipient's optic nerves to provide a video display. It has a range of one mile, and can be used to subscribe to a cell phone or net service provider.

Statistics: Radio (Reduced Range, ×1/10, -30%; Temporary Disadvantage, Electrical, -20%; Video, +40%) [9]. *9 points*.
Availability: Minor procedure (simple at TL10-12). $200. LC4.

Memory Flesh (TL9)

These synthetic flesh implants allow the recipient to shift between two different sets of facial and bodily features: his own and another set specified when it is installed.

Statistics: Alternate Form (Cosmetic, -50%, Temporary Disadvantage, Electrical, -20%) [5]. *5 points*.
Availability: Radical procedure (major at TL10-12). $20,000. LC3.

If the subject already has bioplastic skin (p. 212), this is a minor procedure.

Subdermal Armor (TL9)

This flexible armor is implanted *under* the skin. At TL9, the skin is peeled off and the armor inserted, then replacement skin is grafted back on. At TL10+ it may be possible to use nanotechnology to actually grow the armor under the skin. A careful tactile examination, a diagnostic bed, or a medscanner can detect the armor, but it is invisible to the naked eye and does not appear on metal detectors. It provides DR 12 vs. piercing and cutting damage and DR 4 vs. other damage.

Statistics: DR 8 (Limited, Piercing and Cutting, -20%; Tough Skin, -40%) [16]; DR 4 (Tough Skin, -40%) [12]. *28 points*.
Availability: Radical procedure (major at TL10-12). $2,000. LC2.

Smart Tattoos (TL9)

These tattoos are made with video ink. They can follow preprogrammed scripts, or even act in response to changes their sensors detect in the skin (sweat, temperature, etc.). A tiger tattoo might roar when it detects anger, or purr when the wearer is aroused.

Statistics: Distinctive Features 1 (Switchable, -10%) [0]. *0 points*.
Availability: Simple procedure. $200. LC4.

Stinger (TL9)

This concealed implant houses a single disposable hypo (p. 197) sheathed under a fingernail or in a body cavity. The recipient has no ability to manufacture drugs or toxins; he must buy hypos loaded with injectable drugs, poisons, or metabolic weapons. It takes 10 seconds to remove and replace a hypo in the mount.

A fingernail-mounted stinger attacks just like a jab with a disposable hypo. It has reach C, does 1 HP damage for penetration purposes, but with no wounding, and delivers a follow-up attack based on whatever agent was loaded into it. If the user has claws rather than normal fingernails, the injection can be a follow-up attack to the claw's damage.

A body-cavity stinger is mostly useful to deliver a surprise attack during an intimate moment; the GM may allow a Touch-8 sense roll to notice the tiny mount before it can be used. A stinger in the mouth can also be a follow-up attack to a bite.

Statistics: Extra Arm (Switchable, +10%; Takes Recharge, -10%; Weapon Mount, -80%) [2]. *2 points.*

Availability: Minor procedure. $500 (hypos not included). LC3.

Weapon Mounts (TL9)

These are modular weapons installations attached to a cyborg's body. Each can mount a single weapon that weighs no more than the recipient's Basic Lift. Mounted weapons cost cash – *not* points – and their weight counts as encumbrance.

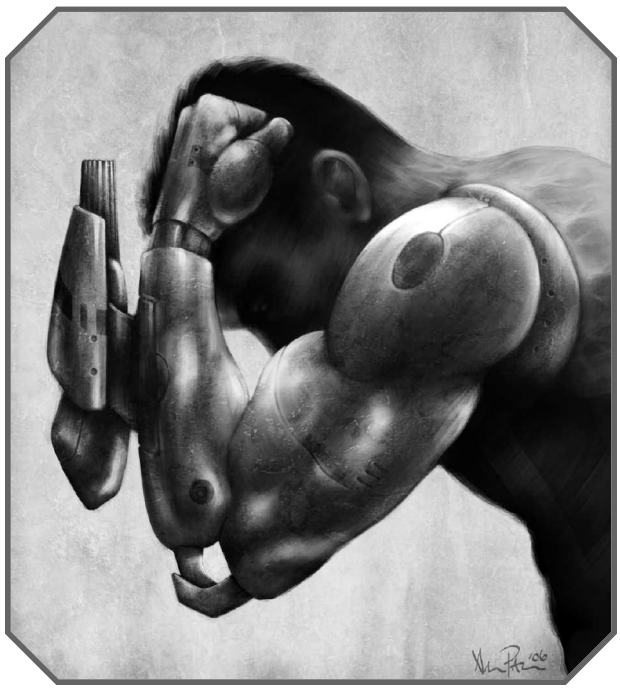
A mounted weapon is plugged-in, not built-in. The user can swap it for another weapon with a suitable interface. It takes five seconds to mount or remove a weapon.

Concealing a weapon mount is similar to hiding a firearm of similar bulk. A Bulk -5 rifle built into one's arm will have a protruding muzzle, while a Bulk -1 holdout pistol may have only a tiny gun-port built into the user's palm.

All mounted weapons can be detected by searches. Enemies or the authorities can unplug and confiscate them, just like carried weapons.

Bionic Arm or Hand Mount (TL9)

This is a weapon mount built into an existing bionic arm or hand (p. 209). It may be mounted above or below the arm, or fire out through the palm. The weapon's weight may not exceed Basic Lift if in an arm, or half of Basic Lift if in a hand.



Statistics: Extra Arm (Weapon Mount, -80%) [2].

Availability: Minor procedure. $100/lb. of weapon weight. LC of weapon.

Heavy Weapon Arm (TL9)

This weapon mount replaces the user's arm with a socket joint and a hardpoint for attaching a weapon, usually rifle-sized. The mounted weapon must weigh equal to or less than the user's Basic Lift.

Statistics: To replace one arm with a weapon mount, take Extra Arm (Weapon Mount, -80%) [2] and One Arm [-20]. *-18 points.*

Availability: Minor procedure. $100/lb. of weapon weight. LC of weapon.

Accelerated Reflexes (TL10)

A system of electronic nerves and computer hardware that replaces large sections of the nervous system.

Statistics: Extra Attack 1 (Temporary Disadvantage, Electrical, -20%) [20]. *20 points*.

Availability: Radical procedure (major at TL12). $50,000. LC2.

Bioplastic Skin (TL10)

This modification covers the recipient's body with a sheath of living smart bioplastic (p. 171). It is thin and sensitive enough that it looks and behaves like normal skin, and even heals itself. It is invisible armor covering the entire body. It has DR 15 vs. burning or piercing damage, DR 5 vs. other types of damage.

Statistics: DR 10 (Limited, Burning and Piercing damage, -20%; Tough Skin, -40%) [20]; DR 5 (Tough Skin, -40%) [15]. *35 points*.

Availability: Major procedure. $20,000. LC3.

If installed first, bioplastic skin reduces the cost and difficulty of certain other cybernetic skin modifications.

Cyberhair (TL10)

This implant replaces sections of ordinary hair with thin cybernetic tendrils attached to a reinforced scalp. Cyberhair does not grow and cannot be cut by ordinary razors or scissors, but it can coil close to the scalp when the recipient needs a "haircut."

Cyberhair can be used as a simple manipulator, which may be useful if the user is grappled or tied up. It must be at least shoulder-length to be effective.

Shoulder-Length Cyberhair (TL10)

Statistics: Extra Arm 1 (Extra-Flexible, +50%; Short, -50%; Temporary Disadvantages, Electrical, -20%, and Maintenance, 1 person, weekly, -5%; Weak, 1/4 body ST, -50%) [3]. *3 points*.

Availability: Major procedure (minor at TL11-12). $3,000. LC4.

Waist-Length Cyberhair (TL10)

Statistics: Extra Arm 1 (Extra-Flexible, +50%; Temporary Disadvantages, Electrical, -20%, and Maintenance, 1 person, weekly, -5%; Weak, 1/4 body ST, -50%) [8]. *8 points*.

Availability: Major procedure (minor at TL11-12). $4,000. LC3.

Knee-Length Cyberhair (TL10)

Longer and tougher, with a reinforced scalp to support the hair's capabilities.

Statistics: Extra Arm 1 (Extra-Flexible, +50%; Long, +100%; Temporary Disadvantages, Electrical, -20%, and Maintenance, 1 person, weekly, -5%; Weak, 1/2 body ST, -25%) [20]. *20 points*.

Availability: Major procedure (minor at TL11-12). $10,000. LC3.

Variskin (TL10)

The recipient's skin is replaced or coated with smart film. He can change its color and texture to blend in with the surroundings. If nude, he gets +2 to Stealth skill when perfectly still, or +1 if moving. Clothing reduces this to +1 when perfectly still. It takes one second to alter skin pigment, and unnatural colors such as green or chrome are possible. The skin can also function as a video display terminal for data run through neural interface or computer implant.

Statistics: Accessory (Video terminal) [1]; Chameleon 1 (Controllable, +20%) [6]. *7 points*.

Availability: Minor procedure (simple at TL11+). $1,000. LC2.

If the patient has bioplastic skin (p. 212) the procedure is simple.

Gill Implant (TL10)

This implant allows the recipient to breathe underwater, using a device that extracts oxygen from water (it's not a true set of fish gills). It uses two C cells per day of operation.

Maintenance involves opening an access panel in his chest or back, cleaning filters, and installing new power cells.

Statistics: Doesn't Breathe (Gills, -50%; Temporary Disadvantages, Maintenance, 1 hour, daily, -10%, and Electrical, -20%) [4]. *4 points*.

Availability: Major procedure (minor at TL11-12). $8,000. LC4.

Hive Implant (TL10)

This implanted swarmbot hive (p. 37) can carry a single swarm measuring one square yard. It includes recharging ports hidden by a skin flap, allowing the swarm to recharge from a power system or the included C cell. The swarm and a control system (such as an implant computer and advanced com implant) must be acquired separately.

Statistics: Accessory (Swarmbot Hive) [1]; Payload 1 [1]. *2 points*.

Availability: Minor procedure. $1,000. LC4.

Intestinal Recycler (TL10)

The human digestive system is imperfect, so waste matter always contains useful chemicals that could have been metabolized and used by the body. This implant collects waste matter and reprocesses it.

Statistics: Reduced Consumption 2 [4]. *4 points*.

Availability: Major procedure (minor at TL11-12). $4,000. LC4.

Nanoweave Subdermal Armor (TL10)

Advanced flexible armor implanted under the patient's skin. It has DR 18 vs. piercing and cutting damage and DR 6 vs. other damage.

Statistics: DR 12 (Limited, Piercing and Cutting, -20%; Tough Skin, -40%) [24]; DR 6 (Tough Skin, -40%) [18]. *42 points*.

Availability: Major procedure (minor at TL11-12). $5,000. LC2.

Polyskin (TL10)

A combination of micromachines, smart bioplastic implants, and artificial glands that allow the recipient to alter his appearance. He can adjust apparent weight, skin color and tone, and facial structure.

The system can be purchased for the face or for the entire body. It can also be combined with sexmorph (p. 214).

If the recipient already has TL10+ bioplastic skin (p. 212) divide the dollar cost of the implant and the recovery time by 2.

Polyskin Body (TL10)

Statistics: Elastic Skin (Temporary Disadvantage, Electrical, -20%) [16]. *16 points*.

Availability: Radical procedure. $36,000. LC2.

This is only a major procedure if the recipient already has bioplastic or living metal skin.

Polyskin Face (TL10)

Statistics: Elastic Skin (Face only, -25%; Temporary Disadvantage, Electrical, -20%) [11]. *11 points*.

Availability: Major procedure. $15,000. LC2.

Reinforced Skeleton (TL10)

Micro- or nanomachines can reinforce a patient's skeleton with carbon fibers, transforming his bones into structures with the strength of metal. Implants take over the function of bone marrow and produce blood cells. Weight does not increase. While the reinforced bones do not show up on metal detectors, they can be identified with X-rays, diagnostic beds, and other advanced sensors.

Statistics: HP+5 [10]; DR 20 (Skull only, -70%) [30]; DR 10 (Limited, Crushing, -40%; Tough Skin, -40%) [10]. *60 points*.

Availability: Radical procedure (major at TL11-12). $50,000. LC3.

Ripsnake (TL10)

This cybernetic assassin's weapon is a concealed bionic limb linked to the user's nervous system. It uncoils from a natural body opening (usually the mouth) when deployed, and can attack semi-autonomously.

In certain situations, a ripsnake can deliver an automatically successful attack to the vital organs. For example, if a would-be assassin with a ripsnake concealed in his mouth kisses someone, it can coil out and down his victim's throat.

Statistics: Extra Attack 1 (Ripsnake Only, -20%) [20]; Impaling Striker (Cannot Parry, -40%; Long, +1 SM, +100%; Temporary Disadvantage, Electrical, -20%) [12]. *32 points*.

Availability: Major procedure. $26,000. LC2.

Sexmorph (TL10)

This suite of sphincter valves, synthetic hormone glands and memory or bioplastic implants allows the recipient to switch gender in 10 seconds. If desired, a user can also adopt a neuter phase (no obvious genitalia or breasts) or transsexual phase (male genitalia, female breasts, or vice versa) with voice and features as desired.

Statistics: Hermaphromorph (Temporary Disadvantage, Electrical, -20%; transsexual form also, +20%) [5]. *5 points*.

Availability: Major procedure (minor at TL12). $10,000, LC3.

Slickskin (TL10)

The recipient's skin is covered with a switchable smart matter nanofilm. When activated, most of his skin becomes virtually frictionless. The palms of the hands and the soles of the feet are not affected.

Statistics: Slippery 3 [6]. *6 points*.

Availability: Major procedure (minor at TL11-12). $12,000. LC3.

Thermal Imaging Eyes (TL10)

This is a pair of bionic eyes with tiny infrared imaging cameras, day/night telescopic optics, and a HUD (p. 24) chipped into the optic nerves.

Statistics: Accessory (HUD) [1]; Infravision (Temporary Disadvantage, Electrical, -20%) [8]; Nictitating Membrane 2 [2]; Telescopic Vision 1 (Temporary Disadvantage, Electrical, -20%) [4]; Blindness (Mitigator, -70%) [-15]. *0 points*.

Availability: Two major procedures (minor if replacing existing bionic eyes). $8,000. LC4.

Hyperdense Skeleton (TL11)

A reinforced skeleton (above) impregnated with hyperdense nanoparticles for additional damage resistance. A hyperdense skeleton increases body weight by 10 to 20 percent.

Statistics: HP+5 [10]; DR 40 (Skull only, -70%) [60]; DR 20 (Limited, Crushing, -40%; Tough Skin, -40%) [20]. *90 points*.

Availability: Radical procedure (major at TL12). $100,000. LC2.

Hyperspectral Eyes (TL11)

These bionic eyes are similar to thermal imaging eyes (p. 214), except that multispectral cameras replace the infrared cameras.

Statistics: Accessory (HUD) [1]; Hyperspectral Vision (Temporary Disadvantage, Electrical, -20%) [20]; Nictitating Membrane 3 [3]; Telescopic Vision 1 (Temporary Disadvantage, Electrical, -20%) [4]; Blindness (Mitigator, -70%) [-15]. *13 points*.

Availability: Two major procedures (minor if replacing existing bionic eyes). $12,000. LC4.

Monocrys Subdermal Armor (TL11)

This diamondoid nanocrystal mesh grown under the patient's skin provides DR 24 vs. piercing and cutting damage and DR 8 vs. other damage.

Statistics: DR 16 (Limited, Piercing and Cutting, -20%; Tough Skin, -40%) [32]; DR 8 (Tough Skin, -40%) [24]. *56 points*.

Availability: Major procedure. $10,000. LC2.

Living Metal Skin (TL12)

A thin, flexible, sensor-equipped nanoskin of living metal replaces the recipient's own skin. The endoskeleton is self-sealing and enhances strength.

Statistics: Filter Lungs [5]; DR 20 (Flexible, -20%) [80]; Lifting ST +5 [15]; Nictitating Membrane 5 [5]; Sealed [15]; Striking ST +5 [25]; Super Jump 1 [10]; Temperature Tolerance 5 [5]. *160 points*.

Availability: Radical procedure. $40,000. LC2.

Brain Implants

Brain implants are inserted into the recipient's skull and linked to his central nervous system. Some societies may see brain implants as sinister. Others may consider altering the mind to be more socially acceptable than modifying the body.

Brain implants are riskier than other implants. Critical failure on major or radical procedures may cause brain injury, resulting in a loss of one point of IQ, or a disadvantage like Epilepsy or Phantom Voices.

Braintap (TL9)

A braintap is an advanced form of implant communicator that lets the recipient transmit his experiences as sensies (p. 57). Others can use the receiver to experience or record the sensory information experienced by the braintapped character.

Braintaps are used by sensie stars, journalists, or anyone else who wants to record his personal experiences. A normal braintap can be turned on or off by the user, but remote-controlled braintaps are also possible. It is possible to implant a braintap in an animal. If well-trained, such animals make very useful scouts or familiars. A braintap can also be implanted without someone's knowledge, during other surgery – a favorite trick of intelligence agencies.

Remote-Controlled Cybernetics

Cybernetics may be implanted in someone against their will and remotely controlled. This won't cost the recipient any character points, since it isn't an advantage for him. Usually only brain implants are designed for remote control, but other options are possible, such as remote-controlled bionic arms, ripsnakes, cyberhair, or digital skin.

Communicators can always be remotely controlled. Other cybernetics will need a remote-controlled communicator implant (any type) or an implanted digital mind (p. 216).

Braintap Jack (TL9)

This incorporates a plug-in cable jack (p. 42) plus a sensie transmission module. If the user has a computer implant (below), he can store data in it.

Statistics: Cable Jack (Send Only, -50%; Sensie, +80%) [7].

Availability: Major procedure (minor at TL10-12). $3,000. LC4.

Wireless Braintap (TL9)

This incorporates a radio transmitter with a one-mile range and a sensie-transmission module. If the user has a computer implant, he can store data in it.

Statistics: Radio (Secure, +20%; Reduced Range, ×1/10, -30%; Send Only, -50%; Sensie, +80%) [12].

Availability: Major procedure (minor at TL10-12). $12,000. LC3.

Computer Implant (TL9)

This is a computer implanted in the recipient's head and controlled through its own direct neural interface. It takes only a thought to call up a file or access a database. Data scrolls across the periphery of the user's vision, and he hears the computer as a voice in his head.

The implant includes an optical-recognition feature using the user's eyes and ears as sensors. It can speed-read documents, for example, and store them in its database. (It takes normal time to read them later, though one could ask the computer to provide a synopsis).

The interface can also run "virtual tutor" (p. 56) augmented reality programs that not only talk but show how to do things by overlaying instructions on the user's visual field. Although several programs could theoretically be run at once, the user can only focus on one at a time. A computer implant is most useful with an implanted communicator.

The recovery time represents the amount of time needed to master the computer's functions.

Computer Implant (TL9)

The user should also have a neural jack (p. 217) or implant radio (p. 211).

Statistics: Accessory (Tiny computer) [1]; Photographic Memory (Temporary Disadvantage, Electrical, -20%; Recorded data only, -20%) [6]. *7 points*.

Availability: Major procedure (minor at TL10-12). $4,000 + the cost of a tiny computer (p. 22) with the compact option. LC4.

Chip Slots (TL9)

A chip slot is a sterile dime-sized skull socket, covered with a cap, into which modular brain implants ("chips") can be inserted. Each chip interfaces directly with the recipient's brain and nervous system, providing knowledge and ability. Chips containing individual skills, techniques, or mental advantages can be manufactured and purchased.

Chips: Chips themselves are tiny plugs that weigh 0.05 lbs. (just under an ounce). Skill chips cost $1,000 per character point at TL9, $500 per point at TL10, $200 per point at TL11, or $100 per point at TL12. Most are LC3.

Statistics: Variable. Buy the Chip Slots advantage (p. B71) with the limitation (Temporary Disadvantage, Electrical, -20%). A suggested maximum number of slots is (TL-7). A suggested maximum points per chip is (TL-7) × 5.

Availability: Major procedure (minor at TL10-12). Cost is $5,000 per slot plus $3,000 per point of abilities that a chip can hold. LC3.

Skip Slot (TL9)

This is a general-purpose chip slot optimized for skills. Running a chip with 4-points in skills, it can give someone an easy skill at attribute+2, an average skill at attribute+1, a hard skill at attribute+0, or a very hard skill at attribute-1. It can also add +1 to any existing skill level.

Statistics: Chip Slots 1 (4) (Temporary Disadvantage, Electrical, -20%) [14].

Availability: Major procedure (minor at TL10-12). $17,000. LC3.

Implanted Digital Mind

A person may directly control his own implant computer, but it is also possible to implant one that contains an artificial intelligence or a mind emulation (p. 220).

A computer implant with a mind of its own is usually an NPC. If obedient, it will be an Ally. It appears constantly (quadruple cost), since it's an implant; if programmed to obey it will have the Minion enhancement. (A computer implant that is a Dependent or Patron is conceivable, but may be difficult to justify.) It's also possible for a character to have a computer implant who is a not a friend. It may even be an Enemy; if so, the character usually has an Involuntary Duty that explains why the implant hasn't been removed.

The computer implant is simply an entity that happens to reside inside the user. If the host is injured by an attack, use the Overpenetration rules (p. B408). The implant may be damaged by any hit to the skull that exceeds the host's DR, the DR of his skull, and an additional cover DR equal to half the host's HP. The implant's own DR will also protect it.

The implant's consciousness is not affected by the host's own loss of consciousness.

An implanted digital mind should pay points for any of the body's cybernetics that it controls – see *Remote-Controlled Cybernetics* (p. 215). Cybernetics can be jointly controlled; in this case, the host and the implant both pay points for it.

Computer Implant Template

-17 Points

An implanted computer can be a PC or associated NPC! This is a built-in computer implant with a mind of its own. The template's Mindlink is with the person it is implanted into. If it's a PC, the person it is implanted into is usually an Ally or Dependent.

Combine this with any AI template (p. 25) or the Mind Emulation template (p. 220).

Attribute Modifiers: ST 0 [-100]; HT+4 [40].

Secondary Characteristic Modifiers: HP +2 [4]; Basic Move -6 [-30].

Advantages: Absolute Direction (Requires signal, -20%) [4]; AI [32]; Doesn't Breathe [20]; Doesn't Eat or Drink [10]; DR 5 (Can't Wear Armor, -40%) [15]; Injury Tolerance (No Eyes, No Head, No Neck) [17]; Machine [25]; Mindlink [5]; Mind Reading (Mindlink Required, -40%*; Sensory Only, -20%; Touch-Based, -20%) [6]; Sealed [15]; Radio (Burst, +30%; Secure, +20%; Video, +40%) [19].

Perks: Accessories (Tiny computer) [1].

Disadvantages: Electrical [-20]; Quadriplegic [-80].

Features: Taboo Trait (Fixed ST, DX, HT, HP).

Availability: Major procedure (minor at TL10-12). $4,000 plus the cost of a tiny computer (p. 22) and AI software (p. 25) or a mind emulation (pp. 26, 220) program. LC4.

* Works the same way as the identical limitation for Possession (p. B76).

Lenses

Puppeteer (TL9) (+100 points). The computer can use biopresence software to possess the body of its host. This can also be combined with any of the above subrace options. Add Possession (Mindlink Required, -40%; No Memory Access, -10%; Telecontrol, +50%) [100]. If the host has a biopresence implant so that possession is automatic, add Puppet [5], increasing the cost to +105 points. Add the cost of biopresence software (p. 109).

Mind Interface (TL10) (+6 points). The computer implant can sense the surface thoughts of its host. Remove the Sensory Only limitation on Mind Reading. This can be combined with Puppeteer. +$10,000. LC3.

Neural Interface Implant (TL9)

A neural interface (pp. 48-49) permits the user to control electronic devices using his mind. It picks up electronic impulses and translates them into electrochemical signals in his brain. There are two models in common use, and some people may implant both:

Neural Jack (TL9)

This is a socket implanted in the body (usually the back of the neck, base of the spine, or skull) with a communications interface. The user can plug an optical cable (p. 43) into it and connect to a phone line, modem, etc.

Statistics: Cable Jack (Sensie, +80%) [9]. *9 points*.
Accessibility: Major procedure (minor at TL10-12). $4,000. LC3.

Wireless Neural Interface (TL9)

This is a wireless neural interface radio with a one-mile range. It can also function as a radio communicator.

Statistics: Radio (Reduced Range, ×1/10, -30%; Secure, +20%; Sensie, +80%) [17]. *17 points*.
Accessibility: Major procedure (minor at TL10-12). $5,000. LC3.

Neurotherapy Implant (TL9)

Computer chips may be surgically implanted into the brain to restore misbehaving or damaged functions, or to act as a bridge between injured and healthy areas.

A neurotherapy implant can be implanted to neutralize mental or physical disadvantages that impair brain or neurological function, such as Dyslexia, Epilepsy, Killjoy, Non-Iconographic, Neurological Disorder, and Short Attention Span.

If brain damage such as a stroke or bungled brain surgery causes DX or IQ loss or other disadvantages (e.g., Blindness or Mute, or partial paralysis resulting in a disadvantage such as One Arm), the GM may also allow the implant to fix it.

Statistics: Add the Mitigator (-70%) limitation for the disadvantage.
Availability: A persona map of the patient is required before a neurotherapy implant can be installed; see *Brainscanner* (p. 203). This data is used to program the implant. Major procedure (minor at TL10-12). $500 per -1 point of disadvantage. LC3.

Psych Implant (TL9)

This implant stimulates areas of the brain to produce psychological reactions. Moderate regimes use them as an alternative to prison or psychiatric treatment – repressive ones rely on them for mind control.

A psych implant gives the subject an additional mental disadvantage. Common implants induce Combat Paralysis, Gullibility, Pacifism, or Slave Mentality, and are used to restrain violent individuals or render the subject easily controllable. Illegal implants are available that compel Berserk, Dyslexia, Paranoia, or a Phobia. An implant can not create self-imposed mental disadvantages such as Code of Honor.

The disadvantage is not active until after the recovery period, although the subject will feel a growing urge to act in the fashion indicated. Any implant-induced disadvantage ends when the implant is removed. However, anyone who has worn a psych implant for three or more months may acquire the disadvantage permanently. After the implant is removed, the implantee should make a Will roll at +4 to avoid the disadvantage continuing, with a penalty of -1 for each doubling of time, e.g., Will+3 at six months, Will+2 after a year, Will+1 after two years, etc.

Therapeutic implants also exist which *negate* mental disadvantages, such as Bad Temper or Phobias; use the rules for Neurotherapy Implants. After several months the effect may become permanent. Roll vs. Will as above when the implant is removed – if the roll fails, the disadvantage is gone. The GM may require it to be bought off with character points.

Statistics: A disadvantage granted by a psych implant will have the (Temporary Disadvantage, Electrical, -20%) limitation. A disadvantage that is negated by a psych implant will have the (Mitigator, -70%) limitation.
Availability: A persona map of the patient is required; see *Brainscanner* (p. 203). This data is used to program the implant. Major procedure (minor at TL10-12). $1,000 per -1 point of disadvantage added or mitigated. LC3.

Biological Operating System (BOS) Implant (TL10)

This implant controls biofeedback systems and diagnostic monitors, as well as nanomachine drug factories that that help the user manage his body's physiological state.

Statistics: Alcohol Tolerance [1], Deep Sleeper [1], Metabolism Control 1 [5], No Hangover [1]. 8 points.
Availability: Major procedure (minor at TL11-12). $10,000. LC3.

Sensie Transceiver Implant (TL10)

These brain implants enable a person to transmit or receive live or recorded sensory impressions from another person. They are essentially two-way braintaps.

Sensie Transceiver Jack (TL9)

This incorporates a plug-in cable jack (p. 42) plus a sensie transceiver module. If the user has a computer implant (p. 215), he can store data in it.

Statistics: Cable Jack (Sensie Only, +0%) [5].
Availability: Major procedure (minor at TL10-12). $2,500. LC4.

Wireless Sensie Transceiver (TL9)

This incorporates a radio transmitter with a one-mile range and a sensie-transmission module. If the user has a computer implant, he can store data in it.

Statistics: Radio (Secure, +20%; Reduced Range, ×1/10, -30%; Sensie Only, +0%) [9].
Availability: Major procedure (minor at TL10-12). $4,500. A/1 year. LC3.

Cognitive Enhancement (TL10)

This implant establishes new connections between itself and different parts of the brain., Normal neurons are replaced with cybernetic duplicates. The benefits provided are capabilities at which electronic computers exceed the capabilities of human brainpower, such as spatial awareness, memory and processing speed.

Statistics: Choose from IQ+1 to IQ+3 [20/level], 3D Spatial Sense [10], Eidetic Memory [5], Enhanced Time Sense [45], Intuition [15], Language Talent [10], Lightning Calculator [2 or 5], Oracle [15], Mathematical Ability [10/level], Musical Ability [10/level], Single-Minded [5],Visualization [10]. The maximum points available per operation are 15 at TL10, 45 at TL11, and 60 at TL12. Then add Temporary Disadvantage (Electrical, -20%).

Availability: Major procedure. $5,000 × point cost (before applying Temporary Disadvantage). LC3.

Puppet Implant (TL9)

A puppet implant allows someone else to remotely control a cyborg's body. The teleoperator must have appropriate software, hardware, and access – see *Biopresence Software*, p. 109. A puppet implant requires a communications implant or sensie implant.

Statistics: This may count as the Involuntary form of Duty (p. B133) if someone else holds the access codes.

Availability: Radical procedure (TL9), or major procedure (TL10-12). $45,000. LC2.

Personality Implant

The combination of a puppet implant and a computer implant (pp. 215-216) housing a digital mind is also called a personality implant. It can take possession of the cyborg. Personality implants might be used for coercive purposes – for example, a cult leader might implant them in his followers. They could also be voluntary, with people owning and accessing personalities that are programmed to obey them, or storing the personas of deceased friends, lovers, or ancestors in their heads.

Backup Brain (TL11)

This computer and sensor system monitors the user's chemical and electrical thought processes, reshaping its own neural network to imitate them. The backup brain will configure itself into an electronic duplicate of the user's mind after a number of months equal to the user's IQ. After it has successfully mimicked the user, a simple operation can shut down the organic brain and give the backup brain control of the user's body.

The advantage of doing so is twofold: the implant is more resistant to brain damage, and it does not suffer IQ losses due to aging or brain disease. A backup brain implant can also be transplanted into a clone body. (This is a radical cybernetic operation.) If successful, the result will be a clone controlled by a computer that behaves exactly like the original person.

If the user dies, the brain implant may survive, preserving the user's memory and personality. This is the case whether or not the ordinary brain has been shut down. If the user was killed by any injury that left his head intact, the implant will always survive. If the brain implant user was killed by a head injury, the implant will survive unless the head was totally destroyed (i.e., damage to the head alone was greater than 5 × HT). If the implant survives, it can be salvaged and transplanted into a cloned body.

Statistics: Once the implant has taken over, the user's ability to avoid IQ losses from aging and sometimes evade death is the Extra Life (Copy) advantage

Availability: Radical procedure. $25,000. LC3.

Cybernetic Uplift

These modifications are normally added to pets or working animals in order to give them additional capabilities.

Enhanced Voicebox (TL9)

This implant gives an animal that can't speak the ability to form human words, much like a parrot can. It can be added to any mouse-sized or larger animal.

The animal's Cannot Speak disadvantage is nullified as long as the implant is functional. Giving a non-sapient (IQ 5 or less) animal a voicebox does not mean that it can actually learn a language, but it can be taught to speak a few words.

Finger Paws (TL9)

Finger paws can be added to a bionic or organic leg on an animal with walking paws, such as a rat, dog, cat, or tiger. The paws are replaced with crude hands that can be used both for walking and grasping objects. Neural implants help the animal become comfortable with its new digits.

Statistics: Basic Move -1 [-5]; Bad Grip 1 [-5], Foot Manipulators (2 arms) [-6]; No Fine Manipulators (Mitigator, -70%) [-9]. *-25 points*. This replaces No Fine Manipulators [-30].

Availability: Two major operations (minor at TL11-12). $10,000. LC3.

Neural Uplift (TL9)

This procedure improves the intelligence of a non-sapient animal by implanting computer components that emulate higher neural and brain functions. It may not be added to an animal with IQ 6+.

Statistics: IQ+1 (Temporary Disadvantage, Electrical, -20%) [16]; Wild Animal *or* Domestic Animal (Mitigator, -70%) [-9]; Stress Atavism (Mild, 12) [-10]. *-3 points*. This replaces Wild Animal or Domestic Animal [-30].

Availability: Radical procedure (major at TL10-12). Reduce difficulty of the procedure by one step (e.g., major to minor) if performed on an animal with a racial IQ 1-3. $5,000 × average racial IQ *before* the cybernetic uplift operation. LC3.

Total Cyborg Brain Transplants

A total cyborg is someone whose entire body has been replaced with artificial parts. Only his brain, parts of the spinal cord, and a few other nerves remain human.

Robot bodies large enough to house human brain cases have a total cyborg mentality lens. The most common are androids, but other types are possible. Robot templates with No Brain, Diffuse, or Homogenous are precluded, which is why there are no total cyborg versions of bush robots or nanomorphs.

In general, a TL9 machine can hold a human-sized cyborg brain case (brain and life support system) if it was designed to hold a computer at least as large as a microframe. It replaces the computer with one that is one size smaller. At TL10+, life support systems can be made compact. The robot body need only have been built for a personal computer to have room for a human-sized brain. Nonhuman brains may require a larger or smaller volume.

Total cyborgs may not have other cybernetics, with the exception of brain implants.

Statistics: The character takes on the robot body's racial template with the Cyborg lens; his brain is the same. See *Mind Transfer* (p. B296).

Availability: Radical operation (major at TL10-12). $40,000 for the brain case, plus the cost of robot body. The cyborg's body is functional after the operation.

Uploading

Memories are encoded within the physical structure of the brain. Uploading is the process of copying this into a digital form. Uploads can create a *mind emulation* – a computer program that emulates the workings of the original person's mind. A mind emulation is not just a recording, but a working model of the way a particular brain functions.

Destructive Uploading (TL10)

This technology involves the preservation and destructive analysis of the subject's brain so that chemically stored memories can be recorded as digital media. For example, the subject's brain may be placed into biostasis, then sliced by robotic surgeons into tiny segments, each of which is scanned at very high resolution.

This procedure is fatal and may be controversial: Is it suicide or transcendence? Individuals may choose destructive uploading to obtain a form of immortality, often out of a desire to live as a posthuman entity in a superhuman robot body. They may also have no choice; with destructive uploading, the dead can be revived and interrogated. (See *Uploading the Dead*, below).

Destructive uploading requires the patient (or his preserved brain). The surgery is performed using a TL10+ surgical facility, chrysalis machine, or automed. Make a Physician roll at -5, and an Electronics Operation (Medical) roll at -5.

Success means the data was gained. If either roll fails by 1, it means only enough data for a low-res copy (p. 220) was gained; if either roll fails by 2, it means only enough data for a very-low-res copy is gained. If either roll fails by 3+, or is a critical failure, the upload fails. Only one try is possible; success or failure destroys the brain.

Bush Robot (TL11): A bush robot (p. 86) can use its branching molecular arms and sensors to perform destructive uploading without any special equipment. It uses Surgery skill instead of Physician skill.

Non-Destructive Uploading (TL10)

This process uses advanced scanning systems to record the mind *without* destroying the brain. This makes it far easier to make copies which exist at the same time as the original person. It might use an advanced form of magnetic resonance imaging (HyMRI) or other non-invasive scanner. It may also require physical probes. These might be a development of the scanning, tunneling microscope (STM), or use sensors placed in the brain to assist in mapping it.

Since the original is not destroyed, it is practical for people to store "backup" copies of themselves. This is very useful if mind downloading (pp. 220-221) is possible, allowing the original mind to be replicated in a new body.

A typical upload-resolution scan takes an hour per attempt and a successful Electronics Operation (Medical) roll. Multiple tries are possible. The GM should roll secretly in case a critical failure occurs.

TL10 Imaging: This can only make low-res scans (p. 220). On a critical failure, the user has made a very-low-res scan without realizing it.

TL11 Imaging: This can make normal scans, or take low-res scans very quickly (in 10 minutes and at +2 to skill). On a critical failure, the user has made a scan of the next lower resolution without realizing it.

Uploading the Dead

As long as the brain is intact, it is possible to upload a dead person's mind and retrieve a mind emulation. Either invasive or noninvasive methods can be used. Uploading is impossible when the brain suffers total destruction (-10 × HP), exposure to 5,000+ rads, or death from a failed HT roll that resulted from damage to the skull or eye.

Deep structures containing long-term memories may survive for hours after death, but not indefinitely. Use the usual success rolls, but apply a -2 penalty for working with a corpse, as well as an additional -1 penalty per hour past death unless the brain is preserved or in nanostasis. Uploading a corpse preserved via freezing is at an extra -3 due to cell damage from freezing. Memories from the last 1d × 20 minutes before the person died will usually be lost in the uploading process. This means someone revived via uploading might have no memory of how he died.

Uploading via Backup Brain (TL11)

See *Backup Brain, p.* 218.

Mind Emulation (TL10)

A successful upload provides the necessary "braintape" of the subject. Bringing it to life requires coding that into a mind emulation – a model of the living brain.

Ghost Compiler (TL10): Required to allow someone with Computer Programming skill to create a ghost mind emulation (below). Complexity 10, normal cost. LC2.

Ghost-Editor Program (TL10): This allows someone to use Brainwashing skill on a mind emulation. Complexity 11, normal cost. LC1.

Where does a mind emulation go after it's been uploaded? There are several possibilities:

Low- and Very-Low-Res Copies

Sometimes an uploading or downloading procedure doesn't work out right – or shortcuts are taken. The result is a low- or very-low-res copy.

Low-Res: This is an imperfect copy. It can be deliberately made at +2 to skill and 50% of the normal time and cost, or it may be the result of an accident. A low-res mind-emulation (above) or mind download (below) will have only half as many points in skills. The subject may also suffer from Partial Amnesia [-10]. If so, the subject has a 50% chance of having the Flashbacks (Mild) [-5] disadvantage, representing partial memories.

Very-Low-Res: This is a badly degraded copy. If a mind emulation or download is made from it, the copy has -1 IQ [-20] and Total Amnesia [-25]. It has a personality, but only one-quarter its normal points in skills (round down). Advantages based on emotional sensitivity – e.g., Charisma, Empathy, Fashion Sense, Rapier Wit – are lost. The subject has a 50% chance of gaining Flashbacks (Mild) [-5] as above.

Backup Storage

A mind emulation can simply be stored, unconscious, as data; if non-destructive uploading is possible, old backups may be regularly deleted and replaced by newer updates. A mind emulation requires about 100 TB. The location and security of one's backups may be a paramount concern, with specialized facilities that are devoted to protecting them. Insurance agencies, organizations, or governments might maintain "memory vaults" that store backup copies of members or citizens. Backups could be awakened, interrogated, enslaved, or worse if they fell into the wrong hands, and entire adventures could revolve around recovering one.

Treat an accessible backup as the Extra Life (Copy) advantage.

Robot Bodies

A mind emulation can be run in a computer brain in a robot body. A person might want to return to a body that resembled his original form, a younger and healthier version, or a completely new shape.

Ghost Comps and Communities

A mind emulation might reside in a computer rather than a robot. Mind emulations may travel by copying themselves, or move through expansive virtual realities. Entire communities of emulations and AIs may exist on a computer network, or a single gigantic computer system.

Computers in Biological Shells

A computer brain running a mind emulation may be implanted in a biological body – perhaps even the original body, or a clone of it, depending on its condition after the emulation was created. Use the rules for living flesh androids (p. 28). The body may wear out, but the computer can always be removed or the data copied to a brain in a new body.

Multiple Bodies, Multiple Possibilities

It's possible to copy a mind emulation many times over. Mind emulations may take advantage of this by existing in many different forms at the same time!

Downloading Minds

Superscience may allow an uploaded mind to be imprinted on a living brain. See *Downloading Minds* (below).

Mind Emulation Templates

Any computer with sufficient Complexity (see below) can run a sapient mind emulation. A mind emulation differs from an AI in lacking the Automaton meta-trait and possessing other metatraits. This creates a sub-race (p. B454) version of the template.

Mind Emulation ("Ghost") Programs

A mind emulation's Complexity depends on the average racial IQ of the being that was uploaded: Complexity 4 + (IQ/2), rounded up. Thus, a race with IQ 10 requires a Complexity 9 program. Lower Complexity by 1 for beings with the "Fixed IQ" taboo trait (as in the Domestic and Wild animal meta-traits); e.g., a dog with IQ 5 requires only a Complexity 6 emulation.

A mind emulation has the advantage Digital Mind [5] and the taboo trait "Complexity-Limited IQ," and optionally one or more of the lenses under *Optional Intelligence Lenses* (p. 28). For a nonhuman, also apply the race's IQ, Perception, and Will modifiers, and all racial mental traits.

Downloading Minds

This is the transfer of an uploaded mind into a living brain. It may use nanomachine or replicator technology to replicate every neural connection in the original brain, rebuilding the new brain into a copy of the desired mind. It could also be a highly sophisticated form of regeneration ray (p. 202) technology.

Campaign Effects of Uploading

What does uploading mean for adventurers? In game terms, having a backup copy in storage means the character has the Extra Life advantage (p. B55). If he creates multiple living copies, the extras usually become NPCs. See *Multiple People* (p. B296) for the rules ramifications of backups or extra uploads.

Even the existence of backup copies can have profound effects on the campaign. First and foremost, adventurers can never be sure that someone is *permanently* dead. Digital recordings are easy to hide; cell samples used for downloading can be frozen. Even if the law says a foe is legally dead, and no longer has access to his money or property, he can return to haunt them as a ghost in the machine. As a result, assassins and kidnappers will attempt to destroy or steal digital copies of minds as well – maybe even first. This also applies to the PCs; some foes will attack their copies before going after them. And if a government sentences someone to death or prison, it will try to track down all his mind emulations, so his friends or followers don't revive him.

Another problem with mind emulations are that they diminish fear of death. As a result, it works best if legal or ethical constraints make it a "last resort" way to save characters. GMs may wish to discourage players with backups from casually committing suicide rather than facing tricky situations such as being imprisoned. One way is to point out that the people back home may not know their friend is dead, and may never revive him. Of course, instructions could be left to have a copy made after the PC is missing for several years, but enemies or accident might destroy the copy before the character could be revived, or the character may not be dead at all. A PC might return after being shipwrecked on a low-tech planet for five years, only to find that his instructions have been followed. He has been presumed dead and downloaded into a new copy – and his new self has spent all his fortune, remarried, or blackened his good name.

For ethical (and possibly technical) reasons, downloading is normally performed on a "blank mind" – for example, a clone that was developed in a coma, with no memories or personality of its own. However, downloading into another person's brain may also be possible.

Downloading requires an Electronics Operation (Medical) roll. Success means the mind emulation replaces the original's memories and personality (if it had any). Failure means that the transfer process fails and destroys the brain of the body that was going to receive the download. Critical failure, or any failure by 5 or more, means the transfer seems to work, but there's a hidden flaw. The subject may suffer Partial Amnesia or a Split Personality, or the wrong emulation may have been transferred!

The difficulty of downloading depends on how different the new body's brain structure is from the mind emulation's original body. This allows someone to become a person of a different sex, age, or species. Such downloads are useful for spies or students of alien cultures, or as punishment or torture ("work off your bad karma as a dog"). However, the GM is free to rule that two species are too dissimilar for a transformation to be possible.

If downloading to the brain of another person of the same species, roll at -1 to skill. For transfer to a different species, apply physiology modifiers (p. B181).

The effects of successful downloading are covered under *Mind Transfer* (p. B296). That is, the old racial template is replaced by that of the new body. The *Mind vs. Brain* (p. B296) rule should apply except in science-fantasy settings; downloading an emulated human mind into a cat's brain would result in a drop in IQ, for example.

A failed download will result in a low-res copy (p. 220). A critical failure results in a very-low-res copy. It may take some time to realize this, however; the GM should roll secretly.

Clinical Mind Transference Equipment (TL10^): The host body must be placed inside this coffin-sized unit. $500,000, 250 lbs., E/200 hr. LC3.

Portable Mind Transference Equipment (TL11^): This mind transference unit is suitcase-sized. It need only be attached to the host's head. $50,000, 25 lbs., D/20 hr. LC2.

Downloading Nanosurgery (TL12): The new host body's brain is restructured via surgical nanomachines, using the mind emulation data as a template. This requires a chrysalis machine plus $100,000 worth of nanobots. LC2.

Replicator-Based Downloading (TL12^)

A replicator (pp. 93-94) can materialize a brain or body for transplant purposes. Use the rules for replicators; the quality of the resulting download depends on the quality of the original scanning information used to make the template. The necessary template is a Complexity 10 program. LC2.

Personality Overlays

"Overdubbing" a conscious mind may either overwrite that mind (destroying it and creating the new person), or result in an unstable blend of both minds. If the latter, the effect is a Split Personality (p. B156) with -10 to -30 additional points of different mental disadvantages for each personality. Flashbacks, Manic-Depressive, On the Edge, and Paranoia are all appropriate.

Incarnation

If a mind emulation of a formerly biological entity can be downloaded into flesh, why not a digital mind? A former AI struggling to live as a biological entity could be a very interesting character!

Chapter Nine
Vehicles

It was a slow night. They still hadn't fixed Weather Satellite One, so the blizzard just kept on coming, most flights to the spaceport were grounded, and sensible people were staying indoors. But an old guy's got to work, and I'd flown my hack in worse. Long time ago, I flew all-weather combat vertols for the Army.

I'd just got a cup of ethanol from Tata Potata to keep me warm, and I was parked on Fifth and Lenin across from the bar, hoping for a late call. That's when I saw the hunchback in heavy coat run out of Spinnaker Joe's Garage carrying a big suitcase.

"Hey buddy – you need a cab?"

He stepped into the pool of light from the street lamp and that's when I saw he wasn't a human – it was a Yezendi. Blue skin, spines, the works. Probably a warrior caste, and here in Leonidas, that meant Syndicate. Bad news – like the red radiation warning symbols on the suitcase. Then the alien ripped open the coat, revealing a grav belt pack, and rose into the air in majestic silence, vanishing into the blizzard.

Freaking contragravity. Can't stand it. Since they started importing it, no one wants an air car. But I spoke too soon. About five seconds later, a dame came running out wearing the remains of a suit of ablative armor.

"Taxi!"

I was on my break, and she looked like trouble, so I flashed the "No Service" sign. She didn't take no for an answer. Without waiting, she grabbed the door and pulled. There was faint crack as the lock broke, and she slung herself inside. My air car sank on its suspension. She must have weighed a quarter ton.

"You're an android." Then, brilliantly, "I guess you're too heavy for a grav belt."

"Never ask a lady her weight, old man." She muttered something about antimatter, then scanned my instrument panel. "You got radar?"

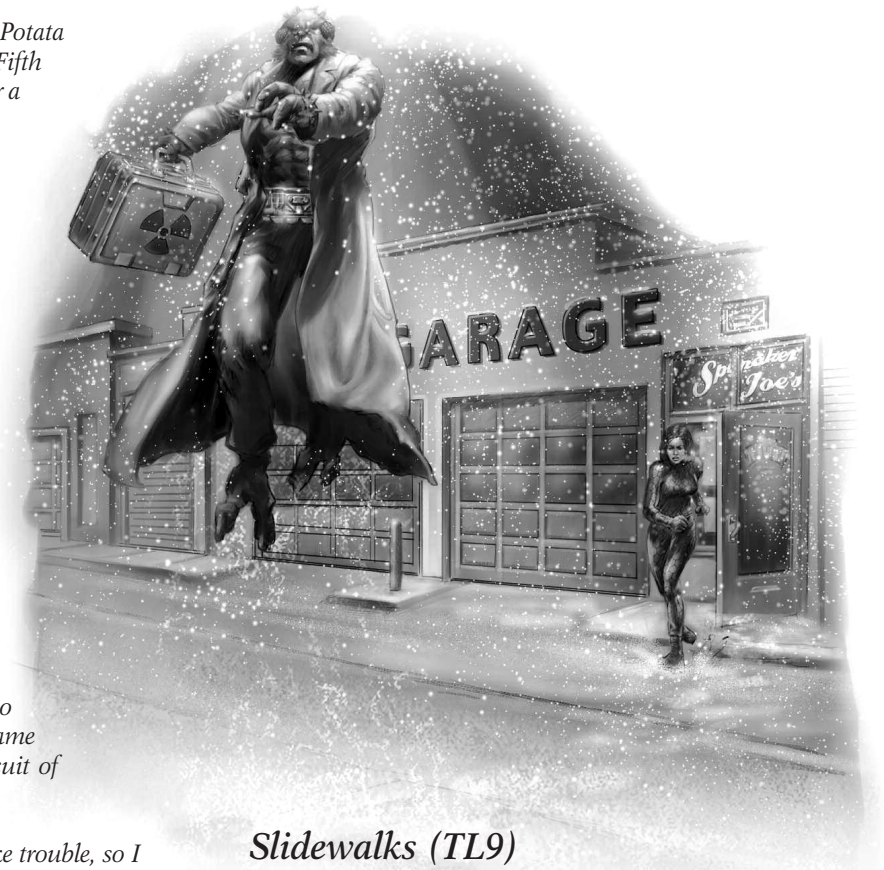
"Yeah."

"Then follow that alien!"

Transportation is every bit as important as communicators or computers, and adventurers are constantly in need of new ways to get around. This chapter covers vehicles, matter transmission, and other transportation technology.

Planetary Travel

The problem of efficiently moving masses of people and cargo confronts every society, especially heavily populated and urbanized ones.



Slidewalks (TL9)

In large space habitats or the downtown core of crowded cities, roads and sidewalks might be replaced by the slidewalk, a passenger conveyor belt similar to a high-speed horizontal escalator. The slidewalk is made up two sets of belts running in opposite directions with a platform in between. Each set operates at five-mph intervals from 5 mph to 30 mph. The slowest belts are nearest the platform.

While walking is easy, running on a slidewalk is difficult. Add or subtract two mph for each point of Move to the slidewalk's speed to give the speed of travel. Make a DX+3 roll each turn to avoid falling. This roll is -1 per 10 mph if running in the direction that the slidewalk is moving, or at -3 per 10 mph if running in the opposite direction. Running on a slidewalk is ill-mannered, and may be illegal. GMs can impose reaction penalties or legal penalties depending on the culture.

Self-Driving Vehicles (TL9)

Many ultra-tech vehicles are fitted with an inertial guidance system, a global positioning system, anti-collision radar, and computer autopilots. Taxis may be totally automated – just insert a credit card and give the destination; $2 per person per mile is the usual fare. In densely-populated metropolitan areas, or in regions with high Control Ratings, manually-controlled vehicles may be illegal. All vehicles might be required to lock into an automated Municipal Traffic Control system. After a destination is indicated, the system takes control of the vehicle and guides it to the specified destination. This makes it hard to sneak around, and easy for the government to corral fugitives in vehicles.

Mag-Lev Trains (TL9)

Subway and commuter trains may use magnetic levitation (mag-lev) for propulsion, eliminating rail friction and allowing speeds of up to 300 mph. Mag-lev lines are most efficient when constructed in evacuated tunnels, removing all air resistance and enabling the trains to reach supersonic speeds. If intercontinental tunnels are built, 1,000-mph mag-lev trains replace aircraft and surface shipping. The capital investment for an evacuated mag-lev system is enormous; only very wealthy societies can afford one. Operating costs are comparatively low, however, so a railway with the capital investment paid off can have cheap fares. Government subsidies may help pay for the infrastructure.

Mag-lev is also cheap on worlds with no atmosphere. Under these circumstances, fares average $20 per person (or $100 per ton of cargo) per 1,000 miles.

Super Airships (TL9)

In atmosphere, cargo and passenger airships may be the most economical long-distance transport. Airships are cheap and reliable, though limited to worlds with dense or standard atmospheres and reasonably placid weather. Airships average 50 mph over long hauls, and streamlined vessels using airfoils and aerostats may fly faster than 100 mph. Fares are usually $10 per 100 miles, per person or per half ton of cargo. Airships need only minimal facilities, and can get by with no more than a mast to tie up to, so they are an attractive option for undeveloped planets.

Ballistic Liners (TL9)

Hypersonic suborbital space planes can carry 100 or more passengers to anywhere on an Earth-sized planet in less than three hours. The cost is $500 to $1,000 per person or ton of cargo. Suborbital vehicles require extensive take-off and landing facilities, and are unlikely to make stops at small towns, frontier outposts, or lonely archaeological sites.

Transcontinental Tunnels (TL9)

Robots and advanced boring machines can dig tunnels between continents for about $10 million per mile. (In contrast, the Channel Tunnel between France and the United Kingdom is 31 miles long and cost about $20 billion.) These are generally used for supersonic mag-lev rail lines.

Fusion-Powered Watercraft (TL10)

Surface ships are one of the most economical ways to move massive cargoes over intercontinental distances. Vehicle-sized fusion reactors are likely to be used in both spacecraft and ocean-going vessels.

Contragravity (TL10^)

Contragravity generators transform electrical energy into lift and in some cases, into thrust as well. This field can push against or neutralize gravity.

The primary application is flight. Contragrav revolutionizes planetary transportation. Silent and graceful flying cars can land and park on anyone's rooftop, or fly through doors into top-floor garages. On worlds with open societies, people become even more cosmopolitan due to ease of travel. People may still cluster, or they may spread out: a neighbor could be someone living within a few hundred miles.

With the sky full of commuters (and even floating buildings or cities), traffic control may be a challenge. Densely populated worlds require all privately-owned flyers to be monitored by a planetary traffic-control system; if a collision seems imminent, the traffic computer yanks control away from both pilots. Disabling the traffic-cop circuits requires an Electronics Operation (Security)-2 roll and takes 10 seconds; failure locks the vehicle down and alerts the authorities.

Wearable contragravity devices such as the grav belt are the ultimate personal transportation. Grav belts are light enough to wear at all times, whether shopping in the mall or exploring an alien world. They may revolutionize society as much as the automobile did. Authoritarian governments and parents may hate them because of the mobility they give individuals. Explorers, light infantry, and joyriding teenagers will love them. Why walk when you can fly?

Contragravity gets adventurers into action, and can also be dramatic and atmospheric. On the down side, if flying is easy, there isn't much point in sailing, driving, or walking. It's hard to get excited about a "man against nature" adventure where the heroes must cross a thousand miles of mountainous, monster-infested jungle when they can just strap on their grav belts and flit over it.

Lift Tubes (TL11^)

Buildings may incorporate lift tubes (also called "g-tubes") – high-speed tractor beams (p. 88) used as vertical or horizontal "people movers." They may be mostly for cargo, but could also be used in luxurious hotels, starliners, military bases, amusement parks, etc. They are intimidating, but very safe – far more people fall off slidewalks and break their necks then are killed in lift-tube failures.

Space Travel

Space travel is covered in detail in other ***GURPS*** books. The key issue is whether superscience technologies exist or not. Without superscience, space flight is usually expensive

and slow; interplanetary travel takes months, and interstellar flight takes decades, centuries, or millennia. With superscience – specifically reactionless or faster-than-light drives – interstellar travel may take only a few days, and interplanetary travel may be a matter of hours.

The first step into space – getting into orbit – is often the most difficult, especially from a world like Earth. A variety of technologies for getting into space are possible, including space shuttles, contragravity (p. 223), and space elevators.

Space Elevator (TL9)

A space elevator, or beanstalk, is a super-strong cable running from the equator on a planetary surface into geostationary orbit (about 21,700 miles up for Earth). The beanstalk is built using carbon nanotube cables, thickest at the base, narrower at the top. A counterweight – either an extension of the cable (useful for snagging and hurling spacecraft) or an asteroid or space station – is attached to the other end. Elevator cars run up and down the cable, taking anywhere from a day to a week to reach the top. After the construction cost has been paid, it might cost as little as $3/lb. to reach orbit.

Beanstalks may range from satellite-sized systems with hair-thin cables to giant mega-structures with bus-sized elevator cars for passengers and cargo. The cost of construction is $40 billion per ton/day of cargo capacity (assume that passengers require about a ton each due to safety and life support requirements). Multiply cost by the square of local gravity, e.g., a lunar beanstalk (1/6 G) is 1/36 as expensive. The cost of construction may increase if space junk, satellites, or low-orbiting moons must be cleared away first! LC2.

Riding a beanstalk elevator to or from orbit costs $500 and takes from six hours to a week, depending on elevator speed. The best elevator cabins resemble those of trains, with food service, entertainment, and a spectacular view.

VEHICLES

Descriptions and statistics for several vehicles are provided below, from flying belts to grav tanks. For a key to vehicle statistics, see pp. B462-463.

All of these vehicles have a minimum of equipment, and can be customized using the gear described elsewhere in this book. Every 20 lbs. of equipment added subtracts 0.01 tons from the vehicle's Load.

Vehicle Systems

These systems are often found in ultra-tech vehicles.

Crashweb: An "smart" airbag that provides ablative DR equal to TL for seated vehicle occupants involved in a crash or collision. An activated crashweb will prevent the user from doing anything until he gets free (DX-2 roll to do so each turn).

If a collision is expected and the occupant is not worried about surviving it, he can turn off the crashweb. This feature is common in military designs or libertarian societies, but civilian passenger vehicles sold in CR3+ societies may require the crashweb to be operational. To disable a crashweb in such a civilian vehicle, make an Electronics Repair (Security) roll; each attempt takes one minute.

Full Life Support: A vehicle with full life support is completely sealed (p. 171). It recycles air and water supply for its occupants as long as it has power. It can function normally in vacuum or other hostile environments. Its climate control system provides a comfort zone extending from absolute zero to 500°F. Some vehicles can moderate even higher temperatures.

Limited Life Support: This functions like full life support as long as it has power, but does not recycle air or water; it only has enough for a limited duration, specified in man-days. Six man-days of support can provide air and water for one adult for six days, two for three days, and so on. The vehicle can replenish this supply if it has a source of breathable air or drinkable water.

NBC (Nuclear-Biological-Chemical) Kit: This is an environmental control system equipped with sensors to detect contaminants, filters, and an overpressure system (the interior is kept at a higher pressure than outside) to keep impure air out. Much like a filter mask (p. 177), it defends against nuclear fallout, germs, and chemicals such as pollution or poison gas. Only people entirely inside the vehicle may benefit from an NBC kit.

ATVs

These ground vehicles are designed for off-road travel in trackless wilderness. Ultra-tech ATVs aren't just designed for Earth – they're built for hostile environments on alien worlds as well.

Wheeled ATV (TL9)

This is an eight-wheeled all-terrain vehicle used by survey teams and prospectors. The wheels have oversized self-inflating tires and independent electric motors. The vehicle is powered by a pair of F cells, giving it a range of 500 miles. Its tough composite hull can survive up to 30 atmospheres of pressure. It has full life support (p. 224) and radiation PF 2.

Standard equipment includes headlights, a one-man airlock, an inertial navigation system (p. 74), a large radio (p. 44), a personal computer (p. 22), and three workstation terminals (p. 24). An auxiliary solar panel can operate all onboard systems except the motors indefinitely, allowing the vehicle to be used as a base camp.

Use Driving (Heavy Wheeled) skill to operate it. It has a watertight hull and auxiliary hydrojet propulsion system, and can swim at Move 1/4.

Exo-Spider (TL10)

This is a car-sized eight-legged vehicle designed for the roughest terrain, such as icy mountains or craters. It is powered by a closed-cycle turbine engine with a range of 360 miles. Its hull can withstand 30 atmospheres of pressure, and it has limited life support (10 man-days) and radiation PF 10.

It has the same equipment as the wheeled ATV (above), except that it is equipped with a holographic crew station (p. 24). Use Driving (Mecha) skill to operate it.

PERSONAL VEHICLES

These are standard commuter vehicles. They could be family cars or police cruisers.

Smart Car (TL9)

This is an electric car with a motor in each wheel, a light alloy and composite body, and a fuel cell power plant. It runs for six hours with a cruising range of 400 miles.

It is equipped with a computerized crew station (p. 24), an inertial compass (p. 74), an infrared surveillance camera (p. 61), a rugged personal computer (p. 22), small ladar (p. 64), a small cellular radio (p. 50), and an entertainment console (p. 51). Each occupant has a crashweb (p. 224). The car has a biometric lock (p. 104) on its doors, and the vehicle is also equipped with headlights and tail lights.

The driver uses Driving (Automobile) skill to operate it, although the vehicle is often driven under computer control.

Dynamic Car (TL10)

This four-wheeled electric vehicle is powered by superconductor cells. It can operate for 12 hours with a cruising range of 1,000 miles. The vehicle's reconfigurable smart skin subtly adjusts the shapes of the body and the wheels for optimum aerodynamics and ground traction.

The car has the same systems as the smartcar described above, but its body has programmable camouflage (p. 99) allowing it to change color and pattern on command. The interior features self-adjusting memswear (p. 39) seats. If empty, it can fold into a SM+2 box for ease of parking. A $100, LC3 hack lets it do this on command, doing thrusting crushing damage to occupants based on its ST.

FLYING CARS

Ultra-tech advances in composites, flight-control software, and miniaturized power plants make the old dream of flying automobiles possible.

All flying cars have these standard systems: computerized controls, headlights, an inertial compass (p. 74), a personal computer (p. 22), and a small multi-mode radar (p. 65). Other details depend on the model, as described below.

Air Car (TL9)

This is a streamlined automobile with a bubble canopy. It flies using thrust from four pod-mounted ducted fans, but it also has an ordinary wheeled suspension and electric drivetrain that lets it operate like an ordinary car. It can hover in mid-air, or take off and land vertically, or fly as fast as a light airplane with a range of 900 miles. The quoted performance statistics are for ducted-fan flight; as a ground vehicle, the air car has Handling/SR +1/3 and Move 3/45* on the ground, with an 1,800 mile range.

The vehicle has two doors and four seats. It is operated with Piloting (Vertol) and Electronics Operation (Sensors); Navigation (Air) is also useful!

It can fly with only two engines, but if a total systems failure occurs or it runs out of fuel while airborne, it deploys a landing parachute that will usually bring it down safely (assume Parachuting-11). All occupants are also provided with crashwebs (p. 224).

Ground Vehicle Table

TL	*Vehicle*	*ST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ.*	*DR*	*Cost*	*Locations*
9	Smart Car	46	+1/5	12	3/60*	1.4	0.6	+3	1+4	5	$20,000	G4W
9	Wheeled ATV	100	-1/4	12	2/40	10	2	+5	1+9PVS	40	$200,000	g8W
10	Dynamic Car	40	+2/5	12	6/75*	1.1	0.6	+3	1+4	10	$30,000	G4W
10	Exo-Spider	80	+2/2	13	8/16	5	1	+4	1+4PVS	70	$200,000	g6L

Grav Jeep (TL10^)

This is an open-topped contragravity vehicle that resembles a streamlined automobile with no wheels. It has a personal computer (p. 22) and a small intertial compass (p. 74). A pair of F cells give it a 2,000-mile range. The pilot uses Piloting (Contragravity) skill.

Supersonic Air Car (TL11)

This is a streamlined high-performance air car. It has a sealed cabin and 48 hours of limited life support. It's capable of Mach 2 thanks to its miniature nuclear-powered air-ram engine, which provides unlimited range (and requires refueling every five years). The supersonic air car has a pair of gull-wing doors with two front seats and two rear seats. Its electronics include holographic controls (p. 24), an inertial compass (p. 74), and medium multi-mode radar (p. 65). Use Piloting (Vertol) skill to fly it.

Grav Speeder (TL12^)

This is a saucer-shaped contragravity craft capable of outstanding agility and hypersonic speed. It is powered by an antimatter reactor with a five-year power supply. Its inertial dampers neutralize all acceleration forces experienced by those inside, which is essential as it can make "impossible" 100G maneuvers. It has a modular equipment bay for up to 200 lbs. of additional accessories. It requires Piloting (Contragravity) to operate; Electronics Operation (Sensors) is also helpful.

Flying Cars Table

TL	*Vehicle*	*ST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ.*	*DR*	*Cost*	*Loc.*	*Stall*
9	Air Car	45	+2/3	11f	4/190	1.2	0.4	+3	1+3P	4	$500,000	G4Wr	0
10^	Grav Jeep	50	+3/3	12	10/100	2	1	+4	1+5	4	$400,000	O	0
11	Supersonic Air Car	50	+4/4	11	10/600	2	0.8	+3	1+4P	12	$500,000	g	0
12^	Grav Speeder	50	+10/5	13	50/1,500	1.6	0.6	+4	1+3P	100	$2,000,000	g	0

TANKS

In the future, tanks may be obsolete . . . or may still be a battle-winning combination of protection, mobility, and firepower. Ultra-tech tanks improve all these areas, but their greatest advantage is better situational awareness, thanks to virtual-reality sensors and their own miniature air forces of drones or swarms. Even so, friendly infantry are still vital to avoid ambush in cities or rough terrain! Adventurers may see tanks as dragons that require cunning and courage to slay, or the cavalry that charges to the rescue.

The tanks described below are all designed to be easily transported by aircraft or spacecraft. Larger ones are possible!

Light Battle Tank (TL9)

This tank has a tough composite-laminate hull that is reinforced by electromagnetic armor (p. 187), but it relies on stealth and sensors to get the first shot. It runs quietly on rubber-band tracks, powered by a hybrid diesel-electric engine. The crew (a driver and commander-gunner) are stationed in the hull, protected by a NBC kit (p. 224).

Its unmanned turret is armed with a 100mm tank cannon (p. 136) with the electrothermal upgrade (p. 139) and a coaxial 15mm chaingun (p. 136). Atop the turret is a smaller turret with a strike laser (p. 115) for air defense and missile interception. The rear hull houses 10 tactical missile launchers (p. 145) in fixed upward-facing mounts.

Electronics include two holographic crew stations (p. 24), a hyperspectral imaging sensor (p. 61), a medium laser comm (p. 44), a medium radio (p. 44), a tactical ESM (p. 62), and a tactical sound detector (p. 62).

It is operated by a driver who uses Driving (Tracked) and Electronics Operation (Sensors) and a commander/gunner with Artillery (Guided Missiles), Gunner (Beams, Cannon, Machine Gun), and Electronics Operation (Comm, ECM, Sensors).

Hovertank (TL10^)

This tank rides on a cushion of air, using auxiliary jump jets to cross rough terrain. The hull is sealed with full life support (p. 224). The main turret has a 40mm railgun (p. 141) or a plasma cannon (p. 127) in a stabilized mount. The vehicle also has a small turret with a strike laser (p. 115) in a stabilized mount for point defense. Electronics include two holographic crew stations (p. 24), hyperspectral imaging sensors (p. 61), a medium laser comm (p. 44), a medium radio (p. 44), and a tactical sound detector (p. 62). The vehicle is protected by infrared cloaking (p. 99), a multispectral chameleon surface (p. 99), radar stealth (p. 100), and a tactical ESM (p. 62).

Crew and skill requirements are the same as the light tank with the exception that Driving (Hovercraft) is used. LC1.

Grav Tanks (TL10^)

Grav tanks combine the agility of an attack helicopter with the armor and firepower of the main battle tank. The grav tank has the same capabilities as the hovertank, but is capable of transonic flight using contragravity. Use Piloting (Contragravity) instead of Driving skill.

Tanks Table

TL	Vehicle	ST/HP	Hnd/SR	HT	Move	LWt.	Load	SM	Occ.	DR	Cost	Locations
9	Light Battle Tank	150	-2/5	11	2/25	30	1	+5	2S	500/200	$2,000,000	2CTt
10	Hovertank	150	-3/4	11	2/50	30	1	+5	2S	700/300	$3,000,000	Tt
10^	Grav Tank	150	+1/5	11	10/500	30	1S	+5	2SV	700/300	$3,500,000	Tt

HOVERCRAFT

These ground-effect vehicles ride on a cushion of air. Hovercraft are less maneuverable than conventional ground vehicles, but can travel on land and water.

Armored Hovercraft (TL9)

This armored vehicle is designed to transport a squad of soldiers and provide them with fire support. It is also very effective as a coastal patrol (or smuggling!) craft. It uses a gas turbine or fuel cell power plant, and has a range of 800 miles.

Its crew compartment holds two, and is accessed through a top hatch. A powered rear ramp leads into a compartment that can carry up to eight passengers and cargo. Electronics include two holographic crew stations (p. 24), hyperspectral sensors (p. 61), an inertial navigation system (p. 74), a medium laser comm (p. 44), a medium radio (p. 44), a personal computer (p. 22) with the hardened option, tactical AESA (10 mile range) (p. 65), and a tactical ESM (p. 62). Defenses include infrared cloaking (p. 99) and radar stealth (p. 100).

It has a small stabilized turret atop the hull. Its primary sensors are in a telescoping mast-mounted periscope (the X location) that extends up to 15 feet for over-the-horizon reconnaissance. It is protected by composite armor.

It has a small independent turret that is a stabilized mount; it can be fitted with up to 400 lbs. of weapon systems appropriate to its TL. At TL9, a typical weapon mix would be a 25mm autocannon (p. 136), an MLAWS (p. 145), and two 40mm mortar boxes (p. 136). Appropriate skills are Artillery (Guided Missile), Driving (Hovercraft), Electronics Operation (Sensors), and Gunner (Machine Gun).

Hover Jeep (TL9)

This open-topped light hovercraft is suitable for both civilian and military uses. It is powered by a single F cell for six hours, giving it a range of 240 miles. It has two front and four rear seats. The pilot uses Driving (Hovercraft) skill. Its equipment is fairly austere: headlights, a computerized crew station (p. 24), a HUD (p. 24), an inertial compass (p. 74), a medium radio (p. 44), and a personal computer (p. 22).

Hovercraft Table

TL	Vehicle	ST/HP	Hnd/SR	HT	Move	LWt.	Load	SM	Occ.	DR	Cost	Locations
9	Armored Hovercraft	130	-2/4	11f	5/50	20	2	+5	2+8S	150/70	$500,000	tX
9	Hover Jeep	50	-1/3	12	3/40	2	1	+4	2+3	10	$40,000	OX

Minisubs

These are vehicles designed for underwater research, salvage, and special operations. All three subs described below share certain characteristics.

Each has a bridge with a pair of holographic crew stations (p. 24) plus a variable number of passenger seats, and a one-man airlock.

Other equipment includes a medium hydrophone (p. 63), a medium sonar (p. 65), microframe computer (p. 22), a periscope (15') with a medium radio (p. 44) and thermal imaging sensors (pp. 60-61), and a medium sonar comm (p. 44). A sound baffling system gives a -3 penalty on rolls to detect the submarines with hydrophones, but only when they are moving at speeds below 50 mph.

A stabilized turret is standard for all the minisubs described below. Civilian versions equip the turret with a searchlight (p. 74) and heavy laser torch (p. 80); military or paramilitary models often carry a blue-green strike laser (p. 115).

Deep-Sea Minisub (TL9)

This is a 30-foot-long submarine that can dive into the deepest parts of the ocean or explore the seas of alien worlds. It is saucer-shaped, with a spherical pressure hull surrounded by an unpressurized engineering section that houses twin hydrojet propellers. It uses a nuclear power plant which gives it unlimited range, and it can safely operate at a depth of up to 10 miles. Another feature is a pair of ST 30 robot manipulator arms that an operator can control with his own DX and skills, using either virtual reality gloves or a neural interface.

Supercav Minisub (TL9)

This is a short-range sub designed for underwater courier, attack, or patrol duties. The vessel has a streamlined wedge-shaped body, and is propelled by vortex-combustor ramjet engines that combine aluminum dust with water (this serves as both oxidizer and reaction mass). It uses a gas generator to create a supercavitating bubble around the vehicle, reducing its drag and permitting very high underwater speeds. The supercav minisub can dive to a depth of 900 feet and has a range of 200 miles.

Nuclear Minisub (TL10)

This is a fusion-powered multi-purpose minisub. Its features are identical to the deep-sea minisub except that it has ST 45 arms, full life support (limited only by the food that is carried aboard) and unlimited cruising range. The reactor is good for 200 years.

Diver Propulsion Systems

These gadgets let single divers travel long distances underwater. Naval black ops teams find them particularly useful, and in underwater colonies, everyone might use them.

Aquasled (TL9)

This one-man underwater propulsion system resembles a small sled equipped with a hydrojet propulsion system. The diver grips the control handles on the sled and is pulled forward. It has a headlight and depth gauge; it may carry up to 10 pounds of other gadgets, such as weapons or sonar. It runs for eight hours on a D cell and weighs 60 lbs. LC4.

Underwater Jet Pack (TL10)

This is a backpack underwater propulsion system using a vortex-combustor ramjet. It has a range of 10 miles and weighs 40 lbs. It takes three seconds to strap on or remove. An extra fuel cylinder is $40 and 20 lbs. LC4.

Minisub and Diver Propulsion System Table

TL	*Vehicle*	*ST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ.*	*DR*	*Cost*	*Loc.*	*Draft*
9	Aquasled	15	0/2	12	2/15	0.13	0.1	-1	1	5	$2,000	E	2
9	Deep-Sea Minisub	150	0/3	12	1/6	28	1	+6	6PS	100	$25,000,000	2Argst	10
9	Supercav Minisub	135	+1/3	11	8/150	20	0.5	+5	2PS	30	$30,000,000	gst	6
10	Nuclear Minisub	150	0/3	12	2/18	28	1	+6	6PS	150	$50,000,000	2Argst	10
10	Underwater Jet Pack	11	0/1	12	6/12	0.11	0.1	-3	1	5	$600	E	2

Tilt-Rotor Transport

Tilt-rotor airplanes have two oversized propellers that can swivel between a vertical position (to fly like a helicopter) and horizontal position (for efficient, high-speed airplane flight). They are especially useful for military special ops, but may also be popular commuter and cargo aircraft.

The tilt rotor has two computerized crew stations (p. 24) for the pilot and co-pilot, with a cabin and cargo area to the rear. Access is provided by two side doors and a rear cargo door under the tail. The aircraft is sealed with limited life support (60 man-hours). Other onboard systems include an inertial navigation system (p. 74), a personal computer (p. 22), a medium multi-mode radar (p. 65), and a medium radio (p. 44).

A tilt-rotor pilot uses Piloting (Heavy Airplane) when in fixed-wing flight (required for speeds over 150 mph) and Piloting (Helicopter) when in a helicopter mode. Electronics Operation (Comm, Sensors) and Navigation (Air) skills are useful. A co-pilot is not required, but can share the workload.

Tactical Tilt-Rotor (TL9)

This is an armored special ops version of the tilt rotor. It has the same capabilities as the tilt-rotor transport plus infrared cloaking (p. 99), radar stealth (p. 100), and a large radar (p. 65). A small independent turret is under the nose. The pilot or co-pilot will usually have Gunner (Beams or Machine Gun) skill.

Utility Vertol

These are wingless direct-lift transport vehicles, similar to the air car (p. 225) but larger. They perform the same roles as helicopters do at TL7-8, but their lack of wings or rotors lets them maneuver in built-up areas. Typical missions include aerial assault, flying ambulance, logistics support, and VIP transport.

Utility Vertol (TL9)

This is a streamlined vehicle like a wingless cargo jet, with a tail assembly, four pods containing vectored-thrust ducted fan engines, and a retractable skid undercarriage. It is lightly armored, but its redundant systems enable it to fly despite systems failures or combat damage.

It has a front cockpit with two crew seats for a pilot and a co-pilot; behind that is a small cabin with eight passenger seats and a cargo bay. There are doors on either side of the fuselage, and two under the tail. All seats are provided with crashwebs (p. 224). Electronics include a pair of computerized crew stations (p. 24), an inertial navigation system (p. 74), a medium multi-mode radar (p. 65), a medium radio (p. 44), two personal computers (p. 22), and a large radar (p. 65). Military models add additional stealth systems – see the Defenses chapter for various options. It has a sealed hull with an NBC kit (p. 224).

The pilot uses Piloting (Vertol) skill. Other useful skills are Electronics Operation (Communications and Sensors) and Navigation (Air). A co-pilot is common, and will have the same skills.

Nuclear-Powered Vertol (TL11)

This has the same capabilities as the utility vertol, but is equipped with a nuclear air ram giving unlimited range (for five years). Instead of ducted fans, it sucks in air, heats it, and expels it for thrust. It can operate in any atmosphere of greater than trace density. In addition to the air ram, the vehicle is equipped with an underbelly ducted fan used for "cool" takeoffs and landings that do not rattle buildings or scorch the tarmac.

Tilt-Rotor and Vertol Table

TL	*Vehicle*	*ST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ.*	*DR*	*Cost*	*Loc.*	*Stall*
9	Tactical Tilt-Rotor	130	-1/4	12f	4/200	20	3	+6	2+18	30	$40,000,000	gt3WrWi	0
9	Tilt-Rotor Transport	130	-1/4	11f	4/200	20	4	+6	2+28	6	$20,000,000	G3WrWi	0
9	Utility Vertol	90	+3/3	11fx	4/200	10	2	+5	2+8S	30	$12,000,000	g3Rr	0
11	Nuclear-powered Vertol	100	+3/4	11	10/350	12	4	+5	2+12PSV	90	$24,000,000	g3Rr	0

Grav Bikes and Platforms

These are small vehicles that use superscience contragravity (CG) generators for lift and propulsion. Grav vehicles are quiet, unless they are hybrid machines that use contragravity only to cancel lift and some other propulsion system for thrust.

Contragravity Platform (TL10^)

The most basic contragravity vehicle, this is an open flying disk with a control pedestal. One or two people can stand on it. It's a versatile, simple, and slow. It uses a D cell for power with a range of 50 miles. LC4.

Grav Bike (TL10^)

This flying motorcycle is similar to a grav speeder, but smaller and more agile. It has two saddle seats and an aerodynamic windshield. Its electronics include a built-in small computer (p. 22), a portable terminal (p. 24), and a windscreen HUD (p. 24). Use Piloting (Contragravity) skill. Its three E cells give it a range of 1,000 miles.

Hoverbikes and Hover Platforms (TL10^)

These are identical to the grav bike and contragravity platform, but they use repulsorlift systems based on pressor beam technology. They can only rise two yards off the ground, but they require significantly less power than an equivalent contragravity vehicle. No statistics are listed for them; use the values for a grav bike or hover bike, but double the range.

Microplanes

These are portable aircraft that can be stored in kit form and assembled with a few tools.

Dragonfly Microlight (TL9)

This small propeller airplane is often used as a recreational aircraft or carried by explorers, but it is also useful for covert insertions. The wings and body are constructed of transparent, high-strength polymers over foamed metal structural membranes. The Dragonfly can be broken down for transport into two backpack modules, each weighing a mere 35 lbs. Assembly or disassembly takes a single person only nine minutes; a Mechanic+2 roll and a tool kit are required.

It carries one person in an open saddle. It lands and takes off on skids; it has a range of 100 miles, or more if it can glide with a good tail wind. Its construction provides it with radar stealth (p. 100).

Backpack Dragonfly (TL10)

This advanced version of the Dragonfly folds into a single 35-lb. backpack. No assembly is required. It takes three seconds for the aircraft to unfold or contract.

Nightwing Microjet (TL11)

The Nightwing is a technological marvel: a supersonic combat jet that can fit in the back of a cargo van. In unassembled form it consists of four 200-lb. modules. Thanks to smart connections, these systems can be linked together in 20 minutes, forming a small but highly capable multi-mission jump jet.

The assembled Nightwing is a diamond-shaped flying wing, 12 feet long and 15 feet wide, with a blended pilot canopy, variable-geometry swing wings, and vectored-thrust turbojet engines. Its responsive "skin" is a semi-transparent electrically-active bioplastic membrane, giving it an ethereal appearance and a very low radar signature. It has a range of 1,200 miles.

Its equipment includes a holographic crew station (p. 24), an inertial navigation system (p. 74), a ladar smartskin (p. 64) with a 10-mile range, a medium laser comm (p. 44), a medium radio (p. 44), a personal computer (p. 22), and a tactical ESM (p. 62). The aircraft is sealed with limited life support (12 man-hours) (p. 224).

The Nightwing has two payload bays, each configurable to accept one 100-lb. gadget. Typical modules include a large tactical ladar (p. 64), a cargo container (100 lbs.), an extra fuel tank ($400, adds two hours to range), or a strike module with a stabilized mount for any weapon weighing up to 70 lbs. Modules must be changed on the ground; each attempt requires a tool kit, a Mechanic+3 roll, and one minute.

Grav Bike and Microplane Table

TL	*Vehicle*	*ST/HP*	*Hnd/SR*	*HT*	*Move*	*Lwt.*	*Load*	*SM*	*Occ*	*DR*	*Cost*	*Loc.*	*Stall*
9	Dragonfly	16	+2/5	12	5/35	0.14	0.11	+2	1	2	$4,000	E2R2Wi	15
10	Backpack Dragonfly	16	+2/5	12	5/35	0.13	0.11	+2	1	2	$6,000	E2R2Wi	15
10^	Contragravity Platform	10	0/1	12	5/15	0.21	0.1	-2	1+1	3	$10,000	E	0
10^	Grav Bike	30	+4/2	11	20/80	0.4	0.2	0	1+1	3	$25,000	E	0
11	Nightwing	36	+6/4	12	10/600	0.5	0.15	+3	1+1P	30	$540,000	gr3WrWi	0

Flight Packs

These are strap-on aerial propulsion systems. Most flight packs are controlled by a panel built into an arm curving in front of the user; computer autopiloting is standard, so only one hand is required to operate them. Instrument readouts are usually projected into a helmet HUD, but the pack can connect to a neural interface for hands-free operation.

It takes four seconds to strap on a flight pack, two seconds to remove it. All of these "vehicles" require Piloting (Flight Pack) skill to operate.

Helipack (TL9)

This is a pair of three-foot wide ducted fans attached to a backpack harness and control unit. It's useful for emergency rescue work, and thanks to the relatively quiet power plant, has some military applications. It won't operate in a trace or vacuum atmosphere. It requires two yards of clearance to either side of the wearer – he can't fly through narrow passages or doors. The helipack weighs 200 lbs. and uses an E cell for power. It has a range of 200 miles. LC3.

Contragravity Belt (TL10^)

The "grav belt" is a personal contragravity harness – a belt and a small backpack – that lets the wearer fly at up to 80 mph. The belt is designed to support one wearer, although he may carry someone else in his arms if Load permits. 20 lbs., 2D/4 hrs. LC3.

Nuclear Jetpack (TL11)

This fusion-powered jetpack is intended for use by battlesuits. It sucks in air, heats it with a reactor, and expels it as a hot plasma jet for thrust. The plasma wash does 2d burning damage with the radiation damage modifier to anyone directly below and behind within two yards. The user is a beacon on infrared: while the jetpack is in use, stealth systems and countermeasures have no effect, and he is +3 to be spotted.

Gravity Cloak (TL12^)

A successor to the grav belt, this is a much lighter system. It might take the form of a flexible cloak made out of solid-state gravitic circuitry. Fastened around the neck and at each wrist, it generates a contragravity field, enabling the user to fly in the same manner as with a grav belt. It may be controlled through arm movements (at -2 to skill) or through a neural interface built into the cloak fastening (which also contains a C cell). It takes two seconds to put on, one to remove. 5 lbs., C/1 hr. LC3.

Zero-G Thrusters

These are microgravity flight rigs used for short-range travel outside of spacecraft or space stations. They use cold-gas thrusters to provide maneuverability, and can be easily donned, doffed, and serviced by a single individual. Use Free Fall skill to operate them.

Hand Thruster (TL9)

A hand thruster propels the user with bursts of compressed gas. Each burst accelerates or decelerates a normal-mass human by one yard per second in the direction opposite to that in which the thruster is pointed. A successful roll against Free Fall or Vacc Suit skill is necessary to point the thruster in the desired direction. The unit's cylinder is good for 30 one-second bursts. A hand thruster weighs four pounds, including the cylinder; extra cylinders cost $10, weigh one pound and take three seconds to replace.

Thruster Pack (TL9)

A strap-on unit for short jaunts in free fall. It consists of a thruster pack, a pair of arms with reverse thrusters, and a control arm that curves in front of the user. Maneuver jets are located at strategic points along the entire pack; a built-in autopilot assists the wearer. It takes 10 seconds and a Vacc Suit roll (which can be tried again every five seconds if missed) to strap into the thruster pack. The large cylinder allows 100 seconds of full acceleration. Successful Free Fall rolls allow the user to control his speed and direction. It weighs 40 pounds, including one cylinder. Extra cylinders cost $30, weigh 10 lbs. and take five seconds to replace.

Flight Pack and Thruster Pack Table

TL	*Vehicle*	*ST/HP*	*Hnd/SR*	*HT*	*Move (G)*	*Lwt.*	*Load*	*SM*	*Occ*	*DR*	*Cost*	*Locations*	*Stall Speed*
9	Hand Thruster	6	+1/1	12	1/30 (0.1G)	0.1	0.1	-5	1	5	$50	–	–
9	Helipack	17	+2/2	12	3/30	0.34	0.3	-2	1	10	$20,000	E	0
9	Thruster Pack	14	+3/1	12	3/300 (0.3G)	0.12	0.1	-2	1	10	$2,000	E	–
10^	Contragravity Belt	10	+2/1	12	10/40	0.16	0.15	-3	1	3	$12,000	E	0
11	Nuclear Jetpack	18	+2/1	11	5/30	0.35	0.3	-2	1	20	50,000	E	0
12^	Grav Cloak	7	+2/1	12	10/40	0.15	0.15	-3	1	3	$6,000	E	0

Drop Capsules

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

Life pods and drop capsules incorporate a computer with Navigation (Space)-12, or the user can override this and program his own landing. Critical success means the user lands within a mile of where he intended. Success means he's within 5d × 100 miles, less 200 miles times his margin of success (e.g., success by 5 reduces the radius by 1,000 miles), minimum one mile. Failure means he could be anywhere on the planet. Critical failure means a disaster of some sort: landing in rough terrain, getting stuck in orbit without fuel to deorbit, or optionally, a too-steep reentry that results in the capsule burning up (a fate best left to NPCs).

Life Pod (TL9)

This is a four-person escape capsule designed to let people evacuate a spacecraft or space station in the event of disaster.

If launched from a vessel in deep space, a life pod is designed to maneuver a safe distance away from a damaged vessel and broadcast a distress signal.

If launched from a vessel in planetary orbit, the pod provides its occupants the option to land; if they are not responsive, it will do so if its library data indicates it is safe to do so (e.g., it won't try to land on a gas giant!). Reentry is handled by an autopilot. After a series of braking parachutes have reduced speed, the capsule uses a parachute to descend to a soft landing. If it lands in water, air bags are automatically inflated, and the capsule will float.

A life pod is equipped with padded acceleration seats for four people and a pair of lockers holding 200 lbs. of cargo. These are usually stuffed with medical and survival kits, but in an emergency the lockers can be emptied, allowing an extra person to cram into each locker.

The capsule is equipped with a medium radio beacon (p. 44), an inertial navigation system (p. 75), and 90 man-days of limited life support (p. 224). Its internal energy bank will power its beacon and life support system for up to a month.

The pod's surface is equipped with a programmable camouflage (p. 99) intended to give it a radar-reflective surface or adjust the exterior for high visibility. The pod is controlled by a personal computer (p. 22) and a simple crew console. Its maneuvering rockets require Piloting (High-Performance Spacecraft), but most pods are equipped with an AI so they can be used by unskilled escapees. LC4.

Drop Capsules (TL10)

A drop capsule is a re-entry capsule protected by an ablative shield, allowing an occupant or cargo canister to be safely dropped from a spaceship in low orbit. It takes two minutes to load a drop capsule. The capsule must be launched from a vehicle bay or missile launcher on a trajectory that will de-orbit it.

Re-entry is handled by an autopilot. After a series of braking parachutes have reduced descent speed, the capsule breaks up a mile or so above the surface. A conventional parachute, parawing, or grav belt can then be used. The drop capsule is not reusable. A drop capsule's split DR is DR 100 ablative armor (all of which is usually gone after the re-entry) on its underside, plus DR 20 from its composite body. LC3.

Stealth Capsules (TL10)

These are similar to standard drop capsules, but are made of material with a low sensor signature and packed with ECM equipment and decoys. They have radar stealth (p. 100) and sensor jammers (p. 99). A stealth capsules automatically launches radar and infrared decoys and activates its own jamming systems, giving itself an extra -5 to be struck by homing missiles. It may also deploy a spare parachute to "jink" itself off a sensor screen. This generally triggers a second roll (at -5) by the sensor operator to avoid losing contact. A stealth capsule is somewhat more cramped than a drop capsule. LC2.

Drop Capsules Table

TL	*Vehicle*	*ST/HP*	*Hnd/SR*	*HT*	*Move*	*LWt.*	*Load*	*SM*	*Occ.*	*DR*	*Cost*	*Locations*
9	Life Pod	50	-5/1	13	1/1,000 (0.1G)	1	0.5	+2	4SV	100/20	$100,000	–
10	Drop Capsule	50	–	13	–	1	0.5	+2	2SV	100/20	$10,000	–
10	Stealth Capsule	50	–	13	–	1	0.3	+2	1SV	100/20	$50,000	–

Matter Transmission

Matter transmission is instant travel from place to place. Depending on what limits exist for it and how cheap it is, matter transmission may render most other forms of transportation obsolete.

Technologies

The simplest way to explain matter transmission is that it creates a junction between two separate points. This might be a wormhole, a macroscopic analogue to a quantum jump, a hyperspace bridge, a space warp, or some other superscience. This type of matter transmission is often closely related to faster-than-light drive or communications technology.

Another form of matter transmission could involve matter-to-energy conversion. This involves scanning the subject, converting him into energy, beaming the pattern to a distant location, and then converting him back. The transmission beam's limitations will depend on the type of energy used (for some examples, see the various communicators in Chapter 3). It may or may not be composed of particles that travel through normal space and can be blocked by solid objects. This form of MT also implies ultrascan (p. 66) and replicator (p. 193) technology – including the possible duplication of people – and the existence of powerful total conversion power plants and energy beams.

Matter transmission is usually assumed to be instant, or nearly so, working at faster-than-light speeds. It could also be limited to the speed of light; over a short distance, the practical difference is negligible.

A few specific implementations of matter transmission are described; many more are possible, and each will have different effects.

MT Booths (TL10^)

This type of matter transmission requires enclosed matter transmission (MT) booths and is only possible booth-to-booth.

A typical booth is the size of a shower stall or old-style phone booth. A typical model can transport up to 400 lbs. at a time, usually one or two people. Range is limited to 20 miles (due to conservation of energy effects) but multiple booths can be linked in relay for longer distances, allowing a traveler to hop across a planet in a matter of seconds. Interplanetary or interstellar teleportation is impossible, so booths are only useful on the surface of planets (or in large ships or space stations).

Public booths may be common. If so, travelers can go from one booth to any other booth within 20 miles for $1 per jump. Longer jumps cost more, but since the computer automatically transfers the cargo from booth to booth, it still takes only seconds. Addresses are given verbally to the booth's computer, which is programmed to act as an "address book" of destination codes. It takes only two seconds to use a booth, but there might be a line of people waiting for it.

This form of matter transmission reduces travel time in civilized areas to near zero, but doesn't affect the rest of the campaign very much; it is ideal for those who want to introduce matter transmission at lower TLs. If MT booths are commonplace, streets may disappear and people could start to think of addresses in terms of teleport coordinates. It's possible to go anywhere on a world without seeing anything but the inside of a booth.

Matter Transmission Booths (TL10^)

The default assumption is that MT booths are expensive. There may be public booths, but well-off individuals or organizations can also afford to buy their own. They'll probably put it in the lobby or get an unlisted booth number to prevent just anyone dropping in! A private model can be linked with another dedicated booth within 20 miles, or be linked to the general network for $1,000 per month. $100,000 each, 1,000 lbs., external power. LC3.

Cheap Matter Transmission Booths (TL11^)

Another option for matter transmission is that full-size booths are cheap, costing 10%-20% of the prices above. If so, everyone may have a matter transmission booth, and houses may not even bother with doors – though they might lock the door to the booth. $20,000 each, 200 lbs., external power. LC4.

Longer Ranges (TL10-11^)

It's possible that teleport booths may have greater ranges; this is up to the GM. A system with continental range (3,000 miles) is 10 times the normal cost and weight. A planetary-range system is 100 times cost, weight, and power; an interplanetary-range system is multiplied by 1,000; an interstellar range system by 10,000. The GM may impose an arbitrary limit on maximum range, whether it is 10 light years or 1,000 light years.

Other Spinoffs (TL11^)

If matter transmission booths can scale up or down in size, they have many other applications. Large systems may be used for moving cargo or mass transit, or even as part of production lines. A booth as small as a letterbox could be purchased for $1,000, and run off building power, or be rented like a phone for $20 per month. Mail and goods can be delivered via matter transmission. They can be used for garbage disposal, or to order pizza. Want to go shopping? Call up a store's computer data base, then sit and watch the booth display holographic images of the store's inventory. Make a selection, and it appears as soon as you pay for it.

Telegates (TL11-12^)

This is another means of matter transmission. A telegate or teleportal is a "wormhole" gateway that leads to another telegate somewhere else. While activated it remains constantly open, and people can see through it, walk through it, even fire weapons back and forth from either end (just don't hit the telegate machinery). Energy differences are automatically compensated, so it is possible to step from a

telegate in orbit to one on a planet below, and back. The gate may be fitted with a ward (see p. 173) to keep things from leaking through, but still allow people to walk through it.

Using a telegate requires that the coordinates on both gates match. If telegates are used instead of matter transmission booths for a planetary transportation network, this will be performed automatically by the network's control system. Telegates may be just an alternative to matter transmission booths (above), but other possibilities exist – see below.

Telegate Networks (TL11^)

These are connected networked telegates. Use the same rules as for a teleport booth network, but a gate is "held open" (pay the cost every second instead of per jump). If two gates are open to each other, they're "busy" and no gate elsewhere in the network will be able to reach them until they're closed again.

Gates in a telegate network cost the same as teleport booths. If they're larger than doorway-sized, multiply the cost and weight by the radius in yards.

Paired Telegates (TL11^)

Some versions of teleport technology may require telegates to always be paired with particular other telegates. Rather than a network, these form a closed system, A to B. In order for either telegate to be used, both must be turned on and in range; optionally, turning on one gate activates the other if it is in range. Going somewhere else requires a different pair of telegates.

No skill roll is required to use one; just activate it and step through. When functioning, the gateway is one yard across – anyone standing next to it can take two seconds to step through, or dive through in one turn with a successful DX or Acrobatics roll.

Paired telegates have only half the weight and cost (but normal power) of telegate networks. If given a continuous power supply (such as a reactor), it's common for the telegates to be constantly open. In the case of gates connecting across interstellar distances, it might be impossible to shut the gate off without permanently severing the link.

Star Gates (TL11^)

These are interplanetary or interstellar telegates, which could be paired or networked. There may be an engineering requirement that all interstellar or interplanetary range gates must be placed in space stations distant from a planet, perhaps due to interference from planetary or stellar gravity. If the gates have to be several thousand – or million – miles away from a settled world, then spaceships may still be in use as shuttles between planets and gate stations. Such gates may be big enough for ships to pass through them.

If star gates can be installed on planetary surfaces, people can simply walk through them and reappear on another planet. This would mean starships are mainly used for initial exploration – once a gate has been delivered, a "frontier world" becomes part of mainstream civilization, open for rapid colonization and cheap trade.

Cosmic Freeways (TL11^)

Another possibility for planetary star gates is a series of paired gateways that are constructed as an archway or tunnel on a roadway, canal, or train track – just take the first left at the turnpike, drive through the telegate and you're on a road on another planet. There are no spaceships, just roads (or railways!) leading to the stars. A Precursor cosmic freeway might even be used by low-tech societies who believe it to be a magical or divine path.

A single highway system could link dozens of worlds, or even other dimensions, though the vehicles had better be designed for multiple environments. To avoid making it too easy, assume that no telegate can be within (say) 150 miles of another gate, thus allowing for a bit of travel before reaching the next world.

Minigates (TL12^)

What if telegates could be very small? A minigate is a flat circle or rectangle with a power pack and controls mounted on the back. It has a two-mile range.

A minigate can be carried like a shield, providing Defense Bonus 4. If this makes the difference in stopping an attack, or the user blocks a melee attack with the shield, the blow or projectile goes through the gate. Make sure no one friendly is standing on the other side!

Minigates are wielded with the Shield skill. $100,000, 20 lbs., E/30 minutes. LC3.

Dimension and Time Travel

Any teleportation device could lead to a different time or dimension. In fact, time warps are a logical consequence of any faster-than-light teleportation system (which is one reason why they're superscience).

Time portals leading to the past can create paradoxes if the time travelers' actions change history (although strictly speaking, even their simple presence will change the past in some way). However, the GM can rule that paradoxes spin off alternative time lines. If the PCs travel back in time and prevent World War I from occurring, in the future the portal leads to 1914, but not *our* 1914. Time portals to the future are less of an issue, provided no backward travel is possible.

For more ideas on handling time travel, see ***GURPS Infinite Worlds.***

Teleport Projectors (TL12^)

Teleport projectors are two-way matter transmission devices; they can snatch up someone as well as sending him somewhere, and they do not require a receiving booth. Conservation of energy problems do not affect them – an

orbiting ship can teleport someone up from the planet below, if it has the proper coordinates. They can also teleport a bomb, so unless the GM decides that force screens or some kind of defensive screen (see *Reality Stabilizer*, p. 194) can block them, they become a formidable weapon.

Projectors require precise coordinates. If the target to be beamed up or the destination is not in sight, it must be precisely located by active or passive sensors. A teleport projector is thus limited by the range and accuracy of sensor systems, which can be a critical factor in game balance. The GM may require Electronics Operation (Sensors) skill rolls to get a "lock" onto a particular place or subject.

A standard teleport projector is a platform large enough to transport a single person, or two in a tight embrace, or up to 400 lbs. weight. The projector controls are focused on a specific point. Anything standing on the platform is teleported to that destination point. If the destination point is occupied by a solid object, the GM may assume the teleport fails, or that the result is some form of disaster.

Range is 10,000 miles; using the projector takes 10 seconds and a skill roll against Electronics Operation (Matter Transmitters), with a -1 per 1,000 miles of distance. Add +4 if teleporting between two cooperating projectors. Failure means a near miss, critical failure a disaster (perhaps the victim is teleported above or below ground, or off course, or the projector breaks).

A typical projector is $15,000,000, 3,000 lbs., plus an extra $5 million and 1,000 lbs. per platform. It uses external power. Projectors that can only send, but not retrieve, are possible; these are half weight and cost. LC1.

Teleport Beacons (TL12^)

GMs should think carefully before introducing teleport projectors, since they make it very easy to whisk characters out of danger, steal objects or kidnap foes, and so on. An easy fix to this is to require that projectors do not just require a sensor fix, but that the target also have a special "teleport beacon" device attached to it. This makes them useful for delivering and retrieving personnel, but prevents kidnapping enemies, or snatching objects, or rescuing characters who have been captured and stripped of their gear. A teleport beacon is $10,000, 0.1 lb. LC4.

Interstellar Projectors (TL12^)

What if teleport projectors could teleport people anywhere and had interstellar range, perhaps substituting tens of light years for thousands of miles? This is more interesting if no FTL travel exists – only teleport projectors, and they are hideously expensive. Building a teleport projector costs at least $1 billion, and a similar amount to operate. Only governments and the largest corporations have them, though they may rent time on them to other corporations or agencies.

An interstellar projector weighs and costs at least 1,000 times as much as a teleport projector. Each jump also requires a prodigious amount of energy and computer resources, so the cost of each jump is $100,000 for a projector with a platform one yard across or smaller. This is enough to transport a man or a cubic yard of cargo.

The cost of both the system and each jump increases exponentially each time the radius doubles. A projection platform two yards in radius that can transmit an exploration team of a half-dozen men and their gear costs $10,000,000. A four-yard platform large enough for a small vehicle or about 20 men costs $100,000,000.

Here's how exploration might work using interstellar projectors. Using astronomical information, a likely star is located, and a small probe is sent through with a telescope. It locates any planets, then is brought back. If a habitable-appearing planet is discovered, a second probe is sent, this time into orbit. Landing coordinates are determined, and a team of humans is sent through – but because of the exponential cost increases, sending through vehicles or tons of equipment is simply not practical. Only a half dozen or so explorers could be sent, especially if a smaller corporation was fronting the mission. Since any use of the projector for communication or resupply costs several million credits, they would likely be spending several days (or weeks) at a time out of communication, with no heavy equipment and no assistance from a convenient orbiting starship – an ideal setting for adventure.

If a world proved to be habitable, it could be colonized by sending cloning tanks and automated factories. While they would be too expensive for regular commerce (except in luxury goods and information), teleport projectors would be in demand for diplomatic, intelligence or military missions. Adventurers would have plenty of authority to make their own decisions, but not much backup if something went wrong.

Mind Voyages

It is usually easier to transmit information than matter. If mind emulations (p. 220) or artificial intelligences (p. 25) exist, then it would be possible to effectively "travel" by transmitting copied minds encoded in digital form from place to place.

In a civilization where travel is information-based, visiting another world involves your mind emulation being transmitted across space, only to be received and uploaded into a new body (robotic or living). Of course, if there is no form of FTL radio, a transmission might take years to arrive and conditions could be quite different than expected!

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Langford, David. *The Space Eater* (Arrow Books, 1982). An exposition of all the nasty things you can do with regeneration tanks and telegates.

Miller, Marc W. *Traveller* (GDW, 1977). Just about every SF roleplaying game has spawned a book or two of weapons and gadgets, but *Traveller's* many incarnations are unsurpassed in their depiction of a detailed TL10-11^ safe-tech setting.

Morgan, Richard. *Broken Angels* (Gollancz, 2003). Up-to-date space opera focusing on the kind of special-ops mission adventurers seem to get involved in; plenty of ultra-tech military, medical, and spy gear is described.

Niven, Larry. *Ringworld* (Ballantine, 1970). Keystone of the Known Space series, filled with exotic tech from matter-transport booths to stasis fields. Niven is especially good at depicting how these devices affect society.

Piper, H. Beam. *Space Viking* (Ace, 1963). One of the key works in an excellent safe-tech space opera series that inspired many SFRPGs. Also a good source for advanced nuclear weapons and contragravity-using societies.

Smith, E.E. *Gray Lensman* (Fantasy Press, 1951). Doc Smith's *Lensman* series remains the ultimate superscience (and psi-tech!) galactic space opera. This book is packed with manic adventure and ultra-tech gadgetry.

Stephenson, Neal. *The Diamond Age* (Bantam, 1985). Contains many imaginative descriptions of the use and abuses of nanotech.

Stross, Charles. *Singularity Sky* (Ace, 2003). A TL10 safe-tech society tries to fight one with advanced nanotech. Its sequel, *Iron Sunrise,* offers not one but two system-smashing doomsday weapons.

Vinge, Vernor. *A Fire Upon the Deep* (Tor, 1992). Supposes that tech levels (or at least, areas where superscience works) are determined by the galaxy's structure, and describes an amusing galactic communications network that works just like early-1990s Usenet.

Westerfeld, Scott. *The Risen Empire* (Tor, 2003). A lively example of the "new space opera" school that blends cutting-edge nanotech with plenty of superscience. Much of the book is devoted to ultra-tech commando actions described in painstaking detail.

Williams, Walter Jon. *Voice of the Whirlwind* (Tor, 1987). A TL9/11 cyberpunk society with emergent superscience, as well as ultra-tech special ops and espionage. The prequel *Hardwired* is definitive cyberpunk, featuring nasty cyber-tech and neural-interfaced vehicular combat.

Nonfiction

Drexler, Eric, Peterson, Chris, and Pergamit, Gayle. *Unbounding the Future: the Nanotechnology Revolution* (William Morrow, 1991). The promises and pitfalls of advanced nanotech.

Forward, Robert L. *Indistinguishable from Magic* (Baen, 1995). A scientist and science fiction writer imagines possible future technologies.

Nichols, Peter. *The Science in Science Fiction* (Book Club Associates, 1982). A thorough, well-written survey of SF technology (up to the early '80s), and how it works – or why it wouldn't.

Film and Television

Star Trek: The Next Generation (Gene Roddenberry, 1987-1994). The Federation is a definitive example of TL12^ safe-tech society. The workings of its superscience technology have been laid out in unusual depth in many published technical manuals.

Star Wars (George Lucas, 1977). The Empire is an example of a TL10-11^ setting where most of the wealth went to pay for megaprojects!

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