Chapter 4c- Augments, Robots and Drones

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Augments, Robots, and Drones

Augments

Increasing a person's characteristics is one of the sure signs of advancement for many role playing games. In higher tech societies, both genetically engineered vat grown tissue and electromechanical augments are available in various systems depending upon their societal preferences. Each have advantages and disadvantages, and both are capable of substantial characteristic boosts at the highest tech levels. Because these methods are not natural, augments may boost characteristics above their racial maximums. Any augment that increases a characteristic or bodily function, however, carries a penalty in terms of medical issues. Any medical treatment provided using materials below the augment TL have a chance of failing due to poor interaction with the available medicines. Once such an allergy or interaction takes place it becomes a regular feature for all related treatments. For augmented individuals, the cure can be worse than the original injury.

Augments are limited in what they can achieve. Four characteristics may be improved with augmentation: Str, End, Dex, and Int. Soc is a characteristic dependent upon birth, personality, and culture which is not easily subject to augmentation. Edu is a matter of training and experience which may not be directly augmented but may be indirectly increased using a datajack. Datajacks (described below) can increase a skill tied to Edu but does not increase Edu itself. The datajack functions exactly like a computer running an expert system but does so with an implanted set of connections as opposed to exterior interactions. Many implants use tech augments similar to the electro-organic connections found in cyborgs (discussed under robots) and first appear at TL12, the same time true cyborgs appear. Cyborgs differ from mechanical augments primarily by degree: cyborgs have an almost complete replacement of the organic body by machinery, while augments keep a mostly organic body supplemented with machinery.

Gengineering

Gengineering is the use of modified cultured cells to impart new abilities into an adult organism without making heritable changes to the target. The first gengineered tissue is typically available starting around TL9 and usually involves regenerating damaged tissues, appendages or organs. Because regeneration uses the same tissue as the host without any modifications, it is one of the least expensive and most reliable augmentation technologies available and typically the first developed. Enhancing the natural capabilities of a sophont using gengineering is more challenging and requires more manipulation to create something that will be fully compatible with the original tissue. Enhancement is time consuming and requires spending extended time on a high tech world. Because genetically engineered tissue originates with the host and is designed with the host’s body in mind, it is compatible with psionics and is really the only way to enhance a psionicist without permanently reducing their psionic strength.

Gengineering allows sophonts to essentially upgrade their bodies into a more effective configuration. It provides natural abilities that can exceed those of normal sophonts of that species and can give the augmented individuals that critical edge in a tight situation. Augmented individuals still have their own DNA, however; a human augmented with echolocation, for example, will have normal offspring. These augments take time to graft into a host, and then the host must learn to use the new abilities using advanced biofeedback methods until it is as natural to them as breathing. Some augments, such as nictitating membranes, require little to learning to employ. Other augments, such as infrared vision, present an entirely new category of sensory information which literally could not be perceived before. Interpreting these new signals requires training. Changes to the DNA of a developing fetus can also be made, but those only show up as that organism grows and have no additional training time beyond normal skill training.

enhanced hearing range: low frequency limit down to ~5 Hz while increasing the high frequency to 20 kHz.

sound localization: ability to locate sounds accurately in 3 dimensions without improving hearing range.

echolocation: use of high frequency (~18 kHz) sound broadcasts to map out space in 3D. makes individuals more susceptable to becoming stunned by loud noises (-2 DM).

camouflage skin: conscious control of chromophores in the skin to blend into surrounding colors. Gives a -1 DM to spot a sophont when hiding naked.

chameleon skin: more accurate control of chromophores to blend into surrounding colors. Gives a -2 DM to spot a sophont when hiding naked.

neuromorphic skin: extensive change in skin shape and coloring to provide the equivalent of a disguise kit for an individual. It does not change height, but can change apparent weight +/- 20%. Takes 10 minutes to implement a change.

gecko pads: fine hairs and sacks on the surface of hands and feet that improve climbing ability and traction by +2 DM. Gloves or footwear can block this effect.

porcupine skin: fine keratin spines that normally lie flat on the surface but can be forced to stick out 1 cm. If deployed BEFORE contact, grabbing or striking a protected individual caused 1d6 damage. May be blocked by armor.

natural armor: provides additional protection from damage that stacks with other armor.

fangs: extended canines give a sophont a 1d6 bite attack. **Venomous fangs** add a poison component to give 2d6 additional damage. Vampire clothing and behavior is optional.

retractable claws: give a sophont an additional d6 on an unarmed attack. ie. an average human's punch would now do 2d6 damage.

Gengineering Augments

body part	TL	time (weeks)	cost (Cr)
replacement per point	9	4/point	5,000/point
appendage (not head)	9	8	20,000
eyes/nose/tongue/ears	9	8	10,000
single internal organ	9	8	25,000
multiple internal organs	10	12	45,000
enhanced hearing range	11	4	10,000
sound localization	12	8	25,000
echolocation	14	12	50,000
camouflage skin	11	8	20,000
chameleon skin	13	12	50,000
neuromorphic skin	15	24	100,000
gecko pads	12	12	35,000
porcupine skin	14	20	300,000
natural armor +1	13	8	150,000
natural armor +2	15	16	450,000
fangs	10	8	20,000
venomous fangs	12	16	75,000
retractable claws	11	12	40,000
prehensile feet	11	16	30,000
bloodhound scent	12	16	45,000
nictating membrane	10	4	15,000
anti-flare membrane	10	4	10,000
IR vision	10	12	15,000
UV vision	10	12	15,000
magnetovision	12	16	25,000
two vision augments	13	16	40,000
three vision augments	15	20	60,000
characteristic +1	11	12	100,000
characteristic +2	13	20	250,000
characteristic +3	15	32	750,000
blood filtering	11	12	50,000

prehensile feet: allow a sophont to use their feet as an additional set of hands. Standard footwear blocks this ability.

bloodhound scent: allows a sophont to identify odors much more effectively than can naturally occur. Allows tracking and identification based on scent.

nictating membrane: natural eye covering which protects eyes from chemicals (+2 DM) and clears underwater vision.

anti-flare membrane: protects eyes from the stunning effects of bright lights (+1 DM).

IR, UV, magnetovision: allows an individual to see in the indicated extended spectrum. Makes sophonts more vulnerable to stunning effects of bright lights (-1 DM).

characteristics increases: these may only be applied to Str, Dex, End, or Int. These increase the maximum score of the sophont and can allow superhuman stats if applied to individuals with already high ability characteristics.

blood filtering: this augment enhances the removal of poisons and biological toxins from the body. It provides a +2 DM against most poisons and toxins from natural and artificial sources. It does not protect against disease.

Xenogeneering

Xenogineering is adapting living parts of one organism to become part of the genetic makeup of another organism. This is only available at TL 11 and above and requires regular access to both the donor and the host tissue during the development process. At TL11 it is only able to affect developing organisms, but by TL13 it can be applied to some adult organisms and at TL15 essentially any organic ability other than psionics may be grafted into another organism to create a unique breed of organism. Adapting adults is slow however, and it is relatively uncommon to have obvious xenogineered augments even though it is possible. When taken to its highest levels, exceptional abilities such as heat resistance or acid spit may be engineered from one sophont into an otherwise normal appearing human. Psionics are an exceptional ability that, so far, has proven resistant to manipulation using even TL15 resources. Many races would like to be able to create their own psionics or psionically resistant operatives, however, and research is still ongoing in this direction.

When a xenogineered race is being developed, it is typically intended as a long term project being supported by a megacorp or system with deep pockets and a time frame of decades. Each trait must be engineered in separately and at full price for the first individual, although several identical clones could be initiated from that one successful organism for no additional cost. When the same organization is making the second and subsequent organisms, costs are halved as less novel work is required. Xenogineered organisms are typically carefully chosen to have few or no dangerous recessive traits so that perhaps two dozen individuals would be sufficient to start a new race (with carefully controlled breeding for the first few generations). While expensive, organisms adapted to valuable worlds are a great asset when exploiting that world's resources. Note that there is no limit to

Xenogineering Table

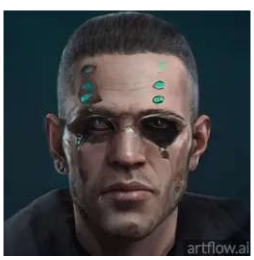
body part	TL	time (weeks)	cost (Cr)
characteristic +1	11	12	500,000
characteristic +2	13	20	1,000,000
characteristic +3	15	32	2,500,000
natural armor +1	13	16	500,000
natural armor +2	15	40	1,500,000
natural weapon (normal)	13	16	250,000
xenogeneered wings	15	40	500,000
poison gland	15	52	1,000,000
superior related sense	13	16	250,000
extrasensory sense	15	52	2,500,000
related breathing type	13	26	200,000
novel breathing type	15	52	600,000
exceptional ability	15	32	2,500,000+

what organism might be xenogeneered- weaponizing small animals might destabilize an entire planetary ecosystem for example.

Certain races have exceptional abilities based upon their physiology and evolutionary history. Different races may breathe tainted air safely, hear radio communications, resist poisons, cold, or heat, spit acid, etc. These organic abilities may be engineered into other organisms, although the more complex capabilities may require even longer and more expensive development (referee's discretion). At high tech levels, organic beings are simply another type of machine that sophonts can manipulate for their own purposes. Uplifted races and merfolk are common examples of how it is possible to alter the nature of organic beings in the future, and if a suitable organic model for an ability exists it could potentially be added to other organisms. It is far more difficult to create unique abilities using gengineering. No currently existing race has an organic jump drive, for example, so there is no way to xenogineer such an ability into humans.

Replacing damaged tissue with newly regenerated healthy ones is a widely accepted practice. Minor genetic manipulation that increases characteristics is also mostly accepted. More extreme xenogineering, however, does not receive the same support and is usually tightly regulated. People recognize the dangers of engineered plagues and most responsible organizations will try to avoid any hint of such activity. Any religious or political group that is committed to racial purity will typically regard any enhancements or xenogineering experiments as reprehensible and may even resort to violence to prevent the spread of species corrupted by such immoral technology. They will certainly act to try and prevent the development of a whole sub-race of xenogineered sophonts.

Technological Augments



Although primitive prosthetics that are more lifelike than just a stick start appearing around TL6, true controllable augments only become available around TL8. By TL 11 it is possible to enhance an organic body characteristic by +1, although it requires much more integration than a simple replacement augment. These technological enhancements may be a true fusion of technology and nature and may appear natural or artificial depending upon desires when the augment is added. Characteristics may be increased by +2 at TL13 or by up to +3 at TL15.

Minor technological augments are widespread and in some cultures are a mark of status or membership in a particular organization. Extensive augments are less commonly seen, but augments do not have to be visible and the true frequency of augmented people may be higher than many believe. All technological augments suffer from 2 clear drawbacks compared to organic augments. First, electromagnetic interference from EMP devices can disrupt augments if successfully targeted. Augments may be shielded from EMP, but such shielding increases the price by 50%. Secondly, technological augments of any kind interfere with the psionic strength of a body. Each augment cumulatively reduces the psionic strength of an individual by -1 characteristic point.

> We can rebuild him. We have the technology . . . We can make him better than he was before. Better, stronger, faster.
>
> *The Six Million Dollar Man*

Electomechanical augmentation comes in a variety of forms. It may be used to provide a replacement limb or organ that functions roughly equivalently to the organism's original capability. This is relatively inexpensive because it only involves the single appendage or organ and no changes elsewhere are needed. Enhanced body functions often depend upon more than one organ. While a robotic arm may be stronger than a normal arm, that does not mean the sophont's legs or torso are strong enough to leverage that strength! Even for constrained senses such as vision, infrared or UV signals would not be something an organic human brain recognizes naturally because it was not part of them during their development. While it can be learned, learning takes training and time. Implanted devices that function without conscious thought or interact with few organ systems take less time to implement.

Implantable versions of other devices are certainly possible and are regularly used as stealthy devices because they are hard to detect. Small devices generally cost at least 10x more when implanted and take at least a week to be integrated. Larger devices may also be implanted. One of the worst disasters ever to take place involved a 75 year old grandmother who had a pocket nuke implanted into her womb. She detonated the device at the 200th anniversary of Lapipan independence and killed well over a million people with the blast and radiation poisoning.

Organ/Sensory Augments

Biomonitors collect and analyze health information so that hazards can be identified more quickly and easily. Also used in dangerous occupations where injuries are common occurences.

Biokits are more advanced monitors that can supply doses of drugs to counteract what the monitor detects or even inject on demand. May only supply 2 doses of 3 drugs, and each drug is purchases separately.

Nanohealing involves the use of nanites that have been programmed to repair damaged cells and tissues in an individual's body. Allows fast healing similar to the natural fast healing trait of some alien races that heal d6 per day instead of 1 per day. It does not heal damage or characteristic loss caused by aging.

Air filters are implanted in the lungs and serve to remove atmospheric toxins or poisons before entering the lungs and thus blocking their function. Works very well in tainted atmospheres.

voice synthesizers allow a previously heard voice to be reproduced accurately. Generally illegal, these are often used to fool voiceprint analysis and voice recognition.

Blood filters remove poisons and toxins from the blood giving a +2DM to resisting their effects.

Vibrasense is a vibration sensing system that may be passive and using environmental noise and vibration to locate a moving object. In active mode, it uses ultrasonics to create essentially a sonar map locating mobile and immobile objects. Active mode can be overloaded by too much environmental noise.

Organ/Sensory Augments

Augment	TL	weeks	cost (Cr)
replacement per point	9	2/point	5,000/point
appendage (not head)	9	4	20,000
characteristic +1	11	4	100,000
characteristic +2	13	8	250,000
characteristic +3	15	12	750,000
biomonitor	10	1	500
biokit	14	8	30,000
nanohealing	15	36	2,500,000
air filter	11	6	15,000
voice synthesis	11	8	10,000
blood filter	12	12	60,000
vibrasense	13	12	35,000
enhanced audio freq.	10	4	10,000
sel. enhanced audio	12	8	15,000
sound localization	12	8	25,000
echolocation	13	12	45,000
psionic shield	12	2	40,000
anti-flare membrane	10	4	10,000
nictating membrane	10	4	15,000
micro/telescopic vision	11	8	15,000 each
IR/UV/magnetovision	11	8	20,000 each
Ballistic Lens	13	8	40,000

Selectively Enhanced Audio allows selective amplification, better sound localization and frequency filters to enhance particular sounds or voices by concentrating on them.

enhanced audio frequency: low frequency limit down to ~5 Hz while increasing the high frequency to 20 kHz.

sound localization: ability to locate sounds accurately in 3 dimensions without improving hearing range.

echolocation: use of high frequency (~20 kHz) sound broadcasts to map out space in 3D. makes individuals more susceptable to becoming stunned by loud noises (-2 DM).

Psionic shields block all sensing and telepathic contact between a psionic and the wearer.

Anti-Flare membranes protect the eyes from the damaging effects of rapid changes in brightness caused by emerging into bright sunlight, laser dazzling, flashbang grenades, etc.

Nictating membranes protect the eyes from dehydration and improves underwater vision. They are usually available as a conscious action and work similarly to a second set of eyelids.

Micro/telescopic vision gives the eqivalent of up to 200x magnification for very small structures or up to 50x magnification for distant objects. Each mode must be added separately. Note that these modes take time to enter or exit from normal vision. Rapid switching between modes is disorienting (-1 DM for 1 minute).

IR/UV/magnetovision eyes allow expanded imaging to new frequencies. Each upgrade is applied separately.

Ballistic lenses are used to project where a target will be at some point in the future. Gives a +1 DM when using a ranged weapon on a moving target.

Implantable Armor and Weapons

The various stabbing weapons (claws, daggers, vibroblades, etc) are generally not visible unless being used and may only be spotted with a -2 DM. Each is retractable at will but are functionally equivalent to their normal counterparts. Because space is limited, cybermods of normal sophonts cannot both function and hide heavier weapons. This may not be true for large or huge sophonts who are massively larger.

Subdermal Armor is implanted material under the skin that protects organs and critical body parts from damage. It is additive with external armor and can provide a significant boost for survivability in violent conflicts. Any bonus above +2 is easily observed.

Stunsticks function like the non-augment version but the built in version is harder to spot with a -2 DM.

Implantable Armor and Weapons

Augment	TL	weeks	cost (Cr)
subdermal armor +1	10	2	50,000
subdermal armor +2	11	3	100,000
subdermal armor +3	12	4	150,000
subdermal armor +4	13	6	250,000
subdermal armor +5	15	9	500,000
retractable claw (2d6)	10	2	4,000
internal dagger (d6+2)	10	2	5,000
internal vibroknife (3d+1)	13	3	20,000
stunstick	11	3	10,000
autopistol (3d6-3)	11	3	12,000
laser pistol (3d6)	12	6	25,000
smartlink	10	1	750
shocking grasp (1d6)	11	3	1,000
fangs	9	2	3,500
venomous fangs	11	8	15,000
gasser	10	1	1,000

Autopistols are single shot weapons that take a full action to reload but are difficult to spot with a -2 DM for being identified.

Laser pistols function exactly like their typical counterpart in terms of battery requirements and require a separate power source from the rest of the enhancement.

Smartlink is a uniquely keyed device that limits access to another device, often a vehicle or weapon. It provides an electronic signature that is required for the paired device to function. Without the smartlink the keyed device won't fire, the vehicle won't start, etc. Only works with appropriate devices.

Shocking grasp gives a 1d6 jolt of electrical energy into whatever is touched. Requires 2 contacts on different fingers and a mental command to spark and may only be used three times before the rechargeable battery is depleted. It may be used as a weapon, but is perhaps more commonly employed to overload electronics.

fangs: extended canines give a sophont a 1d6 bite attack. **Venomous fangs** add a poison component to give typically +2d6 damage. Unlike biological fangs, these fangs must have their poison renewed from outside and may only carry 2 doses. More deadly poison could be used, but a botched attack (failure by more than 2) results in self-administering the given poison.

Gasser is a cyberdevice designed to deliver a dose of gas (whatever is loaded) to someone being grasped. Very difficult to spot (-2DM) and commonly used in kidnappings and the like. Failure by more than 2 results in gassing oneself accidentally.

Implanted Electrical Equipment

DataJacks are programmable computers that can act as a hand computer of the appropriate type. It always runs an Intellect Program and may run 1 expert program to enhance one skill. The quality of the datajack determines the maximum enhancement and at TL15 can provide up to a +3 DM skill modifier. A datajack user must already have at least skill level 0 in a skill to benefit from the expert system. Datajack systems are only able to influence Edu and Int based skillls, so while a datajack could improve a medical diagnosis it would not improve a dexterity based surgical skill check. Datajacks require additional skillsofts to be useful, but skillsofts may be changed by using a minor action. Misprogrammed skillsofts have been known to cause migranes (or worse!) and can be very dangerous to the user.

Skillsofts are software products used by expert programs to provide Int and Edu based skills for computers, robots, and datajacks. Note that skillsofts appear earlier than a datajack able to implement that skillsoft. It is easier to program databases for a computer than to integrate that information with an organic brain.

Transponder is a radiolocation beacon to identify where the signal is coming from. May be blocked by devices/shielding that inhibits radio.

Implanted Electrical Equipment

Augment	TL	weeks	cost (Cr)
DataJack (up to skill 1)	12	8	15,000
improved DataJack (2)	13	8	30,000
advanced DataJack (3)	15	16	60,000
skillsoft-0	7	-	1000
skillsoft-1	9	-	4000
skillsoft-2	11	-	15,000
skillsoft-3	13	-	40,000
skillsoft-4	15	-	75,000
transponder	9	1	1500
radio jammer	7	1	2000
2-way radio comlink	9	2	1000/5000/ 20,000
radio direction finder	8	2	10,000

Radio jammers broadcast a stream of random jibberish on whatever frequency desired to disrupt radio based communications within a modest 5 km area. The source of a jamming signal is usually easy to detect.

2-way radio comlinks are used to receive and transmit data. Audio only links are relatively inexpensive, while video data and digital computer data get progressively more expensive.

Radio direction finders are passive systems which use integrated antennas to determine the direction a signal is coming from, although distance cannot be identified as the strength of the source is not known. These may never be shielded from EMP as that would defeat their purpose.

Other Cybermods

A **smuggling pouch** is a 1 L (1000 cm^3) pouch openable using a disguised pressure sensitive switch. Soft sided and difficult to spot, it takes a successful recon or life science roll to detect with a -2 DM.

camouflage skin: conscious control of chromophores in the skin to blend into surrounding colors. Gives a -1 DM to spot a sophont when hiding (but does not cover clothes).

chameleon skin: more accurate control of chromophores to blend into surrounding colors. Gives a -2 DM to spot a sophont when hiding (but does not cover clothes).

neuromorphic skin: extensive change in skin shape and coloring to provide the equivalent of a disguise kit for an individual. It does not change height, but can change apparent weight +/- 20%. Changes take 5 minutes and must be programmed in by a computer/3 or better.

oxygenators take small oxygen bottles implanted in the torso to directly oxygenate the blood. They only carry enough oxgen for 30 minutes, but are very useful underwater or in very thin atmospheres.

prehensile feet provide a replacement foot which can grab as effectively as a human hand.

detachable hand is a cybernetic hand with full normal functions plus the ability to lock on to an appropriate surface and unattach from the rest of the body. There is a small winch with a 25m monofilament line within the wrist which can support 200 kg.

Other Cybermods

Item	TL	weeks	Cr
smuggling pouch	9	2	15,000
camoflage skin	11	5	7,500
chameleon skin	12	16	30,000
neuromorphic skin	15	24	150,000
oxygenator	10	4	7,500
prehensile feet	10	16	10,000
detachable hand	12	8	15,000
photo. memory	12	4	10,000
audio/video recorder	12	4	15,000
eidetic memory	15	8	45,000
gas spectrometer	15	12	65,000

photographic memory allows a cybernetic eye to snap a high resolution picture that may be recalled or downloaded via datajack or neural link. A radiotransmitter version is 1 TL higher and costs 5000 Cr additional.

audio/video recorders are sensory augments which can store what a sophont directly observes into permanent memory accessible by datajack for later download or recall. A radio uplink is available at TL13 and an additional 5000 Cr.

eidetic memory is the ability to recall data and facts once learned nearly instantaneously. The data must have been learned (ie. not downloaded via datajack) and may or may not be factual. Note also that while the information is there the interpretation must be handled independently.

gas spectrometers replace the normal nasal organ with a portable gas chromatograph to analzye molecules in the atmosphere. Note that the person must breathe the atmosphere in order to analyze it which could produce severe complications.

Robots

Robots are a staple of science fiction, but the concept of an artificial organism has been around centuries longer. The simplest robots start to appear in research and high tech industrial settings around the time of spaceflight (TL7). As robot sophistication and power generation technologies advance, robots become mobile and begin to fulfill more of their potential. Industrial-shaped robots that can understand and respond to simple verbal commands are common around TL9-10, although robots modeled after living organisms are not realistic before TL12. Around the same time biological styled robots arrived it becomes possible to embed and support a living brain inside of mechanized hardware creating true cyborgs. Only by TL14 do robots become so advanced that they are difficult to distinguish from natural organisms on a casual inspection. Using even modest equipment, however, it is quite easy to separate any robot from a living organism. Power supplies, electronic circuits, NAS scanners, psionic signatures, etc are all ways that current robots are distinct from organic lifeforms. Sensors can be expensive, though, and there have been numerous cases where a high end robot has successfully imitated an organic life form long enough to cause major issues.

> Hephaestus left his forge and hobbled on. Handmaids ran to attend their master, all cast in gold but a match for living, breathing girls. Intelligence fills their hearts, voice and strength their frames, from the deathless gods they've learned their works of hand.
>
> *Homer, The Illiad, Book 18*
> *translated by Robert Fagles*

Many different types of robots exist in the various settled systems. A large number of terms can be used to describe the functions of robots, and several of them are listed here. Drones and cyborgs, despite having certain design requirements, are constructed as robots under the same general rules.

Android: Sometimes abbreviated as 'droids, androids are sophisticated robots that are able to apparently reason as well or better than a sophont. They may be biologically shaped or completely functional, but they are capable of reasoning at least within their appropriate domains of knowledge.

Biolog: type of robot designed to mimic a living organism. These can be as simple as mechanical animal companions meant to comfort and monitor a sophont or as sophisticated as a human appearing robot with full emotional and logic abilities.

Cyborg: an organic brain that has been connected to machinery which keeps the brain functioning and which, in turn, is controlled by the organic brain. These are typically larger than an all-electronic robotic brain due to the necessary tubes and feeding reservoirs, but they offer some advantages not available to standard robots. Reprogramming a cyborg is not possible, while even the most sophisticated electronic brains may be hacked. Interestingly, even if a psionic brain is transplanted into a mechanical construct the cyborg is no longer psionically active. Some take this as a challenge to develop the correct interface that will allow a brain to express its psionic powers, while others argue that psionics must require the cooperation between organic body and brain. This is being intensively researched at a number of institutes as it relates directly to what makes psionics possible.

Drone: a mobile unit without the logic capabilities of a robot. Drones require regular input from a user with the Remote Operations skill, while a true robot can operate autonomously. Drones have substantial cost benefits but are restricted to speed of light communications with the operator. Drones are commonly used by robots as slave units operating under a single master brain unit.

Dumbot: a robot with minimal int/edu, these are typically reserved for menial tasks or repetitive industrial activity. Typical dumbots include things such as factory automation, janitorial robots, and landscaping robots.

Master/Slave: a master robot is in direct communication with several different simpler robots that are designed to follow commands from a master system. This is usually set up for reasons of cost, where a high degree of sophistication is needed in a few circumstances but for much of the time a unit is in standby or minimal function mode. Drones are the most common slave units for reasons of cost, and are used for things like starship repair, expendable defensive units and long duration missions in space where solar power is available and the duty stations are unappealing. Communication is still limited by the speed of light, so the master unit is always relatively close to the slave units.

Nanobot: also known as nanites, they are a class of particularly small, advanced machines that are built from the atomic level on up to carry out particular functions. Nanotechnology is a distinct set of techniques that do not follow the rules presented in this chapter for robots. They are small enough that swarm behavior and complex interactions between individual nanobots are required for them to express intelligence or reasoning.

Pleasure Bot: a humanoid shaped robot that is designed to give pleasure and comfort to its owner. Often programmed with Steward and high Emotion skill, advanced pleasure bots are said by some to be superior to living companions due to their complete commitment to their owner.

Robot: a catch-all term for a mechanical construct designed to operate without direct sophont oversight. Nearly every race that has achieved adequate technology has developed these types of devices (sometimes to their regret). They have a large number of high-use cases where robots are the most practical choice for a particular application. Other situations may be on a race by race case, where cultural or societal factors may disfavor or encourage robot usage.

Security Bot: a robot designed primarily for observation, warning, and non-lethal subdual of particular individuals. They tend not to have the same armor and weapons load that a warbot has, but instead will try to protect an area or individual initially by warning off a possible enemy and then by calling for reinforcements and trying to drive them off physically. Weapons will tend to be non-lethal items such as tear gas, stunners, stunsticks and the like.

Warbot: a military robot designed for killing. They often use high tech weapons and serve as elite assault forces spearheading a major assault. Casualty rates of the spearheading units are typically high, and commanders interested in reducing the loss of life will often want their mechanical forces to take the worst of the losses. Warbots usually lack emotion and certainly have maximum security built in.

Laws of Robotics

1. A robot may not injure a human being or, through inaction, allow a human to come to harm.
2. A robot must obey orders given it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Isaac Asimov, "Runaround," collected in "I, Robot"

Robot 'Laws'

The laws of robotics as promoted in idealized fiction would be a wonderful utopia where everyone got along perfectly and conflict was a burden of the distant past. Sorry, not happening. Warbots or assassin droids aside, conflict is a part of existence and there are limited resources available. Robot designers who fail to take adequate security precautions can have hackers controlling their unit, perhaps subtly subverting the programming to allow an intrusion, or more overtly acting to create a catastrophe itself. Robots, even those with high synaptic brains, are controlled by their fundamental programming to carry out actions. The intent of the programmer defines what an AI considers ethical. Just as people and religions differ in how they define morality, AIs would have the same minimal diversity, if not more extreme given their machine basis. Expecting all sophonts or AIs to think alike and follow the same set of 'laws' is not reasonable.

In addition, the laws of robotics fall apart for cyborg operations. Cyborg brains are organic and are based on the skills and personality of the original individual. They are not programmable directly, although they may be vulnerable to psionic intrusion (if not protected). A racist Reptilian brain would create a racist cyborg with the same skills and mental characteristics (Int and Edu) as the original Reptilian. A mechanical body may give them new physical capabilities, but it would not change the nature of their personality.

General Approach to Robots

In most ways, robots are a cross between characters and vehicles and these rules are designed to accommodate this. For skills, characteristics, combat, personalities, and the like, robots typically follow character rules. In combat, for example, they use personal instead of vehicle combat rules (with the exception of damage). In terms of movement, they tend to behave more like vehicles with a small maximum capacity. Robot sizes overlap with the smallest vehicles at the quarter and half ton sizes. A large robot or small vehicle controlled by an AI are nearly indistinguishable. Because robots don't feel pain, they take damage more like a vehicle where particular systems or appendages are damaged and unavailable. Repairs generally use the Robotics subskill under electronics, although specific devices might be repairable using other skills (sensors, mechanic, etc) at the referee's discretion. Typically small vehicles are cheaper than their robot equivalents, although they do not have the same design flexibility.

In terms of intelligence, robots create a somewhat unique set of issues for the referee. Artificial intelligences, or AIs, are by definition intelligent, yet are not generally considered life forms. Neural Activity Scanners (NAS) or psionic 'life' detection abilities that can distinguish living organisms based on their thought patterns offer a hybrid that is difficult to integrate. Under the Cluster RPG rules, since NAS and life sensing are able to determine different levels of consciousness it makes sense that they could detect an upper end AI as such and distinguish it from a cat or a child. Because of its quantum electro-mechanical nature, however, AIs are not susceptible to psionic manipulation such as project thoughts. They are also not affected by weapons which affect the mind, although they are susceptible to EMP attacks unless properly shielded. These limitations seem to be related to the inability of AIs or cyborgs to use psionics of any sort, although a complete understanding of the phenomena is not known. Using a similar logic, cyborgs cannot be reprogrammed but they have an organic brain and therefore can receive telepathic thoughts and be influenced telepathically. Cyborg brains are not affected by EMP pulses, but cyborg bodies are vulnerable there. Perhaps artificial intelligence is simply alien in ways that organic scientists cannot fully comprehend (and robot scientists aren't telling).

Robot Characteristics

Robots use 4 of the same characteristics used to define sophonts- Str, Dex, Int, and Edu. These are determined during the construction and design of the robot and will be greatly affected by the tech level and price point of the unit. Psionics have never been incorporated into any artificial machinery directly even at the highest achieved tech levels. Technology has been able to interfere with or enhance psionics, but not duplicate its effects. Endurance is based entirely upon the power available to the robot and unlike sophonts robots simply cannot function without sufficient power. Finally, robots are generally considered property and therefore have a social standing of 0. Any society that awards 'human' rights to artificial intelligences or cyborgs, however, could allow robots social and legal standing, perhaps even high standing.

C-3PO: I do believe they think I am some kind of god.
Han Solo: Well, why don't you use your divine influence and get us out of this?
C-3PO: I beg your pardon General Solo, but that just wouldn't be proper.
Han Solo: Proper?
C-3PO: It's against my programming to impersonate a deity.

Star Wars: Return of the Jedi

Purchased robot characteristics are limited by the tech level of the robot. Int and Edu have a maximum score of the tech level, and thus at TL12 may not have an Edu or Int score over 12. Str and Dex may also be purchased up to the tech level, but have several other considerations. Robots receive bonus Str due to chassis size at a rate of 1 point per 50 kg up to 500kg. Wrestling a vehicle sized robot is a fool's game. Bonus Dex due to tech level accrues at 1 point per TL above 10. Int and Edu are limited by the capabilities of the computer and the credstick of the purchaser.

Robot Skills

Robots perform actions analogous to skills of player characters. Skills are purchased at the time of robot construction and the total skill points of a robot is limited to their Int and Edu. Skills may be bought for the same number of points used during the character creation process and cost the same amount as a skillsoft and require the same minimum tech level. Level-0 skills cost 1 point and 1 kCr available at TL7, Level-1 skills cost 3 points and 4 kCr available at TL9, Level-2 skills cost 6 points and 12 kCr available at TL11, and Level-3 skills cost 10 points and 40 kCr available at TL 13. Only TL15 robots may have a single Level-4 skill which costs 15 points (100 kCr) and is thus the only skill the robot may have. Robots through at least TL15 may not purchase the Jack-of-all-Trade skills, but a more sophisticated brain may be able to handle that level of flexibility. In general, robots tend to have a few specialized skills that they were built to perform very well. Skills may be changed and upgraded later, but it is usually cheaper to simply buy a new robot than to substantially change the hardware and software needed to perform different tasks. Hacked robots that appear normal but perform differently are another matter.

DAVE: Open the pod bay doors, Hal.
HAL: I'm sorry, Dave. I'm afraid I can't do that.
DAVE: What's the problem?
HAL: l know that you and Frank were planning to disconnect me, and I'm afraid that's something I can't allow to happen.
DAVE: Where the hell'd you get that idea, Hal?
HAL: Although you took very thorough precautions in the pod against my hearing you, I could see your lips move.

2001: A Space Odyssey

Robots have two additional 'skills' that are not included in the general skills list and relate to how they interact with sophonts. They are chosen separately from other skills of the robot and have the same number of available points, although not all points need to be used to reduce the cost. The Interaction skill defines how robots communicate with others whether human or robot. The Emotion skill defines how well they can respond to or demonstrate emotion. If no interaction skills are present, robot functions are only able to be altered through direct programming changes (Robotics subskill under Electronics) through a required hardware interface which can affect all robots (although the port might be difficult to access). Cyborgs, as they are essentially mechanical bodies slaved to an organic brain, have the same skill sets and personality that the brain had before it became fused to the technology. Cyborgs do not have Interaction or Emotion skills. Note that the less sophisticated a robot's brain is the lower its ability to interact with others. Drones have no brains since they depend upon remote commands and therefore have no need for emotion or interaction skills. Interaction and Emotion Skills are purchased at the same price as other skills.

Interaction Skill

The Interaction 'skill' refers to how well a robot can understand verbal commands. If commands are not able to be input without direct access to the hardware, there is very little outside interaction can do to change a robot's behavior. Robots such as warbots tend to be isolated from outside access to prevent hacking attempts. Skill level 0 in interaction allows a unit to follow a small list of verbal commands it understands and gives it access to 3 subskills. Command subskill level 1 gives a more complete list of commands that may be followed, while command subskill level 2 allows full interpretation of complicated verbal commands that require logical connections to be made. The Hierarchy subskill determines who may give a robot orders. A skill of 0 in interaction allows anyone to command the robot. Skill 1 allows only a restricted set of users to issue the robot orders, and Skill 2 gives the robot a higher level of security against unauthorized commands (-4 DM to override commands without authorization). The Master subskill under Interaction allows an AI to control multiple slave robots. Each skill level of Master allows a robot to control 5 separate slave robots at a time although any number of robots may be on automatic.

Emotion Skill

The Emotion skill is what allows a robot to act more alive and understand or mimic sophont emotions. Robots without this skill are automatons and are very boring to interact with and take even obvious commands literally. A skill level of 0 allows a basic recognition of emotion based on interactions and respond to them, but do not allow the robot to express an emotion. It is very easy to fool low level AIs emotionally (+4 DM to deception related to emotions). Skill 1 allows a robot to recognize even complex emotions and express their own set of basic emotions, although not in a completely realistic way (+2 DM for deception skills against the robot- the robot has no ability to emotionally deceive). Emotion-2 allows a sophont-level of emotional recognition and expression, making it very difficult to distinguish from a living organism at this level. This level allows robots to deceive sophonts and other robots emotionally as well as recognize deceptions with no modifiers. Emotion-2 with a deception skill would allow a robot to lie very convincingly (a useful skill for certain specialized robots). Note that to use the emotion skill well a robot must also be able to understand complex spoken words (command-2) and this combination requires 12 points, so emotionally convincing robots only appear around the tech level cyborgs become possible.

> They drive me crazy with their 'Marvin close the door'
> Well isn't it enough to make you 'tidy up the floor'
> You know it spoils a robot's day
> 'Marvin when you're finished you can put yourself away'
> I'm going to flip my lid
> They treat me like a kid
> Robot naughty, robot bad
> Robot happy, robot sad
> Who's a clever robot lad?
> It would drive a human mad
> *"Reasons to be Miserable" (His Name is Marvin) by Stephen Fry*
> *Created by Douglas Adams, Hitchhikers Guide to the Galaxy*

Why Do Drones Exist?

Given the extensive advantages of robots over drones, why do drones even exist? One reason is cost. Robotic skills can substantially increase the cost of units over a simpler remote unit. For many applications, a remote brain is simply unnecessary to carry out the primary function of the unit. A probe drone, for example, is controlled by software and personnel running on the ship which launched the unit. It will often be sent into a dangerous area. An artificial intelligence programmed to protect its own survival might object to being sent into a hostile location. Probes are more expendable when they are cheaper.

A second use for drones is when an AI may be detected based on thought patterns. NAS and psionics both can find thoughts in areas or register an anomalous 'mind'. Stealth shielded drones without true intelligence may be more able to sneak through such detection methods (although they may be detected by other devices). No technology comes without a possible way to identify or circumvent it.

Robots in Combat

Most robots are not designed for combat and will use their vast computer intellect and human-level intelligence to get out of the line of fire. Other robots carry heavier armor than a marine in full battle dress and charge relentlessly into battle. As robots are in many ways a cross between a sophont and a vehicle, their rules for combat are also a hybrid. Robots act in personal combat and their weapons are always on the personal scale rather than vehicular scale. Robots do not have a heading, and armor protects all directions equally. They operate in the personal combat time frame, where a round is about 6 seconds long. They act on a personal initiative modified by the robot's dexterity, and may take reactions at the standard penalties according to their understanding of the situation.

Robots also have a stability score which depends primarily upon their chassis structure. Failing a stability check causes the robot to topple over or be out of control for a round if toppling does not make sense. Every time a robot is damaged beyond its armor it makes a stability check. If the stability check is failed, the robot topples over or ceases functioning for 1 combat round. It may then make another stability check to regain control and start operating again. Once it recovers its stability the robot functions normally using any surviving systems. Unlike sophonts, robots do not feel pain when their arm gets blown off.

When a robot is struck in combat or takes damage for any reason, damage is first reduced by armor. If the armor is tough enough, damage may be reduced to 0. If some damage gets through, half of the time it will destroy the armor of the unit on a point for point basis. If armor is not chewed away, the robot takes damage to its structure on a point for point basis. When structure is reduced to 0, the robot is non-functional. The referee is encouraged to make robot damage as cinematic as possible (ie. sparking wires, gaping holes with internals visible, etc), but individual system losses are not detailed individually. Unlike vehicles or spacecraft, robots are more singular units and often small enough that any hit which penetrates armor can be lethal.

In the case of cyborgs, when the structure reaches 0 there is a 50% chance that the organic brain was killed when the robot was terminated. If the brain is rescued within 6 hours it can survive to be re-embodied, otherwise the brain dies.

Robot Construction

As with all machines, robots require time to build. In general, robots take 1 day per 3000 credits to build. They must be manufactured in a system with the appropriate infrastructure, although slightly more advanced features may be included. Systems may construct robots one tech level higher than that of the system due to imported parts. Thus it is possible (but not common!) for experimental robots to be built using state of the art techniques one level above those generally available. Such robots typically cost 10x their normal price due to their experimental nature and hand built equipment. Note that TL16 robots would only be found in experimental situations and not available for most purposes.

Steps to Build a Robot

1) Chassis Selection
2) Appendages (if desired)
3) Locomotion (if desired)
    choices here will force a minimum required power plant
4) Power Plant (if desired) and fuel
5) Armor (if desired)
6) 'Brain' and skills
7) Sensors
8) Weapons
9) Other Devices and Cargo

Chassis

Chassis come in 3 major size categories, but these categories are more bookkeeping than functional. Category A begins at 5 kg and increases by 5 kg up to 50 kg. This category represents the robots smaller than typical adult humans (although the upper size limit does overlap with small adults). Category B starts at 60kg and increase by 10 kg up to 250 kg. These cover the average to large sized sophonts and are perhaps the most common models. Category C covers 275 kg up to 500 kg by 25 kg and includes more industrial scale robots. These overlap with small vehicles in size and could perform many of the same functions as vehicles. Robots, however, allow a much higher degree of specialization (particularly in programming) that cannot be equaled by vehicles.

Robots come in a variety of basic shapes that will influence future design options. Most industrial robots can have whatever shape is appropriate, often a box, cylinder, or dome. Wedge and cone robots have the advantage that they may be streamlined to increase their speed (at the space expense of requiring appendages and other equipment to be retractable). Biologically shaped robots are inefficient and quite expensive relative to other types of chassis. They do, however, allow the use of additional equipment not included in the basic design of the robot that is intended for use by sophonts of a similar shape. Naturally the appropriate skill must already be programmed into the robot to use the additional equipment. Chassis costs for biological robots that have natural texture and behavior (ie. bleeding, flexibility, etc) cost 3x as much and only appear at TL12, but are challenging to distinguish from the real thing by appearance. They are, however, very constrained as to armor or the like. Each shape has a base stability that serves as a target for a 2d6 check each time the robot is damaged. Stability is checked each time the unit is seriously impacted, either through combat damage, collision, or other forceful interaction.

Robot Shape Modifier Table

Robot Shape	Streamlined	Price Mod	TL	Stability	notes
biological	no	x10	9	6	able to use equipment, 10% less armor
box	no	x1	5	7	
cone	maybe	x1	5	8	lose 10% of volume due to shape
cylinder	no	x1	5	7	
dome	no	x1.5	5	9	
sphere	no	x2	7	10	
wedge	maybe	x1.5	5	8	

Chassis Modifications

Robots have a number of features in common with vehicles beyond how they interact with the world. Protective measures such as environmental sealing are invaluable to a machine underwater or exploring a corrosive atmosphere, for example. Note that vacuum sealing, by itself, is not essential- robots other than cyborgs do not need oxygen, but there are hazards in space which vacuum sealing helps to mitigate. Chassis modifications are usually protective features or enhance the capabilities of other components.

amphibious drive: ground robots may have a second drive added to their basic design which allows them to move at 1/3 speed through the water. This addition doubles the size and cost of the drive due to complexity.

corrosive environment protection: protects unit against heat, cold, radiation, submersion, EMP and corrosives and requires at least a standard hull.

hostile environment protection: protects unit against heat, cold, water submersion and radiation

insidious environment protection: protects against heat, cold, EMP, radiation, corrosives, submersion, and insidious environments. Requires at least a heavy hull and is the best environmental shielding available.

hydrofoils: may be applied to any aquatic surface robot and provide pylons for lifting most of the hull out of the water to reduce friction. Hydrofoils increase the chassis price by 300%, and multiply the base speed of the vehicle by 2 but decrease stability by -2. Hydrofoils may not be combined with streamlining, submersible or wave piercing hulls.

offroad: Ground transport robots may be enhanced to travel over difficult terrain more easily. This costs 50% of the base value of the drive unit and gives a +2DM to all movement on all non-easy terrain. It does not add weight to the robot, but it does reduce the maximum speed by 10%.

pontoons: This allows an aircraft to land and take-off from water. It costs Cr10 per kg of pontoon, 8% of the robot's chassis space, reduces the Base Speed by 10%, gives -1 DM Stability and breaks streamlining. Water movement is at 1/2 the rate of an equal screw propeller.

streamlined: requires no external appendages or weapons and either a wedge or cone shaped chassis. It uses an aerodynamic or hydrodynamic hull to increase the maximum speed 3x over normal. May be combined with environmental protection.

stability: weight is kept lower down in the body and extra gyros are available to maintain orientation

Submersible: Submersible may be applied to any grav or screw propeller unit to allow travel underwater. Screw propellers move at full speed underwater, while grav drives move at 1/5 of their maximum airspeed. The Submersible configuration option increases the chassis price by 500% and may not be combined with streamlining. Submersibles are rated by their Safe Dive Depth and Crush Depth, as determined by the robotl's Tech Level and chassis. These values are calculated for a Size 8 world and standard chassis. For every point of world size difference, up or down, add or subtract (respectively) 10% from the Safe Dive and Crush Depth values. Light Chassis reduces both depths by 20%, while heavy chassis increases them by 10% and extra heavy increases them by 25%. All submersibles require at least Hostile Environment Protection. Self sealing may be purchased separately (but is recommended). May not be combined with wave piercing hull, hydrofoils or pontoons.

Table: Submersible Safe Dive Depth and Crush Depth by Tech Level

Tech Level	Safe Dive Depth (m)	Crush Depth (m)
5	50	150
6-8	200	600
9-11	600	1800
12-14	2000	6000
15+	4000	12,000

wave-piercing hull: the shape of the hull causes the robot to skim more along the surface. Interface friction is much reduced, allowing the robot to be more efficient, increasing its base speed by 50%. The wave-piercing hull uses 3% of a robot's space and costs 50% of the chassis price. Wave-Piercing hulls may not be combined with hydrofoils, submersible or streamlining.

vacuum environmental protection: provides similar benefits to hostile environment protection, but adds the capability to work in trace or vacuum atmospheres. Requires at least a standard hull and is particularly useful for space based robots.

Chassis Modification Table

modification	TL	weight (kg)	Cost (Cr)	Effect
amphibious drive	6	100% drive	100% drive	allows water movement at 1/3 ground
corrosive env prot	9	6% chassis	30/kg chassis	protects against corrosive environments
hostile env. prot	5	2% chassis	10/kg chassis	protects against hostile environments
hydrofoil	7	0	300% chassis	+100% speed, -2 stability
insidious env prot	10	8% chassis	40/kg chassis	protects against insidious environments
offroad	4	0	50% chassis	+2DM for non-easy terrain, -10% max speed
streamlined	6	0	300% chassis	3x faster for some shapes w/ thrust drives
stability +1	9	3% chassis	50% chassis	+1 stability
stability +2	11	6% chassis	100% chassis	+2 stability
stability +3	13	9% chassis	200% chassis	+3 stability
submersible	5	6% chassis	500% chassis	allows underwater travel
wave piercing hull	6	3% chassis	50% chassis	+50% speed
vacuum env prot	6	4% chassis	20/kg chassis	protects against vacuum environments

Chassis may be constructed in different strengths to provide more or less protection to the robot. Light construction is least expensive and is relatively weak, and cannot have any chassis modifications or armor added to it. Standard construction may have up to 5% added armor and any environmental protection except insidious. A heavy chassis may have up to 15% additional armor included, and extra heavy chassis may have up to 25% additional armor. To appear normal, biologs may only have a light or standard chassis. Heavy and Extra Heavy chassis appear clearly artificial. Armored biologs do not benefit from wearing armor- only their strongest armor counts although every robot has 'inherent' armor based on its tech level. Inherent armor DOES stack with outside armor, whether added or worn.

chassis type	Cr/kg	max armor	kg/pt structure	chassis space used
light	4 Cr	no added	25	0
standard	6 Cr	5% added	20	0
heavy	8 Cr	15% added	17	5%
extra heavy	10 Cr	25% added	14	10%

Robotic 'Brains'

Every robot requires synaptic circuitry to carry out the essential processing and storage for it to function. More primitive brains have only minimal capacity and therefore can only obtain minimal skill levels. As processors become more sophisticated they can store more skills and function at higher levels. Linear processors function sequentially which sets an upper limit on their speed. Adding more processors help, but the number of processors speeds things up linearly. Quantum computers provide a level of parallel processing, where a given processor can make more than one calculation at the same time. Synaptic processors speed things up yet again, by increasing the interconnections between the various processors. High synaptic is a modification of synaptic processing where the number of connections increases exponentially, allowing many more inputs and outputs into equations and allowing multiple solutions to be tested simultaneously. At all of these levels the storage available to the robot for data is massive enough that storage is not a major limitation for the 'brain'-the processing capacity is what prevents early robots from going beyond skill level 1. Note that by skill level 3 robots are as good as an excellent sophont at what they do, and given that they will also have a high Int and Edu it is quite likely that they will be able to outperform their living counterparts within their area of expertise. Robots have fewer skills available than most starting characters, though, which makes them particularly good at a restricted set of options.

Int and Edu are determined by the tech level of the computer used to run the robot. A hand computer weighs 1 kg at all tech levels and requires only a power level of 1 no matter what model is purchased. Skills are programmed into the robot's computer and cost the same as a skillsoft designed for a datajack. Companies that provide skillsofts are the same as those that write programs for robots, so it makes sense that prices are similar. The same computer handles normal character skills as well as the robot specific Interaction and Emotion skills. A robot with a lot of high level skills tends to be quite expensive, and often the computer and skills cost more than the rest of the robot hardware combined. Drones and cyborgs make a lot of sense as radio comms or even brain housings are far less expensive than a high end computer with expensive skills.

Computer Table

model	TL	cost (Cr)
0	7	100
1	9	400
2	10	800
3	11	1600
4	12	3000
5	13	5000
6	14	12,000
7	15	25,000

Cyborgs are fundamentally different than computerized robots in that they use an existing brain to become part of the machine and drive its functions. The intelligence, education, and skills of the brain used to make the cyborg determines its capability when the machine is built. Some societies will actually train a potential future cyborg from birth to have a particular set of skills. A cyborg brain support system takes up 10 kg, costs 25,000 Cr, and requires refreshment of the nutrient broth it lives on every month. Each extra kg of storage costs 50 Cr and can hold enough nutrient broth for 1 month. Nutrient broth costs 300 Cr per month and may be manufactured by any TL8 food processing facility. Note that a cyborg which is not environmentally sealed is still dependent upon oxygen for the brain to survive and is subject to suffocation just as any other sophont. Environmental sealing of any type is assumed to provide oxygen for a cyborg. If provided sufficient nutrients and oxygen, cyborg brains may be maintained nearly indefinitely and are considered a form of partial immortality by some.

Robot Locomotion Table

Locomotion Type	min TL	type	space mod	price mod	stability	surface
wheels	2	contact	x1	x1	+1	ground
tracks	4	contact	x1	x2	+2	ground
mole	6	contact	x2	x8	+4	
sphere	8	contact	x2	x2	+4	ground
appendages	8	contact	x2	x4	-1	ground/water
screw propeller	3	thrust	x1	x0.1	+1	water
air cushion	7	thrust	x1	x0.5	-1	ground/water
rotor	4	thrust	x2	x.5	-1	air
jet	5	thrust	x2	x2	0	air
hypersonic	8	thrust	x1.5	x4	-1	air
grav	9	thrust	x1	x1	0	air/water
advanced grav	12	thrust	x0.75	x2	+1	air/water
extreme grav	15	thrust	x0.5	x4	+2	air/water

Locomotion

Note that some robots such as Autodocs cannot move; locomotion is not a requirement. This reduces the cost of the robot but is a design choice made at the time of construction. Terrestrial movement include legs, spheres, wheels, tracks, and air cushions. Appendages are less stable than wheels or tracks but are required for biologs and may be used for swimming (if the appropriate skill is purchased and hostile environmental protection is supplied). Note that robot speeds are substantially less than vehicle speeds in several cases; robot units are often less powerful and smaller than the similar vehicle forms.

Wheels are the cheapest option for movement, but they do not do as well in rougher terrain. 4 wheels are assumed, but additional wheels may be added to increase stability by +1 per pair. Each additional pair of wheels adds 25% to both the drive price and space. **Tracks** provide better stability and offroad movement than wheels but are more expensive, require 30% more power and have a lower top speed. **Spheres** may roll as wheels do, but must have all appendages fully retractable in order to move in this fashion. Space for sphere locomotion must still be purchased to allow the rolling to take place.

Screw Propellers are only relevant for aquatic robots and so are rather restricted in their use. They are far less expensive that gravitic propulsion, however, and are appropriate for robots that operate in water. Water worlds, for example, often have screw driven robots.

Underground movement for robots use a **Mole** type drive. Mining robots, rescue bots, or certain types of construction robots all have very good reasons for wanting to travel through solid material. Such movement is particularly slow, however, compared to any other method.

Flying robots come in several varieties, including **appendages, jets, rotors,** and **gravitic** units. Gravitic movement allows underwater use if the appropriate environmental sealing is applied. Jets and rotors function in an atmosphere, while gravitic flight works fine in a vacuum.

Robot Travel Speeds (kph)

Drive Type	1	2	3	4	5	6
wheels	25	50	75	100	125	150
tracks	15	30	45	60	75	90
mole	.005	.010	.015	.020	.025	.030
sphere	15	30	45	60	75	90
appendages (ground)	7	14	21	28	35	42
appendages (air)	10.5	21	31.5	42	52.5	63
legs (swim) tentacles/tail+fins (swim)	3.5 7	7 14	10.5 21	14 28	17.5 35	21 42
screw propeller	10	20	30	40	50	60
air cushion	25	50	75	100	125	150
rotor	50	100	150	200	250	300
vertical rotor (helicopter)	25	50	75	100	125	150
jet	100	200	300	400	500	600
hypersonic	150	300	450	600	750	900
grav	50	100	150	200	250	300
advanced grav	100	200	300	400	500	600
extreme grav	150	300	450	600	750	900

Moving robots may sometimes be grappled (using the natural weapons skill, a net, or some other means) by sophonts to restrict their mobility. In these cases, simply add the mass of the sophont(s) to the robot and recalculate movement accordingly. If the robot is powerful enough to move both (ie. movement score greater than 1), speed is reduced but the sophont(s) moves with the robot. Fair warning: grappling flying robots may be hazardous to one's health.

Drive unit cost and size varies depending upon whether it is a thrust or contact based drive. Contact drives such as wheels or tracks are 1.3% of the chassis size per speed level and cost Cr 100 per kg. Thrust based drives are slightly smaller at 1% of the chassis size per speed level but are much more expensive, costing Cr 5000 per kg. Lower tech thrust drives such as rotors and screw propellers make up for this high cost somewhat by having a small cost modifier. Drive units for thrust based robots and drones, however, are often a significant fraction of the total cost of the unit.

Power Plant

All robots require a source of power. As only higher tech societies can build robots, only higher tech power plants are considered here. Power plants must be able to provide energy for the regular needs of the robot (with the exception of energy weapons which require their own power packs). Biological robots may use the equipment normally usable by that race if the appropriate skill is purchased. As smaller engines are generally less efficient than larger ones, robots use twice as much fuel (10%/ day base) as their vehicle equivalents. Locomotion also takes up a substantial percentage of the overall output of the power plant. If a robot is stationary, it may use the power grid of the planet or system to which it is attached, or it may have its own backup power system which operates when the main power source is interrupted. Robots that require mobility but never move too far from their base may use a rechargeable battery instead of an independent power plant. A battery of the given size and power level will power a unit for 6 hours. Batteries may be scaled up or down in size to lengthen or shorten their endurance, and units have the opportunity to power down systems to extend battery life. Recharging takes 1/2 the time the robot was active.

In order to calculate the power needs of the robot, the desired travel speed and type of movement are first determined. Power plants scale up in size based upon the size of the robot and the amount of power they are expected to deliver. Note that fusion power plants have significant size limits on how small they can be even at high tech levels. Early fusion plants are too large for the majority of robots and are not an option. While fission power at first glance would have major size disadvantages, radioactive decay can be scaled down to extremely small amounts and is very cost efficient. The space programs of Earth use atomic batteries because of their long life and fuel efficiency. The base size of the power plant is determined according to the power plant table as modified by the modifier table above and the power level (see below). Power plants have a base cost of Cr35 per kg.

Robot Power Plant Modifiers

Plant Type	TL	Space mod	Min size	Price mod	Fuel mod	Fuel price/kg	Fuel type
Internal Combust	4	x3	none	x.25	x3	20	hydrocarbon
Gas Turbine	6	x2	none	x0.5	x3	20	hydrocarbon
Fission	6	x2	none	x2	x0.04	1000	radioactives
Closed Fuel Cell	7	x1.5	none	x2	x25	1	hydrogen
Open Fuel Cell	7	x1	none	x1	x4	1	hydrogen
Fusion	12	x0.75	80 kg	x1	x0.75	1	hydrogen
Advanced Fusion	15	x0.5	20 kg	x2	x0.5	1	hydrogen
Battery-5	5	x6	none	x2	0	0	n/a
Battery-8	8	x3	none	x2	0	0	n/a
Battery-10	10	x1.5	none	x3	0	0	n/a
Battery-12	12	x0.75	none	x4	0	0	n/a
Battery-14	14	x0.5	none	x5	0	0	n/a

How long a robot may stay active is determined by the amount of energy they have available to them. This is limited by the amount of fuel or the size of their battery. Keep in mind that mechanical power plants (internal combustion and gas turbine) are somewhat noisy. While they are clearly effective at delivering enough power to move robots and drones even today, a humanoid emitting clouds of smelly exhaust will not be very realistic.

Table: Power Plant Size per Power Level

Power Level	Base Percentage of Chassis
1	2%
2	3%

3	4%
4	5%
5	6%
6	8%

The means of locomotion also take up a certain amount of a robot's body. For all types of locomotion, those systems take up a base 1.5% of the robot's chassis size per speed class and a base cost of 25 Cr per kg for contact based drives and 800 Cr per kg for thrust based drives.

Appendages

Appendages are also optional for robots as some designs (recon robots, for example) do not need manipulators. Appendages come in 5 different types: heads/turrets, arms, wings, tentacles/tails, and legs. Non biologs will usually have manipulator arms or turrets that do not appear natural but may function in appropriate ways. Biologically inspired robots will have whatever combination of legs, arms, etc which are appropriate for that organism. Wings are available for any biolog, but they must mass at least 30% of the entire robot. Flight doubles the size of the appendage drive and costs 4x as much (legs would be in addition to this price). Adding a tail to a swimming robot costs the same in credits and size as legs, and both can be taken. Note that a prehensile tail not used for moving through water would be better considered a tentacle. Limbs that may be used as either arms or legs and are counted as legs for movement but the drive costs 100% more due to the increased functional requirements. Streamlined robots require retractable appendages or popup turrets in order not to break streamlining. Note that appendages do not add costs to the chassis directly- these costs are included in the base chassis, strength, and dex features purchased. The drive price assumes standard legs are moving the robot, but other types of movement are possible at increased cost.

Robot Appendage Values

Type	min #	min %	typical #	typical %	max %
turret	1	5	1	10	35
popup turret	1	10	1	20	40
head	1	5	1	8	25
arm	1	5	2	7	35
retractable arm	1	10	1	14	35
extended arm	1	10	1	14	35
leg	2	15	2	28	40
prehensile leg	2	20	2	32	40
tentacle	1	5	2	7	35
retractable tentacle	1	10	2	14	35
extended tentacle	1	10	1	14	35
tail	1	20	1	25	40
wings	2	30	2	40	60

* the torso requires at least 30% of the chassis mass

Strength and Dexterity are characteristics that must be purchased separately for each robot. Robots have a base Str of 1 per 50 kg and a base Dex of 1 per TL greater than 9 (ie. +1 at TL10, etc). Each may be purchased up to the tech level of the robot. Small class A units have a maximum strength of 5 + 1 per 5 kg of size, so that at 25kg a robot may have a Str of 10 and by 50kg their strength is entirely limited by their tech level. Additional Strength and Dexterity each cost 1% of the chassis size per point added up to the maximum of the robot's TL. Costs increase as chassis cost * 5% * the partial sum of the number of points (calculated separately), where the partial sum is 1+2+3+...n and can be calculated as n*(n+1)/2. So for a robot with an added Str of 9 and Dex of 12, Str costs 9*10/2 = 45, so 225% of the chassis cost, and Dex costs 12*13/2 = 91, so 455% of the chassis cost. Together, the Str and Dex would use 9+12=21% of the chassis size. High ability scores get expensive, particularly for biologs and their already costly chassis. Both added strength and dexterity take up chassis space, and whether the space is found in a limb or within the torso to drive a nearby limb is immaterial.

In all cases, strength is distributed proportionately to the body plan while dexterity is treated essentially the same for each limb. Some body plans (an octopus, for example) will have most of their mass in their limbs. In terms of the game, 'torso' hits still affect structure while 'appendage' hits damage or destroy extremities. The referee is encouraged to make the effects of the damage cinematic (ie. sparks are flying from the severed arm of the octobot) and potentially functional restrictions as well.

Great strength does not mean that a robot has great leverage. Cargo robots need to accommodate leverage and strength (as well as locomotion) when attempting to move heavy loads. Winches and arms/tentacles may be used to provide the robot with leverage when moving things heavier than the robot itself. A light crane is able to move a standard 1 ton palette, but the center of mass must be kept very near that of the robot.

Wings pose a significant problem for any robot. Two special conditions apply: 1) the robot may have no more than a standard build- even non-biological wings cannot support a heavy robot; 2) a minimum of 40% of the mass must be found in the wings and will thus make up a large percentage of a robot's mass. Most self-powered flight is on the slow end for flying organisms, and therefore requires a larger surface area per kg than a fast moving object. Man-sized fliers are scientifically very challenging to design and would require huge wings. Fortunately science fiction is less demanding. For non-biologs, grav power is so much simpler and more efficient that wings become doubly unnecessary.

Legs must be stronger than arms in most sophonts because legs generally support the body and must move the mass of the robot. Appendages used for movement must use at least 20% of the chassis mass as part of the drive components which allow them to be used for walking and/or swimming. Additional legs beyond 2 may increase the stability of a biolog by +1 per pair of legs, rounded up; ie. a 3 legged robot would gain +1 stability. Note that like other appendages, this mass refers to the distribution of mass for the robot and does not actually use the limited chassis size. 1 leg or 1 tentacle may not be used for movement.

Biologs intended for swimming require either legs, tentacles or fins/tail. Fins and tail increase the maximum speed x3 compared to leg swimming but do not provide movement on land. Tentacles are twice as efficient at swimming as legs and also move fine on land as well. Prehensile legs may work as arms or legs and work for swimming just like other legs do. Swimming biologs also require hostile environment protection or better to withstand extended submersion in water. Normal robots have a general protection against water that lasts for a short dunking or rain, but swimming places more stress on the robot.

Human biologs require very specific ratios of body parts to look 'normal'. While there is always a certain amount of variation between individuals, those with proportions outside of these ranges look odd or deformed. Healthy adult humans mass anywhere from about 40 kg (very small woman) to 180 kg (large man), although children can be smaller and hugely obese individuals can be larger. Heads take up ~ 7-10% of a body's mass, arms mass ~ 10-16%, legs use ~22-30% of the total mass, with the torso or trunk making up 45-55%. Note that if one part of the body is proportionately larger, other parts must be proportionately smaller to make up 100% of the total mass. Non-human biologs have very different ratios, numbers of limbs, etc. and each must be chosen according to the body plan of the organism. Horses, for example, have forelegs of 6-8% each, hindlegs 7-9% each, and the head+neck masses 8-12%. Body segment information is somewhat difficult to obtain for many organisms, so designers should take care to keep biologs within reasonable limits.

Heads may vary somewhat in size, although large heads will usually be too large to be retractable. Heads work as an independently directed appendage which can face a different direction than the rest of the unit (acting in most ways like a vehicle turret). It is an excellent location for a small weapon or directional sensors as they can be turned without reorienting the whole unit. As most sophont brains are located in the head, some designers will not place the robot brain there as it is a common target for aimed shots. Other designers will intentionally put the brain in the head as it is the least likely place to be hit on the hit distribution table.

Armor

For security droids or warbots armor is a critical feature, while for other robots it is an afterthought. All robots have an outer covering made of some material which adds an inherent 5% 'armor' material depending upon the tech level of the robot. Biological robot forms may only have a light or standard chassis if they are intended to appear indistinguishable from the natural biological form. This will limit them to having a total of 10% of their chassis weight as armor. Humanoid shaped robots without a natural appearing outer skin may be constructed with a heavy or extra heavy chassis, and as such can have the full amount of armor but lose any resemblance to the natural organism. When calculating price, 'base' refers to the base chassis cost (build modifier, size, and shape).

Applique Armor (TL4): This armor is essentially plates of ceramics, sand, metals, and other fibers added to the outside of a drone or robot which disperses incoming damage. Each time the robot is hit, one charge of applique armor is used and damage is reduced by 5 points before it reaches the armor. Applique armor may be applied to any robot with standard or better build and at least 1 point of added armor and takes 6d6 minutes per charge to replace. Each charge takes up 0.5 kg per 10 kg of robot, costs Cr20 per kg and breaks streamlining.

Reactive Armor (TL 7): This armor uses explosive charges to reduce the armor penetrating ability of kinetic weapons. It is not effective against beams or energy weapons. When activated by a kinetic strike sufficient to penetrate the armor, the damage from the incoming projectile is reduced by 10 points to a minimum of zero. This uses 1 charge. A vehicle may have any number of reactive armor charges, but only 1 charge may be used per hit. Each charge takes up 0.25 kg per 10 kg of robot. Reactive armor costs Cr50 per space and it takes 2d6 minutes to replace a charge. If all charges are expended, reactive armor provides no additional benefit. Reactive armor breaks streamlining.

Robot Armor Types

Armor Type	TL	Protection	Price	Max
iron (early drone only)	4	2 per 5% of chassis	100% of base	12
titanium composite	7	3 per 5% of chassis	100% of base	18
crystaliron	10	4 per 5% of chassis	200% of base	24
superdense	12	5 per 5% of chassis	350% of base	30
bonded superdense	14	6 per 5% of chassis	500% of base	36

Sensors

Sensors are what allow a robot to detect the outside world. Sensors cover all 5 of the human senses but may include everything from radar to neutrino detectors to neural activity scanners. As robots operate in many different environments they may need specialized equipment that can be easily adapted from personal equipment available to any sophont (with enough credits). Robots also tend to mix in smaller forms of sensors found on certain vehicles, such as sonar, that is not supported by any personal equipment. This ability to mix personal and vehicular equipment is one of the features which give robots a unique place in the universe. All sensors record the information- this is how the robot knows things, after all.

The 5 major types of sensors detailed below have 5 levels of sensitivity and increase with increasing tech level and cost. All of the sensors other than haptic sensors (which take up 2% of the chassis size) take up 0.1 kg. Coarse sensors cost the base amount, basic sensors cost 3x base, standard sensors 6x base, fine sensors 10x base, and extra fine sensors 15x base cost. Depending on the sensor type, they become available at different tech levels and at different base costs. Not every robot requires high end sensors- cargo robots have little need to taste or smell anything, but basic haptic sensors to determine how tightly a cargo is held would be useful.

The primary functions of the robot, the tech level, and naturally the cost will determine which sensors are present.

Audio sensors cost a base 100 credits and measure vibrations in the air produced by various measures. Coarse (TL4) sensors are minimal fidelity, basic (TL5) is higher quality, standard (TL6) refers to approximately human norm, fine (TL8) is superior to human, and extra fine (TL10) allows discrimination well beyond human abilities.

Directional microphones improve fidelity and volume in one direction at the expense of other directions. TL6

Echolocation uses time differences for a sound hitting 2 different receptors to determine the direction and distance of an object. Passive echolocation requires that a sound be produced for it to be heard, so silent objects are effectively invisible. Speakers combined with echolocation can be used as an inaccurate form of sonar in air. TL6

Laser microphones are able to pick up vibrations from surfaces instead of air, allowing detection of otherwise impossible to hear sounds. TL7

Sonar is a variant of echolocation optimized for underwater use. Passive sonar uses sound produced in the environment, while active sonar uses a sound pulse to detect objects. TL5

Subsonic and **Ultrasonic** detectors extend the frequency to well below or well above human hearing, respectively. The finer the base detector, the more discrimination these sensors provde. TL5

Haptic sensors are used to sense touch and related sensations at many locations. Theyc ost a base 500 Cr and take up 2% of the chassis size. Coarse (TL7) sensors provide minimal touch, basic (TL9) gives more sensitivity and discrimination, standard (TL11) is approximately human equivalent, fine (TL13) allows more sensation and information than humans generally gain, and extra fine (TL15) provides the most information and discrimination possible.

Thermometers (TL4) allow the temperature of an object to be known by touch. Infrared vision can make the same basic determination as well.

Specialty Robot Sensors

Sensor Type	TL	weight (kg)	cost (Cr)
bioscanner	15	3.5	350,000
chemosensor	12	2	7,500
densitometer	11	5	20,000
directional microphone	6	0.5	200
echolocation	7	0.5	1,000
electromagnetic probe	10	.1	1,000
elemental analysis	7	5	2,500
hydrosampler	7	5	3,000
infrared sensor	5	.1	100
laser microphone	7	1	750
lidar	7	2	1,500
magnetometer	7	2	750
mass spectrometer	7	15	25,000
medical scanner	12	2	15,000
metal detector	6	1	300
microscopic vision	6	1	1200
neural activity sensor	14	10	35,000
neutrino detector	11	10	75,000
radar	7	10	10,000
radiation counter	5	1	300
radio direction finder	6	2	1000
sonar	6	10	10,000
subsonic hearing	5	.1	200
telescopic vision	7	2	1,500
thermometer	4	.1	50
ultrasonic hearing	5	.1	200
ultraviolet vision	6	.1	200

Medical Scanner: analyzes the health and physical characteristics of living organisms and compares them to a database of known information. It provides extensive information about the organism being touched but is limited to macroscopic plants and animals. TL12

Olfactory sensors refer to smell, or the detection of chemicals in a gaseous state that interact with the robot at a base cost of 300 Cr. Coarse sensors (TL7) identify strong or key odors, basic (TL9) expands those options, standard (TL11) sensors are roughly human equivalent, fine (TL13) would be equal to a bloodhound, and extra fine (TL15) allows distinctions no biological organism would need to make.

Bioscanner: The bioscanner 'sniffs' for organic molecules and tests chemical samples, analysing the make-up of whatever it is focused on. It can be used to detect poisons or bacteria, analyse organic matter, search for life signs and classify unfamiliar organisms. It is not limited to macro scale observations and can collect information for microorganisms.

Mass spectrometers (TL7) ionize a sample and can give very accurate molecular weights of intact molecules as well as fragments of molecules. It does not work on substances which it cannot ionize.

Nutrino detectors (TL13) analyze subatomic particles resulting from radioactive decay and other natural and unnatural phenomena. They are very specialized and very sensitive for certain types of situations.

Taste Sensors analyze dissolved molecules in a particular liquid at a base cost of 200 credits. Coarse (TL6) allows simple ion or pH detection, basic (TL7) expands that range, standard (TL9) gives approximately human equivalent, fine (TL11) gives much broader sensitivity than humans, and extra fine (TL13) allows extensive identification and quantitation beyond human abilities.

Chemical Sensors are sophisticated elemental/molecular analyzers available at TL13 that can calculate the makeup or concentration of even partially broken down material. (Exploration robots have been heard to chew rock, a rather disturbing sound coming from a robot.)

Elemental Analysis (TL6) is a technique used to identify the elements in a sample as well as their approximate concentration. It does not identify how those elements are interconnected.

Hydrosamplers (TL8) expand upon the basic chemical composition of water and include information about microbes and viruses within it.

Visual sensors use reflected light to identify distance and location of bodies in the environment and cost a base 200 credits. Coarse sensors (TL4) give poor discrimination of color and intensity, basic (TL5) is more complete, standard (TL6) is approximately human recognition, fine (TL8) gives extensive spectral and intensity discrimination, and extra fine (TL10) allows detailed analysis of the visual spectrum.

Infrared detectors (TL5) expand the spectrum of detection to wavelengths longer than visible light. It may be used for heat determination or, with fine or better sensors, some chemical analyses.

Ultraviolet detectors (TL6) analyze wavelengths shorter than visible light.

Lidar (TL6) uses a reflected laser beam to locate objects in the environment and their distance. The sensing laser will give away its origin for any detectors of the correct wavelength.

Microscopic vision (TL5) allows examination of very tiny details down to a minimum of 0.2 microns, about 1/2 the size of a small bacteria. It cannot visualize viruses. Fine or better sensors allow spectral distinctions to be made for phenomena such as fluorescence and luminescence.

Telescopic vision (TL5) allows finer details of distant objects to be obtained. More details and higher magnifications are possible with higher quality visual sensors.

Some detectors do not fall within the 5 human senses, even broadly defined. These include radio waves and other electromagnetic detectors, but also densitometers and neural activity sensors.

Densitometer: The remote densitometer uses an object's natural gravity to measure its density, building up a three-dimensional image of the inside and outside of an object. Note that this device has a much shorter range than the vehicle mounted (or spacecraft mounted) form.

Electromagnetic Probe: This device detects the electromagnetic emissions of technological devices, and can be used as a diagnostic tool when examining equipment (+1 DM to work out the problem with it) or searching for hidden bugs or devices.

Magnetometers (TL7) are more sophisticated than compasses and can measure the strength and direction of magnetic fields.

Metal Detector: Indicates presence of metal within a 3 meter radius (including underground), with the indicating signal growing stronger as it gets closer to the source.

Neural Activity Sensor (NAS): This TL14 device detects neural activity up to 500 meters away and gives a rough estimation of the intelligence level of organisms based on brainwave patterns. The data from a neural activity scanner can be interpreted using the Sensors-Instrumentation skill. This device has a much shorter range than the vehicle version.

Radar (TL6) uses radio waves to locate objects in the environment. This requires a broadcast signal and it is relatively easy to locate the source.

Radiation Counter: (TL5) indicates the presence and intensity of radioactivity within an area. The indicating signal will grow stronger as it gets closer to the source, so the range at which a source will be detected varies depending upon the base intensity.

Radio Direction Finder: (TL6) localizes the emission of electromagnetic radiation by intensity and direction.

Communications and ECM

Communications range from simple, local radios to continental scale meson communicators. All drones require a communication system to allow them to be controlled, but radios are commonly round on robots and cyborgs as well. The simplest, earliest devices are based on radio waves, and are gradually supplemented with satellite dishes, laser receivers, masers, and finally meson communications. Each improvement costs additional credits and takes up additional space. When used in spaces, ranges are at least 100x longer than on a planet. All radios include a transponder that may be programmed or silenced as appropriate.

Radio Equipment				Improved Communications			
range	TL	kg	cost (Cr)	type	TL	kg	cost (Cr)
5km	5	0.25	250	satellite	7	20	500
50km	5	1	500	laser	8	radio	3*radio
500 km	6	2	1000	maser	10	2*radio	6*radio
5000 km	7	4	2000	meson	11	4*radio	20*radio

The ability to trace signals, selectively block unwanted signals, and securely communicate with allies becomes essential as communication becomes more ubiquitous. In the case of drones, an opponent with knowledge of the drone and its basic method of communication may attempt to take control of the device away from its operator. In the case of a security drone, this could have deadly consequences. Electronic countermeasures (ECM) are intended to protect ones own communications or to interfere with smart weapons targeting a robot. ECM requires a separate comms action to use and a failed roll provides an additional signal for enemies to target. Active use of ECM negates stealth coatings.

ECM Table

type	TL	weight (kg)	cost (Cr)
Class A (-1 DM)	7	1	500
Class B (-2 DM)	10	2	1500
Class C (-3 DM)	12	3	5000
Class D (-4 DM)	15	5	15,000

Devices

Robots often carry built-in devices which add functionality to the unit. The most common device is some sort of communication equipment required to receive instructions. If the master unit cannot contact or control the slave unit, the slave must rely on its own processing power and previous instructions to determine its actions. Comms are also critical for performing any type of programming for a robot. Every robot has a communications port with links directly to the brain of the robot. In some cases it might be deeply hidden and protected (as for a warbot), but it is built into every brain ever constructed. Cyborgs are the only artificial being without this feature, and while it prevents any sort of tampering with the brain, a cyborg which develops personality 'quirks' cannot simply have its memory wiped and reprogrammed.

Other devices tend to be linked to the primary functions of the robot. Repair droids have mechanical and electrical toolkits, construction droids have welders, etc. These devices usually come standard as part of the robot, but some flexible droid chassis have a variety of optional equipment which can be included depending upon the needs of the buyer. Novel devices for experimental or prototype robots could also be developed by various megacorps or organizations for their own (perhaps nefarious) purposes. Costs for most devices built into the robot should be consistent with prices for similar devices used by sophonts if they are obvious on the robot, whereas internal or hidden devices should cost at least 3x as much due to their concealed nature. Augmented individuals may also have unique or advanced prosthetic devices that are not generally available. Referees have the final say about what appears in their game, and unexpected tech is a useful tool to surprise and challenge players.

Digital scrambler: used to confuse and open a digital locking device. A computer security or streetwise roll is attempted to use the device. A failure does not open the lock, and a failure by 2 or more causes an alarm.

Display screen: used to communicate to nearby sophonts visually and aurally.

Financial Package: Set of inputs and connections which allow the robot to conduct business transactions. Most often used to rent a robot's services.

Holographic Projector: This is a toaster-sized box that, when activated, creates a three dimensional image in the space around it or nearby – the range is approximately three meters in all directions. The image can be given pre-programmed animations within a

Communication Devices Table

Device	TL	weight (kg)	cost (Cr)
digital scrambler	10	.5	1500
display screen	4	.3	50
financial package	7	.3	200
holographic projector	11	1	1000
inertial locator	6	0.5	200
loudspeaker	5	1	100
projector	6	.3	100
voder	7	.2	20

limited range and the projector includes speakers for making sound. The projected holograms are obviously not real so this device is mostly used for communication. The TL 13 version can produce holograms real enough to fool anyone who fails an Intelligence check (made upon first seeing the hologram), at triple the cost, and the TL 15 version can produce holograms that are true-to-life images, at ten times the cost.

Inertial Locator: Indicates direction and distance traveled from the starting location.

Loudspeaker: used to create high intensity sound. May be informative or distracting.

Projector: Uses a simple light source and transparent screen to produce a moving 2D image appearing on a solid surface.

Voder: speaker system used to produce audible communication

General Devices

Fire Extinguisher: used in rescue or repair robots, it uses chemicals to put out smallish fires

Gas Emitter: hooks into a compressed gas tank that can emit any type of gas: smoke, tear gas, tranq gas, nerve gas, etc that will not damage electronic components and can flood 10 square meters per turn.

Geologic Sampler: used to perform basic soil/ground analysis within 5 meters of surface. Requires cargo space to bring material back for further analysis.

Lighter: equivalent to a small welding torch, it is able to ignite flammable material.

Lockpicks: allows robots with Streetwise skill to open locks

Puff Emitter: device that delivers a small burst of gas to a sophont immediately adjacent to the robot or drone. One puff emitter may only have a single type of gas.

Rangefinder: used for surveying, determines accurate distance using parallax

Spotlight: provides illumination for a modest area in whatever wavelengths designed.

General Device Table

Device	TL	weight (kg)	cost (Cr)
fire extinguisher	4	2	200
gas emitter	7	2+gas vol	1,000+50
geology sampler	7	48	15,000
lighter	4	.2	50
lockpicks	5	--	20
puff emitter	7	1	500
rangefinder	5	.5	200
spotlight	3	.5	20
toolkits		10	1000
syringe	3	0.1	20
winch	4	10	250

Toolkits: include a variety of tools related to doing particular types of jobs and are very broad in scope. More than 1 toolkit may be carried and may be switched as needed if the skills are present. Robots with external appendages may use regular toolkits if they are present and the appropriate skills are available. Toolkits include: appraisal, artistic, carpentry, computers, construction, demolitions, disguise, domestic, electronic, engineering, farming, forensic, landscaping, life science, masonry, mechanical, medical, metalworking, physical science, space science, surveying, survival, weaponry.

Syringe: used to administer drug dose to a sophont. Often used by rescue, medical and assassin robots.
More than 1 syringe may be present with different drugs, but any individual syringe may only administer a single drug.

Winch: designed to pull heavy loads up to 5 tons. will require stabilization or a load with wheels for it to move. Note that a winch may move the robot if it is not strong enough to move the object on the other end.

Shielding and Protective Devices

Camouflage: environment specific, reduces the chance of visual or aural detection with a -1 DM

Digital Camouflage: uses advanced outer coatings to give a -2 DM on recon rolls to detect

EMP shielding: conducting material lines the entirety of the robot blocking EMP like a faraday cage.

Laser designators are military targeting computers that use pulse lasers to illuminate a target. They may be blocked by smoke, aerosols, or bad weather. Gives a guided munition an additional +1 DM to hit a target.

Meson designators are high tech targeting compters that use meson pulses to illuminate a target. They are not affected by smoke, stealth, aerosols, or other defensive technologies. Gives advanced guided munitions an additional +1 DM to hit a target. Weapons lower than TL12 are not designed to use this technology.

Psionic Shield: protects a cyborg from telepathy or any unit from direct telekinetic interference.

Stealth: reduces the electronic signature of the robot, giving a -2 DM for sensor rolls to detect or lock onto the protected robot. It does not affect visual cues (see camoflage and digital camoflage above). **Improved Stealth** available at TL14 gives a -4 DM for sensor rolls.

Shielding and Protective Devices Table

Device	TL	weight (kg)	cost (Cr)
camouflage	4	2% chassis	10/kg cha
digital camouflage	10	6% chassis	25/kg cha
EMP shielding	10	2% chassis	20/kg cha
laser designator	6	2	1,500
meson designator	12	5	5,000
psionic shielding	12	.5	40,000
stealth	11	4% chassis	60/kg cha
improved stealth	14	7% chassis	180/kg cha

Weapons

Weapons are a dangerous addition to any robot design. Hacking is as common in the future as it is currently, so an armed, independently controlled robot is a deadly danger to anyone unaware of that robot's nature. A compromised robot can relatively easily be modified to carry a bomb (even a small nuclear device) which will only be triggered under the right circumstances (which may be generated by the robot). Most robots have a physical tampering identifier constructed into their chassis at the factory which is very difficult to replicate or avoid damaging. While it is not foolproof, it can at least provide some warning that a robot may have been corrupted. Hacked robots, however, provide no warning as there are no physical changes to the robot.

Some robots such as warbots may be nothing more than independently motivated weapons platforms. Certain races prefer to use warbots for various physical or cultural reasons, while others eschew them for their own personal preferences. Some of these designs are notorious for their destructive capability which may rival that of a pre- spaceflight tank (or worse!). Advanced weaponry is deadly, and unless an opponent is similarly equipped the technologically inferior side usually suffers in any confrontation. Warbots are highly restricted or forbidden on many worlds and anyone found using or importing such weapons had best be prepared for a fight. (Then again, they are bringing in warbots so fighting is probably their goal.) Because of scale and leverage, all robots are limited to 2 melee weapons and 2 main weapons. Even warbots are restricted to weapons sophonts may carry and use although appropriate design and mass will allow them to use a supported weapon without a tripod or other aid. Robot powerplants are unable to power energy weapons so standard powerpacks devoted to each weapon must be included. Vehicular scale weapons require a robot vehicle constructed under the vehicle rules to provide an adequate base for the heavier weapon.

Robot weapons come in two broad categories: internally mounted/stored or externally mounted. A biological robot of the appropriate race can use any of the weapons or armor systems designed for that race and therefore would never need an externally mounted weapon. Externally mounted weapons are easily observable and break streamlining but cost less and take up less space. Internally mounted weapons may only be observed using more sophisticated techniques such as X-rays or densitometry but take up double the space. Robots programmed as bodyguards often include hidden weaponry that can be used to turn the tables on their attackers. One drawback of internally mounted weapons, however, is the volume of chassis that the weapon takes up. This typically limits the size of internal weapons. As with all devices, there are required tradeoffs and no design can have the best of everything. Assume that any internally or externally mounted weapon includes whatever extensions are needed to use the weapon appropriately; ie. an armless cylinder can still swing a blade. The extension, however, is single purpose and may not be used to do anything that the weapon wielded by a sopont could not do.

Larger robots provide a more stable firing platform than smaller robots. Class A robots (50kg and less) may not use weapons massing more than 3 kg, and Class B robots are restricted to weapons 20 kg or less. Recoil values listed are true for size classes A and B (ie. up to 250 kg). For class C robots less than 375 kg reduce the recoil by 1 and for those 400 kg and larger reduce recoil by 2. Note that recoil values do not go negative, but a big heavy robot has no trouble firing a big heavy weapon. For melee weapons, positive heft penalties are reduced by high strength so pretty much any large robot will have free choice of melee weapon.

Personal weapons often have limits on how often a weapon can fire. All mounted energy weapons draw their power directly from the robot's power source and require a minimum power level to function depending upon the weapon. If damage reduces a warbot's power plant below the minimum level necessary to use the weapon, that weapon becomes inoperable. Ammunition space for weapons must be allocated when the robot is designed. Damage to a weapon or ammo storage may reduce its rate of fire until repaired. A destroyed weapon cannot fire until it is replaced. If an ammo storage space is destroyed, the referee may decide that the remaining ammo present explodes, likely ending the combat.

Thrown/ Slug Weapons

Weapon	TL	Range	Damage	Auto	Recoil	Mass	Magazine	Cost (Cr)
net	3-14	thrown	entangles	no	0	1	1	20-500
revolver	4	pistol	3d6-3	no	0	1	6	150
tranq pistol	8	thrown	2d6	no	0	1	2	150
flechette pistol	9	pistol	2d6-1	4	-1	1	40	250
snub pistol	8	pistol	3d6-3	no	0	0.2	6	150
body pistol	8	pistol	3d6-3	no	-1	0.3	6	500
cartridge pistol	7	pistol	3d6+3	no	4	1.5	2	300
accelerator pistol	9	pistol	2d6+1	4	0	2	40	400
submachine gun	5	shotgun	2d6	4	2(3)	3	40	500
gauss pistol	13	pistol	3d6+1	4	-1	1	40	500
autopistol	6	pistol	3d6-3	no	0	.5	15	200
tranq rifle	7	pistol	2d6+2	no	0	4	3	200
autorifle	6	rifle	3d6	no	1	5	40	500

sniper rifle	7	rifle	3d6+3	no	2	5	4	600
assault rifle	7	assault	3d6	4	1	4	40	1000
accelerator rifle	9	rifle	3d6	no	0	2	15	900
flechette rifle	9	rifle	3d6	4	0	5	80	800
gauss rifle	12	rifle	4d6	8	0	4	80	1500
shotgun	4	shotgun	4d6-1	no	3	4	6	200
autocarbine	5	shotgun	3d6-2	4	2(4)	4	20	200
flechette carbine	9	shotgun	2d6+2	4	0(1)	3	40	500
accelerator carbine	9	shotgun	2d6+2	4	0(0)	1.5	20	750
gauss carbine	12	assault	3d6+2	8	1(2)	3	40	1200

Melee Weapons

Weapon	TL	Range	Damage	Heft	mass (kg)	energy	Cost (Cr)
club	0	close	2d6	0	2	0	5
dagger	1	close	1d6+2	-1	0.2	0	10
stilletto	2	close	1d6+2	-2	0.1	0	50
staff	1	extended	2d6	1	2	0	5
fighting staff	8	extended	2d6	0	1	0	30
spear	1	extended/thrown	2d6+1	2	1.5	0	10
axe	2	extended	2d6+2	2	6	0	60
blade	2	close	2d6+1	0	0.5	0	50
bayonet	3	extended	2d6+1	1	3	0	20
halberd	3	extended	4d6	3	5	0	75
rapier	3	extended	1d6+4	-2	0.5	0	100
cutlass	3	extended	2d+2	0	1	0	100
broadsword	3	extended	4d6	2	6	0	300
mace	3	extended	2d6+2	3	5	0	20
monoblade	8	extended	2d6+5	-1	1	0	1000
monoknife	9	close	2d6+2	-2	0.5	0	750
vibroblade	11	extended	5d6	1	2	2	3500
vibroknife	12	close	3d6+1	0	1	1	2500
energy blade	14	extended	6d6	-1	2	4	7500
energy knife	15	close	4d6	-2	1	2	5000
stunstick	9	close	2d6	0	0.5	1	300
stunstaff	9	extended	2d6+3	1	2	2	800

Energy Weapons

Weapon	TL	Range	Damage	Auto	Recoil	Mass (kg)	Power	Cost
laser pistol	10	pistol	3d6	no	-	3	1	1500
improved laser pistol	13	pistol	3d6+2	no	-	2	2	2000
stunner	9	shotgun	2d6	no	-	2	2	500
improved stunner	12	shotgun	2d6+2	no	-	2	3	750
advanced stunner	15	shotgun	3d6+1	no	-	2	4	1000
laser carbine	9	assault	4d6	no	-	4	2	2000
improved laser carbine	12	assault	4d6+2	no	-	3	3	3000
advanced laser carbine	15	assault	5d6	no	-	2	4	4000
laser rifle	9	rifle	5d6	no	-	5	4	2500
improved laser rifle	12	rifle	5d6+2	no	-	4	5	4000
advanced laser rifle	15	rifle	6d6	no	-	3	6	6000
stagger laser	12	assault	4d6	4	-	7	6	5000
improved stagger laser	15	assault	4d6+2	4	-	6	8	8000
PGMP	12	rifle	10d6	no	8	20+10	10	65,000
improved PGMP	14	rifle	12d6	no	4	10+10	16	100,000
FGMP	15	rifle	16d6	no	6	35	-	250,000

Heavy Weapon Launchers

Weapon	TL	Range	Damage	Auto	Recoil	Mass (kg)	magazine	Cost
grenade launcher	6	shotgun	by grenade	no	1	6	6	400
RAM launcher	8	assault	by grenade	4	1	7+6	6	800
mini grenade launcher	8	shotgun	by grenade	no	0	3	1	400
mini RAM launcher	10	assault	by grenade	4	0	3+4	20	800
flamethrower	6	shotgun	4d6 fire	no	0	20	25	2000
small, short range rocket	7	rocket	by payload	no	3	20	1	varies
mortar	4	rocket	by grenade	no	6	15	1	3000

Supported Weapons

Weapon	TL	Range	Damage	Auto	Recoil	Mass (kg)	magazine	Cost
Light Machine Gun	5	assault	3d6	8	2	21	100	3000
Light Assault Gun	5	rifle	4d6	no	4	21	5	3500
Heavy Machine Gun	5	rifle	4d6	8	2	40	100	5000
grenade launcher	6	assault	by grenade	4	0	40	24	5000
ARMP	7	rifle	5d6	no	6	25	1	7500
VRF gauss gun	12	rocket	6d6	12	1	25	200	12,000
heavy VRF gauss gun	12	rocket	8d6	12	2	40	800	20,000

Ammunition

Many weapons come with a magazine attached, but some drones may want a larger supply of ammo than is typically present. Autoloaders may be used to reload ammo from an extended magazine, but requires 50% more spaces than just the ammo alone. For example, a combat bot might be essentially a self-propelled mortar unit. For it to carry 20 mortar rounds (total weight 20 kg), 10 kg of loading machinery (50% of the ammo weight) would be required. Ammunition costs and weights are listed with the personal weapons.

Cargo

Cargo space in a robot is typically very limited given the small size of robots compared to nearly any vehicle. Smugglers and couriers, however, value even small compartments that may be secreted inside of a unit. In one famous escape sequence, a droid carried an energy sword for its owner and threw it to him at the dramatic moment (source redacted to avoid copyright infringement). Drugs or weapons smuggled into a prison inside of a corrupted janitorial robot has facilitated the escape of more than one criminal (or hero depending upon one's point of view). While costing no credits, cargo space reduces the number of other systems that a robot may have and is thus very expensive in terms of options removed from that design.

Robot Design Descriptor

For consistency, it is best to design and record robots with a consistent interface. Frequently referees or players would like to modify the capabilities of a robot in sometimes minor ways, and an accurate description of how they were designed makes this task somewhat easier.

TL: [tech level]   Robot name

Using a [mass] kilogram class [class] [modifier] [shape] chassis (structure [struct], stability [stability]) with [added stability] added stability and [environmental protection], the [name] designed by [designer] is intended to [description]. The [type] uses a [drive type] drive [modifiers] to move at speed level [speed level] ([movement types]) [submarine info]. It has a [efficiency] [powerplant] powerplant and power level [power level], which has an endurance of [endurance] using [fuel mass] kg of [fuel type] fuel at [fuel consumption] kg per hour. [backup power] The unit has a dexterity of [dex], strength of [str], [appendages and masses] a torso ([torso %] mass). There are [armor] [armor additions] with [stealth] stealth, [camo] camouflage and [EMP protection]. [weapons]. The command and control systems of this [unit type] consist of a [radio] radio, [ECM] countermeasures and [advanced comms]. Sensor capabilities include [audio] audio sensors, [touch] touch sensors, [olfactory] olfactory sensors, [taste] taste sensors, and [visual] visual sensors, with the following additions: [additional sensors]. [miscellaneous equipment]. The [robot name] costs [cost] credits and takes [build time] to build.