MEGATRAVELLER

ROBOTS

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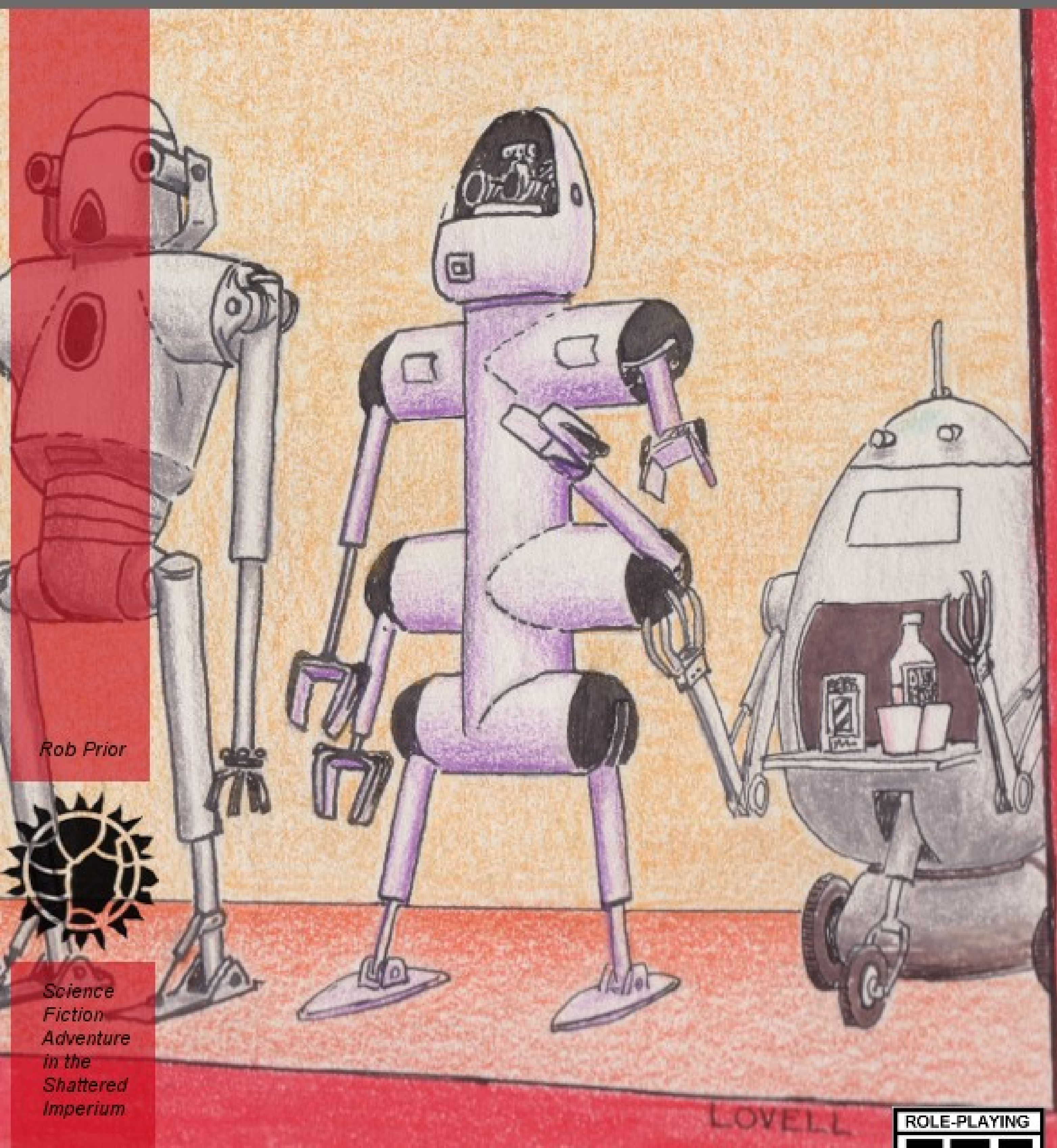

Rob Prior

Science Fiction Adventure in the Shattered Imperium

ROBOTS & ROBOTIC CRAFT FOR MEGATRAVELLER

ROLE-PLAYING FFE GAMES

MegaTraveller:

Robots

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About this supplement

Many Traveller Referees have crafted a robot system for MegaTraveller based on Traveller Book 8: Robots. The Errata for MegaTraveller by Don McKinney indicates that incorporating robots into MegaTraveller is a known problem, and no obvious errata exists.

The editor of this supplement took it upon himself to bridge this gap. He started a discussion thread on the Citizens of the Imperium discussion board, and others contributed a lot of valuable material.

The biggest contribution came from someone who found a draft of a MegaTraveller Robots supplement by Rob Prior, who started to cover many issues beyond construction and design in his work. The editor attempted to contact Rob Prior for permission to use his work, and he is credited as the principal author for this supplement.

Ultimately the editor has made some calls on contentious issues. I apologise to those contributors who so passionately argued cases that did not make it into this supplement.

This supplement has been constructed purely for fun. MegaTraveller has not had any new products for many years. I have no wish to undermine the great work being done by current Traveller publishers, and wish them all the best.

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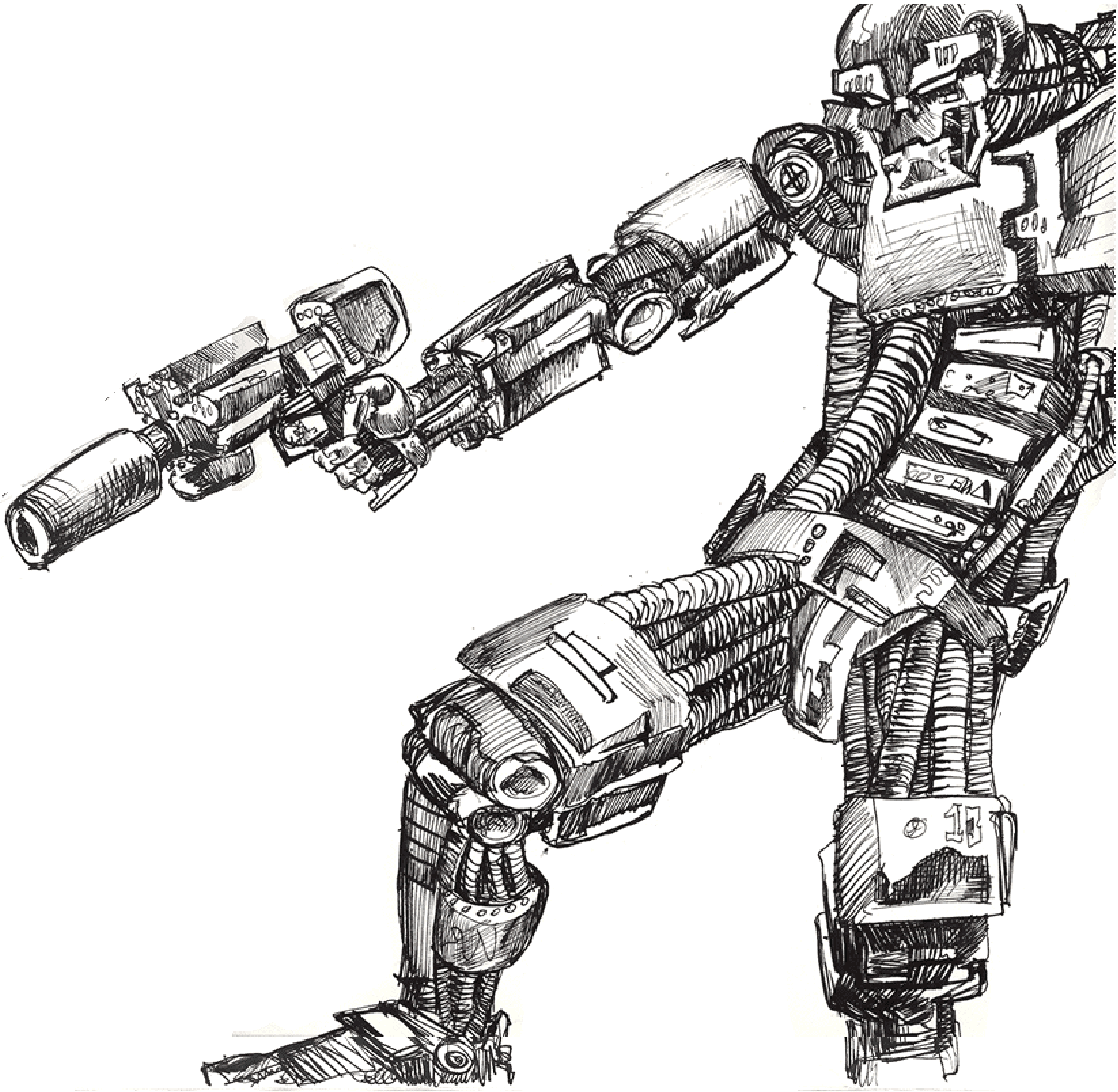
Human beings have dreams. Even dogs have dreams, but not you, you are just a machine. An imitation of life. Can a robot write a symphony? Can a robot turn a canvas into a beautiful masterpiece?



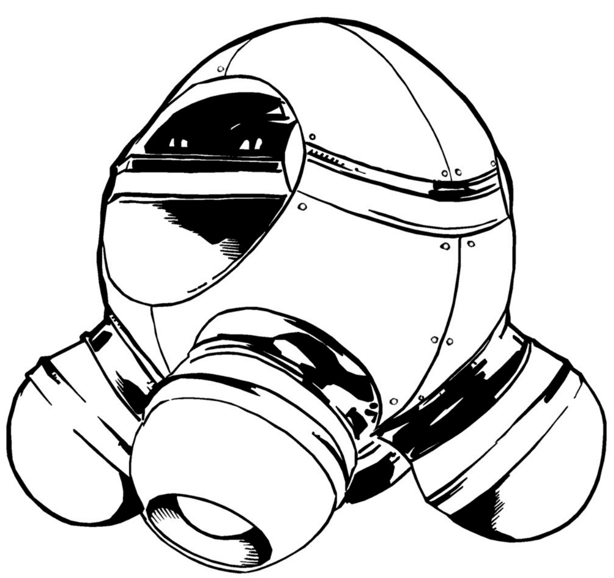
As technology increases, more and more work can be done by machines, giving intelligent creatures - sophonts - cheaper goods and more leisure time. But machines reach their highest potential only when they are finally able to think for themselves, as well as move about and manipulate their environment.

Robots are the machines with these capabilities.

This supplement for MegaTraveller enables referees and players to confidently integrate robots into MegaTraveller campaigns.

The MegaTraveller *Referee's Companion* addresses the role of robots in the MegaTraveller universe, the history, types and uses of robots in Imperial space, and robot manufacturers. It is recommended reading for Referees and Players who want to deal with robots in the Shattered Imperium.

This supplement includes a robot design system that extends the MegaTraveller Craft Design Sequence for robots, and rules as to how to include Robots in your game.



ROBOT DESIGN SYSTEM

The robot design system in this book serves both referees and players. Referees can design robots in detail for their campaigns.

Players can create player character robots for themselves. The robot design system is compatible with the MegaTraveller Craft Design Sequence, and so robots can be immediately added to any combat situations.

A player group might be in a position to design a robot to insert into their campaign. Like starship design, robot design is an unusual task for a player group, but this is a possibility in a game.

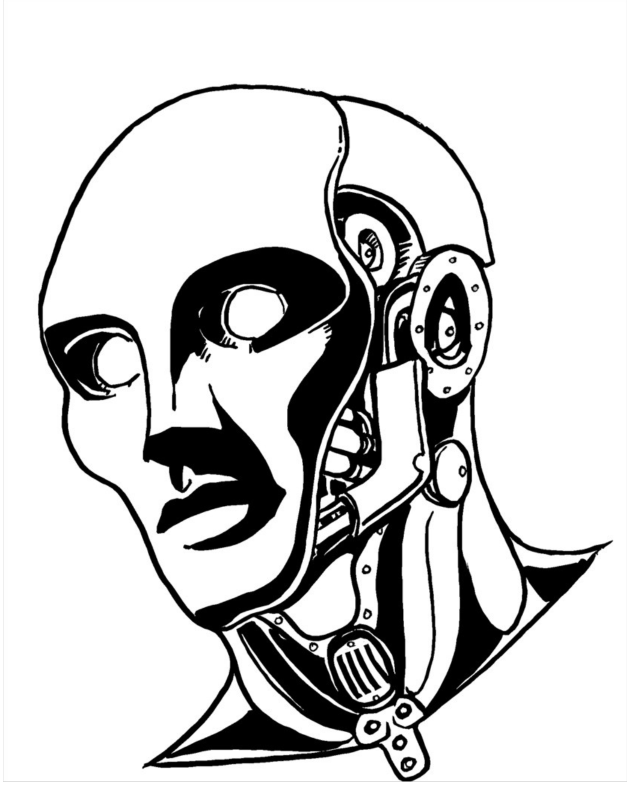
WHAT IS A ROBOT?

There is no one universal definition for a Robot. They can replicate humans and other sophonts, or be constructed for one specialised task. Robots can be autonomous or semi-autonomous, or even under the control of another robot or sophont. The more independence of action that a robot has, the more likely it is to be regarded as a robot.

ANIMAL CARE ROBOT

Robot ID:	Animal Care Robot, TL12, Cr83,388, STR = 33, DEX = 7, INT = 2, EDU = 2
Hull:	1/1, Disp = 0.0104, Volume = 161 litres, Config = 3US, Armour = 4F, Unloaded = 145kg, Loaded = 146kg, Burdened = 171kg
Power:	1/2, Fuel Cell = 30kW, Duration = 4/12 (99 hours)
Locomotion:	1/2, Wheels, P/W = 82, Road = 209kph, Off-road = 52kph
App & Tools:	Medium Arm, Light Arm, Medical Instrument Package
Comms:	Voder, Radio = Distant (5km)
Sensors:	Basic Sensor Package, + *passive IR*, + light intensifier
Offence:	Body Pistol
Defence:	None
Environment:	Basic Environment
Control:	None Necessary
Brain:	CPU – linear = 14, CPU – parallel = 5, Storage – Standard = 24
Software:	Logic = High Data, Command = Basic, Medical-2, Body Pistol-2
Accom:	None
Subcraft:	None
Other:	Fuel (Hydrogen) = 19.83 litres

The Animal Care Robot is designed for basic veterinary care of herds of animals in an agricultural context. It can be adapted to wildlife care with instruction.



Robots are treated as craft for the purpose of this supplement. The range of available hulls is extended to smaller sizes for building a wider variety of robot.

Most robots are discrete machines that perform tasks autonomously under instruction. They are usually comparable in size to humans.

But robotic craft can be bigger and use multiple robot brains and mobile robots for crew. In this way it is possible to construct robots suited for particular tasks to replace sophont labour, but also larger autonomous machines.

Both kinds of robot are covered in this supplement.

INTEGRATING ROBOTS INTO TRAVELLER

Robots can perform major roles in combat. Armoured, with weapons, and programmed with tactics they potentially make a formidable opponent. But they have limitations as well.

Where they excel is in repetitive menial tasks that require high degrees of accuracy.

Rules for how robots perform tasks based on their design mean that all robots can be integrated into non-combat situations very quickly as well.

STARSHIP MAINTENANCE ROBOT

Robot ID: Starport Maintenance Robot, TL12, Cr101,974, STR = 34, DEX = 16, INT = 2, EDU = 5

Hull: 1/1, Disp = 0.0196, Volume = 371 litres, Config = 3US, Armour = 4F, Unloaded = 367kg, Loaded = 371kg, Burdened = 401kg

Power: 1/2, Fuel Cell = 90kW, Duration = 5/17 (136 hours)

Locomotion: 1/2, Tracks, P/W = 130, Road = 259kph, Off-road = 78kph, (Burdened: P/W = 121, Road = 250kph, Off-road = 75kph)

Appendages & Tools: Light Arms x 2, Light Tentacles x 2, Lt Laser Welder, Mechanical Tool Package, Electronic Tool Package

Commo: Voder

Sensors: Eyes x 4, Ears x 2, Spotlights x 2

Offence: None

Defence: None

Environment: Basic Environment

Control: None Necessary

Brain: CPU–linear = 15, Storage–Standard = 50, CPU–parallel = 5, Brain Interface

Software: Logic = High Data, Command = Basic, Engineering-3, Electronic-1, Mechanical-1, Gravitics-1

Accomm: None

Subcraft: None

Other: Fuel (Hydrogen) = 54.46 litres

A common sight in starports, and often used to substitute for the Engineer position. This little robot is commonly instructed in basic tasks such as preparing for jump or firing up the power plant. It excels at these tasks and is often a trusted companion of lonely Prospectors or Scouts.

It stands as a tall cylinder about 2 metres high and almost 1.5 meters in diameter. It uses two tentacles and two arms to manipulate its extensive array of tools and can reliably maintain most systems on a starship.

Before designing a robot, you should have a clear idea of what function the robot is intended to serve. This will help establish which parameters to consider when you have to make trade-offs. A simple cargobot will have to be rugged and cheap, while an experimental expert system may have no cost restriction but require a skill level of Physics-4.

The process of designing a robot breaks naturally into two halves: hardware and software.

Designing a robot's hardware - its body - is almost identical to designing a vehicle, and virtually the same procedure is used. The new devices introduced by this article can be added to standard vehicle designs if desired. Note that for convenience, robot units are listed here as litres, kilograms, and kilowatts rather than kilolitres, tonnes, and megawatts. Multiply values in the Referee's Manual by 1,000 to convert to the units here.

The main difference between a standard vehicle and a robot is that a robot has a brain instead of control panels and a sophont operator or crew.

Designing a robot's software is a simpler task. Programs and control software are selected up to the capacity of the robot's brain. In most cases, the software required for a particular job will dictate the size and cost of the brain installed in the robot.

HULL SECTION

The hull of a robot is the framework that support all the other components. Apart from additions noted here, it is designed in the same manner as a vehicle's hull.

Note that hull volume represents the total external volume of the robot or craft apart from the volume taken by armour. In this way, even "external" components consume hull volume.

Pseudo-biological robots that are intended to mimic their species closely must fall within known parameters for their species. For humans this means volumes of 50 to 150 litres, more typically 60 to 90 (excluding the head). Human Pseudo-biological robots must allocate 10% to 20% to each leg (total volume typically being 30%) but may install components in legs totalling half that leg's volume. Heads must be 9% to 11% of hull volume. Arms are limited to light arms only. Additional hull volumes are listed in the design sequence charts.

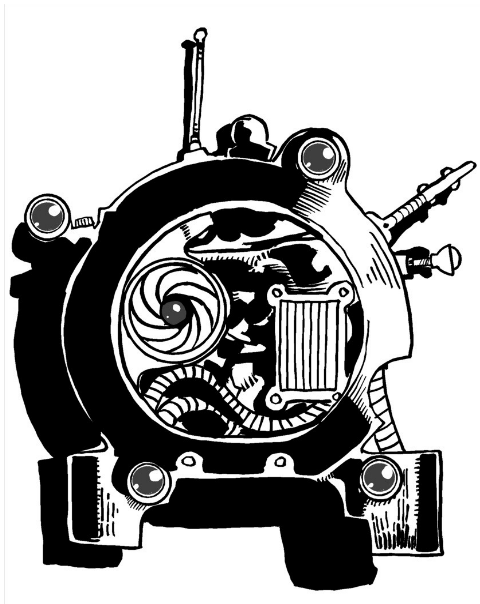
Select the appropriate size hull from the tables in the Referee's Manual. Some entries in the charts in this supplement replicate the Referee's Manual for comparison.

Chassis Configuration: A robot can have any configuration listed in the Referee's Manual. Robots built into planetoid hulls will be rare, and must be of at least small craft size. Two new configurations are also possible: contoured and pseudo-biological. Both of these configurations must be unstreamlined.

Contoured: Hard-skinned with a shape usually patterned after some biological creature, often the creating species.

Pseudo-biological: Soft-skinned biological look-alike, often of the creating race. At TL15 and above, pseudo-biological robots may pass for members of their species but are restricted by the parameters noted in the Hull Section above. Note that the Pseudo-biological configuration price multiplier applies to the *entire* robot, not just the hull.

Both of these configurations are subject to tight restrictions on design. They are modelled on the species that created the robots. The following restrictions apply to robots modelled on humans.



Hull Volume: For pseudo-biological configurations, selected hull volume must be between 40 litres and 150 litres. Larger base hull configurations are possible, but will look overweight for typical heights, or over tall for athletic figures, and so larger designs will lose the effect of being mistaken for members of their creating species.

Head: Heads must be 9% to 11% of selected hull volume.

Armour: Pseudo-biological robots may have no more than 6 armour.

Locomotion: Must be two legs, and total 25% to 35% of the total hull volume (including the head). Upto half of this volume is "given back" as volume available to install other components. However, total leg volume is used in design evaluation for ground pressure.

Appendages: Must be two arms. Total volume each must be between 4.5% - 6% of total volume including the head. For human sized pseudo-biological configuations, this effectively restricts arms to very light or light arms. It is assumed that very light arms will be bulked up by spreading other components to keep the effect of looking like a human.

Head(s): A head is, in essence, a turret and is treated as such during the design.

Armour: Add armour to a robot in the same manner as any other craft. Open frames and pseudo-biological configurations cannot have armour added.

Robots may be polished to reflec standards (armour 10 against laser weapons only). This procedure adds a price mod of x 2. This may not be done to open frame or pseudo-biological configurations.

Minimum armour: All craft are regarded as having armour of (3) - that is, a factor of 3 but only effective against natural and blade combat weapons. If a craft has better armour installed, it supersedes this minimum. Note that Open Frame configured craft may not have any further armour added. Pseudo-biological robots have armour of (1) and may not have any further armour added, but may wear personal armour fitted for the species they mimic.

POWER SUPPLY SECTION

A mobile robot must have a self-contained power supply. A stationary robot or one that moves only in a limited area can have an external power source. Such a robot requires an external power interface. An external power interface can also carry power from the robot to other appliances requiring power.

External Power Interface: The external power interface consumes 1% of the power it supplies. For example, an interface supplying 100 kW consumes 1 kW itself; the robot would require 101 kW from an external source. External power interfaces are also used to recharge batteries. Power interface in kW is divided by kW hours available in batteries to determine recharge time.

External power interfaces weight 1 kg per kW of power they consume; they take up 1 L/kg, and cost Cr200/kg.

For example, to supply 90kW to a robot would require an interface that consumed 0.9kW, took 0.9 Litres, weighed 0.9kg and cost Cr180.

LOCOMOTION SECTION

A robot does not require locomotion. For example, many clerical robots are "deskbots", restricted to one location.

A robot with an air cushion or grav modules requires the appropriate vehicle skill programmed which must be CPU resident at all times. One with wheels, legs, or tracks does not require a vehicle skill.

Where a contact based suspension is used, only power left over from all other components may be used to construct the transmission and rate the on-road and off-road speeds. This will often mean the designer must return to calculate the volume of the transmission. As a rough guide, we recommend allocating 20 watts per litre and calculating the transmission price, weight and volume on this basis. At TL12, this will typically result in road speeds of around 150kph and off-road speeds of 50kph to 75kph.

Zero-G maneuver package: This enables the robot to maneuver in a zero-G environment. The package consists of a gyroscope control set and at least one thruster set. The package does not draw any power.

The combination of gyroscope and thrusters provides maximum stability and maneuvering ability. The thrusters use liquid hydrogen power plant fuel directly, the expanding of the liquid hydrogen to a gas providing the thrst. Each one-second burst provides 0.08kg of thrust, using fuel as indicated in the table in the design sequence. A 50kg robot would be accelerated to a speed of about 16cm per second with a one second burst of 0.08kg thrust. Operationally the number of bursts required will vary greatly. In general adequate fuel provision for routine operations allows enough fuel for one burst every ten seconds for the desired endurance in a zero-G environment. In combat operations this might be as much as every second.

APPENDAGES AND TOOLS SECTION

Robots need **appendages** (arms or tentacles) to manipulate their environment. Arms are stronger, but tentacles are more dexterous. Appendages consume volume like any other component; total hull size describes the total size of the robot including all external appendages. They can be made retractable by doubling their volume.

Arms: Arms are appendages consisting of several rigid members linked by flexible joints. They are assumed to terminate in grippers, a hand, or similar manipulative device, although this is not mandatory. A medical robot, for example, might have a very light arm tipped with a hypodermic for giving injections. The device at the end of the arm contains tactile sensors (providing a sense of touch) and the entire appendage incorporates kinaesthetic feedback to ensure that the robot always "knows" the arm's position. It is assumed all Logic Programmes incorporate software drivers for attached appendages.

An arm can contain installed components of up to 10 percent of the arm's volume.

Tentacles: Tentacles are specialised arms consisting of many short members connected by many joints. The practical outcome of this arrangement is that tentacles have less strength but more dexterity than arms of equivalent size.

Tentacles may not have installed components.

Tool kits and other peripherals provide the means to completing specialised tasks. There are various toolkits and appliances that can be installed as listed here.

Laser Welder: Used to repair hulls and other major work. Treat as laser rifle in combat, but with a maximum range of 5 meters. Local law level does not restrict laser welders.

Laser Welder, light: Lighter version of the laser welder. Treat as a laser carbine in combat, but with a maximum range of 5 meters.

Janitorial Tools: A collection of tools for sweeping, dusting, polishing and vacuuming. Includes static charge dissipation and assorted mechanical cleaning aids.

Mechanical Tools: Identical to the Mechanical Tool Set in the Imperial Encyclopaedia.

Electronic Tools: Identical to the Electronic Tool Set in the Imperial Encyclopaedia.

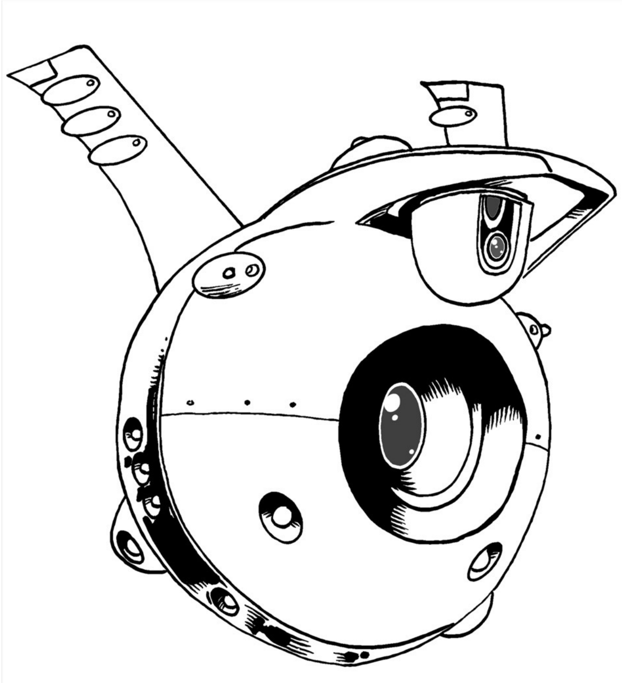
Metalwork Tools: Identical to the Metalwork Tool Set in the Imperial Encyclopaedia.

Carpentry Tools: Identical to the Carpentry Tool Set in the Imperial Encyclopaedia.

Medical Instruments: Identical to the Medical Kit in the Imperial Encyclopaedia.

Surgical Laser: A precision laser that is much more exacting than a laser welder.

Financial Package: A built-in safe deposit box for cash, a set of debit/credit card readers for common cards, and special money handling hardware.



Music Synthesiser: A specialised multi-voice unit that accurately imitates a wide array of musical tones and instruments.

Agricultural Package: Provides an array of plant tending implements. Also appropriate for horticulture.

COMMUNICATIONS SECTION

Any communications device may be installed. If a robot is required to talk in person or using an external communicator such as a starship radio, a voder must be installed.

Voder: This is a speech synthesiser; it is required if the robot is to speak. The voder includes a speaker, and may also be used to talk over a communicator with no sound being produced locally.

Keypad: A touch-sensitive keypad and flat-screen display, often used to communicate with robots that don't have voders.

SENSORS AND ELECTRONICS SECTION

Any device from the Referee's Manual or the following list may be installed.

Visual Sensor: Gives the robot the ability to see. At least two are suggested. Other features can be added to the basic sensor at the limed increase in power requirement, volume, weight, and price.

Audio Sensor. Gives the robot the ability to hear. As with the visual sensors, at least two audio sensors are suggested. Increased sensitivity is possible at the listed increase in power requirement, volume, weight, and price.

Olfactory Sensor: Gives the robot the ability to smell. Increased sensitivity is possible at the listed increase in power requirement, volume, weight, and price.

Basic Sensor Package: Includes 2 visual sensors, 2 audio sensors, and 1 olfactory sensor. This combined sensor package is optimised in size, weight and price. Pseudo-biological robots cannot use this package.

Speech Synthesiser (Voder): Allows the robot to speak.

Taste Sensor: Provides the robot with the ability to taste.

Basic Sensor Package: This includes two visual sensors, two audio sensors and an olfactory sensor. It may not be used by Pseudo-biological robots.

Molecular Analyser: Gives the robot the ability to perform a chemical analysis search for as little as 1 part per 10 million of the compound being sought. Each analysis is time consuming, however, and takes an average of 1 hour.

Flat Video Display: Provides the robot with a flat screen that displays 2 dimensional video images.When combined with the video recorder (see Craft Design Sequence in the Referee's Manual), the robot can instantly play back its video recordings.

Holodisplay: Provides the robot with the ability to display three dimensional holographic images. When combined with the holorecorder (see Craft Design Sequence in the Referee's Manual) the robot can instantly play back its holorecordings.

Acoustic Speaker: Allows the robot to produce simple sounds and music. Does not include speech synthesising. Note that the speaker is rated at 1500 watts - equivalent to a moderate public address system. Because rock and roll ain't no riddle, man. To me it makes, good, good, sense.

Micro Spotlight: A small precise version of the spotlight. Rated at 300 watts

Odour Emitter: Permits the robot to emit specific odours, either pleasant or unpleasant. Used extensively by the K'kree in their robots. Also used by the Hiver in their robots on the Hiver-K'kree border.

Touch Sensors: are already included in the hands of a robot with arms. Extra touch sensors provide the sense over the entire body. Volume of touch sensors in litres is the square root of the volume of the hull in litres times 0.1. Weight in kg is half the volume in litres. Power in kW is the same as weight. Price is Cr1000 plus Cr150 times volume. For convenience, a table of values for various hull sizes is included in the design sequence.

WEAPONS SECTION

Any weapon listed in the Craft Design Sequence in the Referee's Manual may be installed as usual. These weapons may not be installed on an appendage, although they may have a dedicated turret or cupola, or be installed in a fixed mount on the chassis.

Modified versions of personal weapons listed in the Imperial Encyclopaedia may be installed on a robot. These weapons may be installed in appendages. Multiply the weapon's characteristics as listed in the *Imperial Encyclopaedia* - including ammunition and power pack - by the modifiers found in the table in the design chart.

Blade Weapons: Blade weapons are commonly installed on bodyguard robots intended for use on high law level worlds. They must be mounted on an appendage.

Firearms: Firearms are common on military and maximum security robots. They are often mounted on an appendage..

Firearms require an ammunition supply, which must be carried inside the same appendage that the firearm is mounted on or inside the hull for a fixed-mount weapon. Ammunition is installed in magazines (not rounds) using the characteristics as listed in the Imperial Encyclopaedia and multiplied by the modifiers below.

Laser Weapons: Lasers are common on zero-G combat robots and war bots

A power pack for each laser must be installed somewhere in the robot. Small power plants are not capable of producing the bursts of power required by laser weapons. They slowly charge power packs that supply weapons.

High Energy Weapons: High energy weapons are common on high-tech war bots

As for lasers, a power pack for each energy weapon must be installed somewhere in the robot.

Neural Weapons: These are the most common weapons encountered on high-technology security robots, because a mistake by the robot is less likely to endanger a sophont's life. Multiply the weapon's listed characteristics by the modifiers found on the table below.

Recoil must be considered when installing weapons on appendages. High-recoil weapons must be installed on appendages with a strength of 10+; medium-recoil weapons must be installed on appendages with a strength of 5+. There are no restrictions on low-recoil weapons.

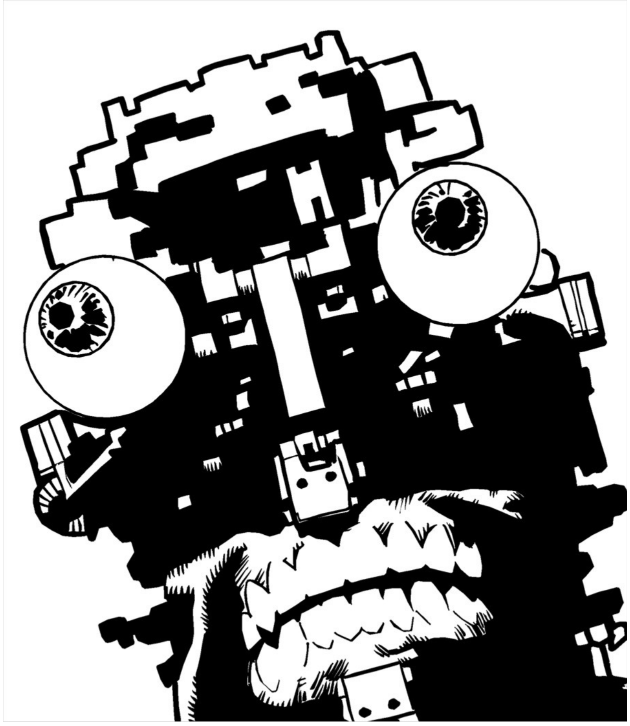
Chassis-mounted weapons are stabilised normally. Arm-mounted weapons cannot be individually stabilised.

The appropriate weapon skill is required for the robot to use the weapon.

A robot's owner is often held responsible for its actions, and so an armed robot should be closely supervised or intelligent enough to be trusted with weapons. Armed robots are illegal on many worlds.

SCREENS SECTION

Screens are installed as normal from the Referee's Manual. Note that robots under 1 displacement ton will not have sufficient space for most screens. Obscuration devices, integral smoke dischargers and anti-laser aerosols are commonly installed on war bots.



BRAIN SECTION

A robot requires a brain and associated circuitry to control its body.

The brain is a collection of processors and storage units which executes control and command software, as well as application programs (skills). While the brain can control a certain number of physical devices, large robots may require additional control circuitry to direct their bodies.

The size and composition of the brain is determined by the robot's function. Multi-skilled and expert robots will require larger (and more expensive) brains than dumbots. Before designing the brain, decide what software the robot needs: the space required by this software will dictate the minimum size and capabilities of the brain.

A robotic brain is a complicated computer consisting of many elements. For simplicity, these are divided into two types: processing units and storage units.

Processing units, or central processing units (CPUs), are computational devices that manipulate data and make choices based on that data. They have a certain amount of internal storage, but their main function is the transformation or processing of data.

Many devices contain slave processors for example, a robotic arm contains several tiny dedicated processors to assist the brain in controlling it. These are far less complicated than the processing units that make up a robot's brain.

There are three types of **processors**.

Linear: A traditional single-process device. Linear processors manipulate one stream of data in a sequence, although they are extremely fast. This type of processor is inexpensive, but is very limited in artificial intelligence. Twenty or more linear processors provide a +1 to the robot's intelligence.

Parallel: A simultaneous multiple-process device. These processors can manipulate many streams of data at once, increasing the amount of data they can process by several orders of magnitude over linear processors. Parallel processors are very expensive compared to linear processors, but provide much better artificial intelligence. For every five parallel processors, add +1 to the robot's intelligence (to a limit of +10).

Synaptic: An inductive processing device. Synaptic processors (also called neural nets) are modelled on the brain circuitry of living organisms. Synaptic processors are excellent at artificial intelligence applications. For every two synaptic processors, add +1 to the robot's intelligence.

Storage units are computational devices that store and retrieve data.

While they can perform limited manipulations, their main function is to quickly store and retrieve massive quantities of information.

There are three types of storage.

Standard: A traditional storage unit. Standard storage is cheap, but it takes a lot of it to give a robot a well-rounded knowledge base. For every ten units add +1 to the robot's education.

Synaptic: A naturally learning storage unit. Synaptic storage is expensive, but allows the robot's education to improve beyond its original level. Initially, synaptic storage works exactly like standard storage. For details on improving education, see the section *Improving Skills and Education*.

Removable: There are times when it is desirable to physically change a storage unit. Removable units contain holographic cartridges which can be exchanged with others. For example, a Janitorial application program could be replace with a Security one, or the data recorded by a security robot could be removed to present as evidence in court. Removable storage is slow and transitory, and doesn't contribute towards a robot's education.

Brain Interface: The brain interface gives the robot the ability to connect to other robots or computers and rapidly transfer data or programs.

Early synaptic processing and storage units are somewhat unreliable, and require cross-checking with more conventional units for proper operation.

As artificial intelligence technology improves less cross-checking is required.

A robot cannot have a greater percentage of synaptic units in its brain than indicated on the Synaptic Limits Table.

Once all software is chosen, the designer must decide which programs will reside in processors, and which will remain in storage until needed.

Programs residing in processors are available for use, while those residing in storage must be loaded into a processor before executing. The robot requires enough processor units to run all programs that will be required to operate simultaneously.

The processor components of the fundamental Logic and Command programs must always be processor-resident, as must the Grav Vehicle and ACV skills of robots with these types of locomotion. Most other application programs can be swapped in and out of storage when required.

In practical terms, this means that the robot's brain must have enough processor units to run the fundamental logic and command programs, locomotion programs, and its largest application program.

Like a sophont, a robot's total skills are limited to the sum of its intelligence and education.

CONTROL CIRCUITRY

In most cases the robot's brain will be large enough to control its body. Large robots - that is, craft controlled by a robot brain - may require additional control and command circuitry.

To determine if a robot requires additional circuitry, compute control points for it (excluding the brain) in the usual manner, section by section. Use personal weapon prices *after* any multipliers applied above to determine control points.

The robot brain itself provides a control multiplier of 250 per point of rated Intelligence. For example, a robot brain with intelligence of 3 would provide a control multiplier of 750. If the robot brain has an INT rating of zero, it has a control multiplier of TL x 10.

If the total control points required divided by the robot brain multiplier come to less than 0.05, no further control circuitry is needed; .this is true of nearly all robots under 1500 litres.

If control circuitry is needed, use the control panels as indicated in the Referee's Manual, using only Linked panels. Where a robot brain is present, fractions of control panels are allowed, although the minimum volume is 1 litre. Note that total control points provided by panels is multiplied by the robot brain multiplier. In most cases only a very small amount of extra control circuitry will be needed.

The combination of the robot brain multiplier with fractions of control panels allowed represents the much more compact nature of any additional control mechanisms that must be provided for a robot brain than a living sophont. No input or out peripheral devices are required.

Using the same logic, Control Panel add-ons do not provide any additional benefit for a robot brain; their extra control derives from better use of technology and design to interface with a sophont.

Where a craft has multiple crew, a robot brain may replace a crew member. Maintenance and Engineering crew may be replaced with autonomous mobile robots with appropriate skills. Other crew may be replaced with robot brains if so desired.

Where a craft contains any sophont crew (even one), full control circuitry must be installed using the Craft Design Sequence, ignoring the robot brain multipliers. Designs may carry sophont "crew" who are passengers without direct control of the craft but who instruct the robot brain. These craft do not need to install control circuitry using the Craft Design Sequence. Alternately, a craft may have both robot and sophont control installed.

JANITOR BOT

Robot ID:	Janitorbot, TL12, Cr17200, STR = 6, DEX = 6, INT = 0, EDU = 1
Hull:	1/1, Disp = 0.011, Volume = 120 litres, Config = 2US, Armour = 4F, Unloaded = 99kg, Loaded = 101kg, Burdened = 105kg
Power:	1/2, Fuel Cell = 20kW, Duration = 7/23 (191 hours)
Locomotion:	1/2, Tracks, P/W = , Road = 174kph, Off-road = 87kph
App. & Tools:	Very Light Arms x 4, Janitorial Package
Comms:	Voder, Radio = Distant
Sensors:	Basic Sensor Package, Spotlight
Offence:	None
Defence:	None
Environment:	Basic Environment
Control:	None necessary
Brain:	CPU–linear = 3, Storage–Standard = 13
Software:	Logic = Low Data, Command = Limited Basic, Janitorial-1
Accomm:	None
Subcraft:	None
Other:	Fuel (Hydrogen) = 28.68 litres

The Janitor Robot will clean, clean, clean all week. Then refuel. Then clean some more. It needs careful instruction for a new area to clean, but will sturdily and reliabily clean a given area once instructed.

Master and Slave Networks: Robots may be slaved to other robots or to a sophont controlled master unit. To be slaved, sufficient slave units must be installed to control the craft. A craft requiring more than one sophont crew may not be slaved. To control a slaved robot, one master unit must be installed per slave unit. The following table contains details of master and slave units.

Slave Units: Sufficient slave units must be installed to account for the control points needed to control the craft; fractions of slave units are not allowed. Each slave unit supplies 0.16 control points. Slave units may use robot brain multipliers from on-board robot brains or computer multipliers. At higher TLs, a small basic brain is routinely included even on slaved robots in order to reduce the volume and weight of slave units needed to control the robot.

To control a slaved robot, one master unit is needed for each slave unit on board a robot. For example, if a particular robot required two slave units to control it, the controlling sophont or robot would need two master units to control that robot.

Master Units: A Master Robot must install the required number of Master Units per Slave Robot to be controlled. Continuing the above example, if the Master Robot was to control 3 slave robots, a total of 6 Master Unit must be installed (2 per slave robot). In addition to this, total the intelligence of all robots in the network and divide by two (drop fractions) - this is the maximum number of slave robots in the network. The Master robot must have intelligence of at least three.

ACCOMMODATION

Where a multi-crewed craft has crew replaced with a robot brain or autonomous robot, accommodation for that crew member is not required.

For small craft and vehicle sized robots, the requirements for gunners and commanders still exist. But use the Robot Brain multiplier instead of the Computer multiplier in the redundant commander and gunner formulae.

The result will be that for the purpose of the design sequence, most robots are one-crew craft with that crew member (the operator) replaced with a robot brain.

For starships and spacecraft, robot brains may be used to directly replace bridge, command, and gunnery crew. Note that crew sizes in the standard Craft Design Sequence assume three 8 hour shifts to crew the ship. Robot brains could each theoretically replace 3 crew members. But as with computers, triple redundancy is required to ensure the ship does not cease operation due to one brain malfunctioning. Engineering, maintenance and stewards may only be replaced by autonomous robots with locomotion, skills and appropriate appendages included. Flight crew may be replaced by either autonomous robots with appropriate skills, or ensuring all sub-craft are entirely robot controlled. Medical Crew are calculated based on the non-robot crew of the ship. For robot crew ships, a Robot Maintenance Crew is included, calculated exactly as for Medical Crew. These robot "medics" must also be autonomous - not just robot brains.

One displacement ton of volume is required per rated Engineering and Maintenance crew for access tubes and corridors for maintenance robots and personnel even where all crew are replaced by robots and robot brains.

SOFTWARE

A robot requires three different types of software to function.

A program must be in the CPU to be active and used by the robot. A non-essential program can be in storage until it is needed again. Storage is also used to remember data for future recall.

Fundamental Logic Programs: The robot requires one fundamental logic program to regulate how it processes data. The fundamental logic programme functions as the brain's operating system in addition to higher functions.

Low Data: The robot remembers all data taken in by its sensors. It cannot analyse or learn anything from the data. Commands must be explicit.

High Data: The robot remembers all data taken in by its sensors and can use the data to learn and gain experience. The robot can improve the skill level of its application programs on its own. Commands must be explicit.

Low Autonomous: The robot can take independent action without direct commands and is able to understand simple inferences. Commands no longer need be explicit and the robot will respond with limited initiative to non-explicit instructions. It can analyse data and arrive at some very simple obvious conclusions. Robots with this program are not truly creative - they cannot originate ideas on their own. This is not yet artificial intelligence. The robot remembers all data taken in by its sensors and can use the data to learn and gain experience. The robot can improve the skill level of its application programs on its own.

High Autonomous: The robot has all the capabilities conferred by the Low Autonomous program and is able to understand most inferences. Commands can be vague and the robot will use moderate initiative to interpret instructions.

Low AI: The robot can reason and draw conclusions or originate ideas whose origins totally mystify the players. The robot has true artificial intelligence and may be mistaken for a sentient. The robot does not like being shut down. All the abilities of information, learning, and self-actuation are present. This level is beyond Imperial technology; the robot can exhibit true creativity and unprogrammed inspiration apparently through reasoning.

High AI: The robot has an artificial mind in every sense of the word. The robot is self-aware.

Characteristics for each fundamental logic program are listed on the table in the Design Sequence. The program must be allocated a certain number of processors, of which a certain number must be parallel and/or synaptic. The program also requires non-removable dedicated storage units.

Fundamental Command Programs: The robot requires one fundamental command program to allow it to decode and analyse the meaning of commands given to it.

Limited Basic Command: Provides the robot with a limited vocabulary of about 100 words or pre-programmed instructions. The speaker must enunciate words carefully or they may be misinterpreted or ignored. Varying accents and enunciation often cause difficulty.

Basic Command: Allows the robot to interpret simple, verb-object commands, like "get the red book" or "show the starport data". Complicated sentence structures like "I'm going to my cabin, so call me if anything appears on the sensors or an alarm sounds" cannot be used. Words must be enunciated carefully or they may become garbled. Varying accents and enunciation are sometimes a problem.

Full Command: Allows the robot to interpret all natural language commands without restriction. Poor enunciation and accents rarely cause a problem.

Characteristics for each fundamental command program are listed on the table in the design sequence. The program must be allocated a certain number of processors and non-removable storage units. In addition, the more powerful command programs require certain minimum logic programs. For example, if a robot has *Full Command* it must have at least *Low Autonomous* logic; it could potentially have *High AI* logic, but could not function with only *High Data* logic.

Application Programs: give the robot its skills. To increase the level of a particular skill, multiply the space and price of the program by the *square* of the skill level desired. Additionally, the space and price of all application programs is doubled below TL 12.

Only space for the first level of a skill must be CPU resident. The remainder can be put in storage. The two exceptions are locomotion skills for thrust-based robots and weapon skills: the entire skill must be CPU resident.

An application program cannot begin with a skill level higher than four.

Robots may have skill levels higher than four only through learning (described elsewhere). A robot cannot have a skill level of zero.

Unlike sophonts, robots are not very adaptable. A robot cannot use a skill in a "serves as" or "includes" capability, unless supervised by a sophont with Robot Ops skill. Exceptions to this are listed below; to avoid confusion, equivalent skill for robots are given as "treat as".

Most of the listed skills are identical to their MegaTraveller counterparts. Changes and new skills are listed below.

Aerospace Combat (Treat as: Tactics minus 1): Provides the robot with an elementary understanding of aircraft combat. Treat as tactics skill minus 1 in aircarft actions only.

Note that Grav Vehicles use Armour Ground Combat instead; this skill only applies to craft that use air for lift. See the *Tactics* skill entry below - robots in this situation will operate better if they have *Low Autonomous* logic.

Agriculture: The robot can properly plant and harvest crops, match the crop to the environment, and maximise crop yield through the use of fertilisers, planting techniques, hydroponics, and so on.

Air Cushion Vehicle: A robot with AC locomotion must have this skill.

Architect: Allows the robot to plan and design structures, from buildings and bridges to starports and entire cities. *Emotion Simulation* is required (to ensure aesthetically pleasing designs).

Armour Ground Combat (Treat as: Tactics minus 1): Provides the robot with an elementary understanding of armour combat. Treat as tactics skill minus 1 in armour ground actions only. See the *Tactics* skill entry below - robots in this situation will operate better if they have *Low Autonomous* logic.

Athletics: Gives the robot an understanding of athletic activities and how to perform them. Higher skill levels confer a more in-depth understanding of athletics and a greater ability to critique specific activities. *Emotion Simulation* is required for sports such as figure skating, where subjective judgement plays a large role.

Brawling: The robot can use its body and appendages in close combat.

Cargo Handling: The robot can load and unload cargo containers, making efficient use of space and correctly storing dangerous shipments.

Cinematography: Gives the robot the ability to use a camera (still and motion, 2D and holographic) in a manner beyond simply recording what it sees. The robot will seek out good camera angles, compose the maximum impact and interest, and so on. Requires *Emotion Simulation*.

Construction/Fabrication: This provides the robot with the know-how to efficiently build a structure from plans produced by an architect.

Drafting: The robot can draft blue prints for building or vehicle designs. It is an alternative to Architect that does not require Emotion Simulation but produces working blue prints that are functional but not inspirational.

Emotion Simulation: Allows the robot to appear to have (or to read) emotions, to seem frustrated, angry, happy, and so on. Certain other applications programs require this program. Emotion Simulation requires at least *Low Autonomous* logic, and must be processor resident; it has no skill level (the robot either has it, or it doesn't). Emotion Simulation is specific to one species.

Fleet Tactics: Operates as a "roving DM" for the fleet in which the robot is placed. If the robot has *Low Autonomous* logic and is in immediate contact with appropriate command facilities such as a ship's computer, and has the ability to communicate with other ships in the fleet (e.g. via brain interface or voder to ship's communicators), then this skill operates as normal. If the robot lacks *Low Autonomous* logic, then this roving DM may only be used if a sophont who has Fleet Tactics is immediately present with the robot.

Grav Vehicle: A robot with grav locomotion must have this skill.

Infantry Ground Combat (Treat as: Tactics minus 1): Provides the robot with an elementary understanding of infantry combat. Treat as tactics skill minus 1 in infantry ground actions only. See the *Tactics* skill entry below - robots in this situation will operate better if they have *Low Autonomous* logic.

Janitorial: The robot can properly clean and maintain living and working areas, doing routine sweeping, mopping, dusting, polishing, vacuuming, and scrubbing.

Lab Tech: Enables the robot to understand and perform basic laboratory operations such as working with chemical substances and using laboratory equipment.

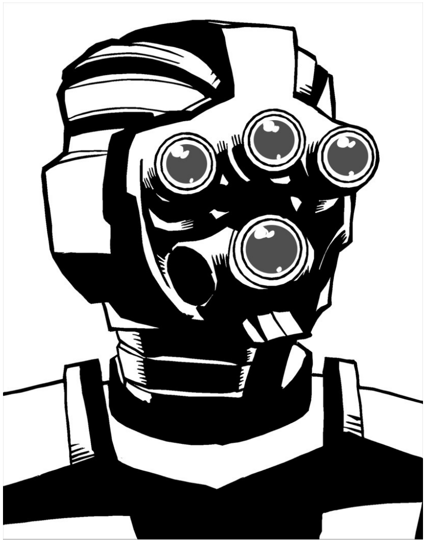
Language: This allows the robot to communicate in another language. The language must be specified when the robot is programmed. Language skills are available on removable storage devices.

Musical: The robot can play a variety of musical instruments (one per skill level). If the robot has a voder, one skill level may be allocated to skill allow it to sing. Performer skill is needed to hold an audience's attention. If not present, treat the robot as a specialised music playback equipment.

Armour Ground Combat (Treat as: Tactics minus 1): Provides the robot with an elementary understanding of nautical (both surface and submarine) combat. Treat as tactics skill minus 1 in nautical actions only. See the *Tactics* skill entry below - robots in this situation will operate better if they have *Low Autonomous* logic.

Performer: The robot can perform in front of an audience and hold the audience's interest, using whatever related talent skill applies. For example, a musical robot would require Musical, while a tour guide would require History. The skill level represents the population level of the audience that the robot can perform for: 1 allows audiences in the tens, 2 allows audiences in the hundreds, and so on. Requires *Emotion Simulation*.

Rescue (Treat as Medical-0): The robot can evaluate dangerous situations, especially conflagrations, and determine the best way to rescue endangered humans. The robot can also perform basic first aid.



Security: The robot can patrol a designated area, changing its route and schedule to avoid a predictable pattern, and will notice unusual events. The robot's actions after an anomaly is detected will depend on its instructions; a minimum security robot would merely report the event to a human guard, while a maximum security robot might hunt the intruders. If the robot will be required to detain unauthorised intruders it must have the brawling skill; an armed robot will require weapons skill in addition to the security program.

Sensor Operations: All Sensor Ops tasks become "unskilled OK" for robots. Robots have enough software installed with their Fundamental Logic to operate any on-board sensors or electronics. Sensor Ops may be purchased additionally for better operation for sensor scanning and locking for Starship Combat..

Ship's Tactics: Operates as a "roving DM" for the ship in which the robot is placed. If the robot has *Low Autonomous* logic and is in immediate contact with appropriate command facilities such as a ship's computer, and has the ability to communicate with the rest of the ship (e.g. via brain interface or voder to ship's intercom), then this skill operates as normal. If the robot lacks *Low Autonomous* logic, then this roving DM may only be used if a sophont who has Ship's Tactics is immediately present with the robot.

Space Combat (Treat as: Ship's Tactics minus 1): Provides the robot with an elementary understanding of space combat. Treat as tactics skill minus 1 in space actions only. See the *Tactics* skill entry below - robots in this situation will operate better if they have *Low Autonomous* logic.

Steward: The robot can feed and care for people. Without emotion simulation the robot is cold and distant, little more than an automated chef and waiter. In order to serve as a starship steward the robot must have *Emotion Simulation*.

Tactics: Operates as a "roving DM" for one side in ground, nautical or air combat. If the robot has *Low Autonomous* logic and is in immediate contact with all other personnel in their unit (e.g. by radio or voder), then this skill operates as normal. If the robot lacks *Low Autonomous* logic, then this roving DM may only be used if a sophont who has Tactics is immediately present with the robot.

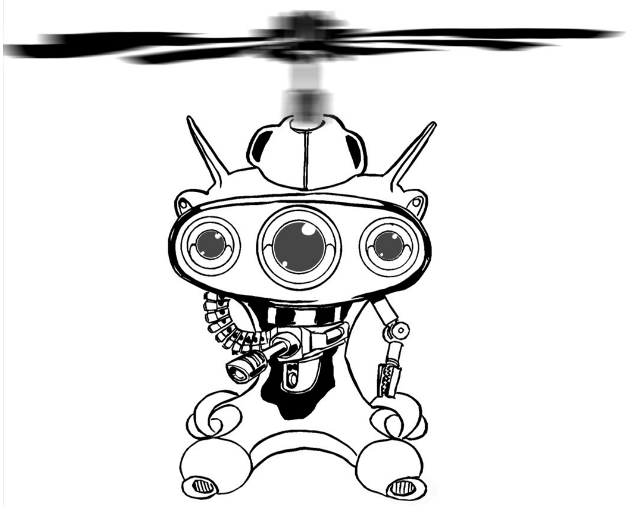
Valet (Treat as: Janitorial-0, Steward minus 1): The robot can act as a body servant, laying out clothes, cooking, tidying, running errands, and so on. Requires *Emotion Simulation*.

Weapon: The robot can use one specific weapon, whether gun or blade. Robots do not use "include" skills for weapons at all and the weapon must be chosen when robot is programmed. A robot with integral weapons must have a skill for each weapon installed. All weapon skills must be CPU resident for quick access during combat.

OTHER SECTION

Fuel must be installed on robots as for any other craft. Note that for robots of human size, the optimal supply of 30 days continuous operation is unlikely.

Further, robots that operate in a hostile environment often still use fuel cells because of their compact nature. In this situation, designers should ensure a closed oxygen and closed hydrogen method is used, and multiply fuel consumption by 9 to account for oxygen use. The fuel in this situation should be noted as hydrogen and oxygen.



AEROSPACE ROBOTS

Using the COACC design sequence, any aircraft may be controlled by a robot brain. Where aircraft require multiple crew, one robot brain may replace all crew provided it has all the relevant skills programmed into the brain.

An aircraft controlled by a robot brain *must* have the appropriate vehicle skill (Helicopter, Jet-propelled aircraft, Lighter-than-air Craft or Propeller-Driven aircraft). The vehicle skill must be resident in CPU at all times.

A robot brain might be included in a deadly interceptor design, or be a remote scout. Once TL9 is reached robots will generally use contra-gravity rather than aircraft, although enterprising designers may find economic uses for aircraft over grav vehicles.

SECURITY ROBOT

Robot ID:	Security Robot, TL12, Cr196249, STR = 18, DEX = 8, INT = 4, EDU = 5
Hull:	1/1, Disp = 0.0123, Volume = 166 litres, Config = 3US, Armour = 5F, Unloaded = 112kg, Loaded = 114kg, Burdened = 124kg
Power:	1/2, Fuel Cell = 30kW, Duration = 5/15 (122 hours)
Locomotion:	1/2, Wheels, P/W = 77, Road = 216kph, Off-road = 54kph, (Burdened: P/W = 71, Road = 210kph, Off-road = 52kph)
App. & Tools:	Light Arms x 2
Commo:	Radio = Distant
Sensors:	Basic Sensor Package, , +2 light intensifier eyes, +2 active IR eyes, +2 extra sensitive ears
Offence:	Laser Carbine (includes power pack)
Defence:	None
Environment:	Basic Environment
Control:	None Necessary
Brain:	CPU–linear = 26, CPU–parallel = 10, CPU–synaptic = 1, Storage–Standard = 50,
Software:	Logic = Low Autonomous, Command = Basic, Security-3, Laser Carbine-2, Infantry Ground Combat-1
Accomm:	None
Subcraft:	None
Other:	Fuel (Hydrogen) = 24.44 litres

This elite Security robot can be found guarding important MegaCorporation buildings and is occasionally used by mercenary units to guard bases. It can be given fairly sophisticated orders and can switch from security to ground combat quickly.

NAUTICAL ROBOTS

The design sequence in the Wet Navy Challenge Magazine series refers back to the Craft Design sequence for crew. Wet Navy vehicles may be either *Vehicle / Small Craft* sized, or *Starship / Spaceship* size. Use the relevant crew replacement rules for robot brains based on the size of the craft.

0 - OVERALL ROBOT DESIGN

1 Robot Purpose

Determine the robot's purpose and the Technology Level at which it is constructed.

2 Robot Size Category

Determine the robot's size category. This is the same as the Craft Design size categories, with additional smaller sizes added.

3 Design Robot by Section

For each section listed, proceed to that section chart and follow the steps there. The sections are numbered to match the Craft Design Sequence. Round all values to the nearest 0.1 kg, 0.1 litre, 0.1 kW and Credit.

A. The following sections should be designed in the order shown.

1. *Hull* Section
2. *Power Supply* Section

3a. *Locomotion* Section

3b. *Appendages* Section

B. The following sections may be designed in any order.

4. *Communications* Section
5. *Sensors and Electronics* Section
6. *Weapons* Section
7. *Screens* Section

8a. *Environment* Section

C. The following sections should be designed in the order shown

8b. *Brain* Section

8c. *Software*

8d. *Control* Section

9. *Accommodation and Crew* Section
10. *Fuel and Other* Section

4 Evaluate Design

Proceed to Design Evaluation. On the basis of the evaluation, adjust the design as necessary. When you are satisfied with the results, the design is complete.

1 - BASIC HULL DESIGN

1 Determine Robot Hull

The robot chassis is referred to as hull.

2 Select Robot Size

The following table extends craft sizes. Units are given in litres, kilograms and credits.

UCP	*Volume*	*Weight*	*Price*
0.0004	5	0.5	60
0.0007	10	1.0	100
0.0015	20	2.0	160
0.0019	25	2.5	195
0.0022	30	3.0	230
0.0037	50	5.0	300
0.0048	65	6.5	340
0.0059	80	8.0	380
0.007	100	10	400
0.011	150	15	600
0.015	200	20	800
0.019	250	25	850
0.022	300	30	925
0.026	350	35	1000
0.037	500	50	1200
0.044	600	60	1280
0.056	750	75	1400
0.074	1000	100	1600
0.148	2000	200	2000
0.222	3000	300	2400

3 Configuration

Determine the Robot's configuration either choosing a configuration from the Craft Design Sequence or one of the robot configurations below.

Type	*Configuration*	*Weight Mod*	*Price Mod*
C	Contoured	x 1.2	x 2.0
B	Pseudo-biological	x 1.5	x 8.0*

The price modifier for the Pseudo-biological configuration is for the *entire robot* not just the hull.

Configurations C and B may not be streamlined. They are modelled on the race creating robots, and come with configuration restrictions.

For humans:

Volume: 40 litres - 150 litres (pseudo-bio only)

Head: Must be 9% - 11% of hull volume

Arms: Each arm may be light or very light only

Locomotion: Must be two legs, total 25% - 35% of hull volume. Upto half this volume may have components installed in it.

4 Armour

Armour is calculated exactly as for other craft designs. Pseudo-biological robots automatically have an armour of (1) - that is, as Jack and may have no further armour added.

Other robot configurations have a minimum armour of 2, except for open frame robots.

For game purposes, all craft including robots are regarded as having an armour of at least (3) (that is, a value of 3 but only effective against melee and brawling weapons).

5 Open Vehicle

Larger robots may be designed to carry occupants, and the Craft Design Sequence restriction on carrying passengers on the outside applies to robots. Note that even smaller robots may have sufficient strength in appendages to lift and carry people.

6 Robot Head

Robot heads are designed exactly as turrets in the Craft Design Sequence.

2 - POWER SUPPLY

1 Power Supply

Use any suitable power supply from the Craft Design Sequence.

Fuel Cells are recommended for most robots of up to 1000 litres. Note that robots working in hostile environments - particularly vacuum - will need to multiply fuel consumption in Fuel Cells by 9 to account for the oxygen needed on top of hydrogen.

2 Scale Efficiency

Use the table from the Craft Design Sequence as relevant to the power supply selected.

3 Power Interface

A power interface may be used for the robot to use its power plant for external applications (e.g. recharge a power pack), or for an external power supply to power the robot.

One percent of power over the interface is lost by the interface or used in operation ("consumed").

Power Consumed	*Vol*	*Weight*	*Price*
1% of power supplied via interface	1 L / 1kW power consumed	1kg / L	Cr200 / L

For example - a robot has no power plant and requires 20kW of power from an external source. The Power Interface consumes 0.2kW, takes 0.2 L, weighs 0.2kg, and costs Cr40. The robot would need to be supplied a total of 20.2kW to account for the power interface along with other components.

3A - LOCOMOTION

1 Locomotion Type

Use any suitable locomotion from the Craft Design Sequence. Pseudo-biological robots *require* installation of legs.

2 Contact-based Transmission

In the Robot Design Evaluation, only power not already assigned to other functions is used to calculate the Transmission. At this stage of the design sequence, it is reasonable to allow 20 watts per litre of Robot at TL12.

3 Avionics

Most robots will be too small to install Avionics and so NOE speed will be restricted to 40kph.

4 Zero-G Maneuver Package

Robots that wish to maneuver and operate in a zero-G environment may install a package that includes a gyroscope with compressed gas thrusters for stabilisation and movement.

TL	*Package*	*Vol (L)*	*Wgt (kg)*	*Price (Cr)*	*Thrust (kg)*	*Fuel Cons. (L / Sec.)*
8	Gyroscope	2.0	2.0	1000	-	-
8	Thruster	0.1	0.1	200	0.08	0.02
9	Thruster	0.1	0.1	500	0.08	0.01
10	Thruster	0.1	0.1	750	0.08	0.005
12	Thruster	0.1	0.1	1000	0.08	0.002

A zero-G Maneuver Package requires one Gyroscope package at least one thruster package. Fuel must be provided from on-board liquid hydrogen but can be drawn from power plant fuel.

Thrust and fuel consumption are measured in one-second bursts. As a guide, a one second burst from a thruster package will propel a 50kg robot to around 16 cm/s in a zero-G environment. While fuel consumption will depend on the amount and complexity of maneuver required, a rough guide would be to allow enough fuel for one burst every 10 seconds in routine operations, or every second in combat situations.

3B - APPENDAGES AND TOOLS

1 Appendages

Robots use appendages and tools to manipulate the environment, and are a separate section.

2 Available appendage types

The following table extends the available miscellaenous devices from the Craft Design Sequence. Installed appendages are restricted for Contoured and Pseudo-biological configurations.

TL	Type	Power (kW)	Vol (L)	Wgt (kg)	Price (Cr)	Dex Mod	Str Mod
8	Arm, Very Light	1	1	1	750	+3	+1
7	Arm, Light	2	5	5	500	+2	+5
6	Arm, Medium	5	20	20	700	+1	+20
5	Arm, Heavy	10	50	50	1000	+0	+50
13	Tentacle, V. Light	3	5	5	1000	+5	+0
12	Tentacle, Light	5	10	10	750	+4	+3
11	Tentacle, Med.	10	20	20	1200	+3	+7
10	Tentacle, Heavy	15	30	30	1500	+2	+10

3 Tools

Installing the following packages helps robots accomplish specialised tasks.

TL	Type	Power (kW)	Vol (L)	Wgt (kg)	Price (Cr)
8	Agricultural Package	7.5	50	50	750
8	Carpentry Tools	10	30	30	500
8	Electronic Tools	3.5	8	8	5000
9	Financial Package	1	4	4	1000
8	Janitorial Tools	4.5	18	18	3500
9	Laser Welder	15	25	25	8000
9	Laser Welder, Light	5	10	10	5000
8	Mechanical Tools	5	25	25	2500
8	Medical Instruments	1.5	15	15	6000
8	Metalwork Tools	10	60	60	4000
8	Music Synthesiser	10	15	15	5000
8	Surgical Laser	2.5	5	5	10000

4 - COMMUNICATORS AND 5 - SENSORS & ELECTRONICS 1

1 Communicators

Select any suitable communicators for the robot. If planning to mount slave or master units for remote control, a communicator must be installed. There are two additional communication devices for robots.

TL	Device	Pwr (kW)	Vol (L)	Wgt (kg)	Price (Cr)
9	Voder	0.5	2	1	1200
8	Keypad	0.1	1	0.5	200

2 Sensors & Electronics

Any suitable sensors and electronics may be installed from the Craft Design Sequence.

3 Miscellaeneous Devices

Note that appendages are listed in a separate section instead of Miscellaeneous Devices.

4 Additional Devices

The following devices may also be installed on a robot in the Sensors and Electronics section.

TL	Device	Pwr (kW)	Vol (L)	Wgt (kg)	Price (Cr)
7	Visual Sensor	0.5	1.0	0.5	100
7	*+telescopic*	1	4	2	200
7	*+light intensifying*	1	2	1	200
7	*+passive IR*	1	2	1	200
7	*+active IR*	2	4	2	300
7	Audio Sensor	1	1	0.5	50
7	*+extra sensitivity*	1	2	1	200
8	Olfactory Sensor	2	3	1.5	1500
8	*+extra sensitivity*	2	2	1	2000
8	Basic Sensor Pkg	4	6	3	1700
7	Molecular Analyser	30	25	25	50000
8	Flat Video Display	5	2	2	500
13	Holodisplay (3D)	8.5	10	10	15000
8	Touch Sensor *	varies	varies	varies	varies
8	Taste Sensor	1	2	1	1750
9	Odour Emitter	1.5	4	2	500
7	Micro spotlight	0.3	0.6	0.3	150
7	Acoustic Speaker	1.5	2	1	200

* To work out Touch Sensor requirements for the particular robot, see step 5.

5 - SENSORS & ELECTRONICS 2

5 Touch Sensors

Volume of touch sensors in litres is the square root of the volume of the hull in litres times 0.1. Weight in kg is half the volume in litres. Power required in kW is the same as weight. Price is Cr1000 plus Cr150 times volume in litres. This table summarises touch sensors for common hull sizes.

Hull Size (L)	*Power (kW)*	*Vol (L)*	*Wgt (kg)*	*Price (Cr)*
10	0.2	0.3	0.2	1047
20	0.2	0.4	0.2	1067
25	0.3	0.5	0.3	1075
30	0.3	0.5	0.3	1082
50	0.4	0.7	0.4	1106
65	0.4	0.8	0.4	1121

Hull Size (L)	*Power (kW)*	*Vol (L)*	*Wgt (kg)*	*Price (Cr)*
80	0.4	0.9	0.4	1134
100	0.5	1.0	0.5	1150
150	0.6	1.2	0.6	1184
200	0.7	1.4	0.7	1212
250	0.8	1.6	0.8	1237
300	0.9	1.7	0.9	1260
350	0.9	1.9	0.9	1281
500	1.1	2.2	1.1	1335
600	1.2	2.4	1.2	1367
750	1.4	2.7	1.4	1411
1000	1.6	3.2	1.6	1474
2000	2.2	4.5	2.2	1671
3000	2.7	5.5	2.7	1822

6 - WEAPONS AND 7 - SCREENS

1 Weapons

Use any suitable weapons from the Craft Design Sequence. The same constraints as to volume, weight and power apply to robots.

In addition to suitable craft mounted weapons, personal weapons may be installed on robots.

To install personal weapons as part of the design sequence, use the opposite table to multiply weight cost and volume of the weapon as listed in the *Imperial Encyclopaedia*.

2 Screens

Screens may be installed on robots as for any other craft.

Weapon type	*Vol x*	*Weight x*	*Price x*
Blade	1.0	1.5	2.0
Firearm	1.1	1.1	1.1
Laser	1.0	1.0	1.0
Energy Weapon	1.5	1.5	1.1
Neural Weapon	1.0	1.0	1.0

8A - ENVIRONMENT

1 Environment

For robots with no sophonts on board, Basic Environment must still be considered to keep internal conditions optimum for all components in hostile environments. Environment is calculated in this separate step as a correction to the Craft Design Sequence as it requires allocation of control points.

Round values to the nearest 0.1kg, 0.1L, 0.1kW and credit. Rounding to zero is permitted.

Note that for designs less than 20,000 litres / 20 kL, basic environment takes up no volume, and has no notable weight or power requirements. The robot hull itself on these designs can be considered to already meet the basic requirements. To optionally avoid complex calculations, simply pay Cr200 for all designs of 20kL or less.

1 Brain Components

Select brain components based on software needs and desired intelligence, within design constraints.

TL	Type	Pwr (kW)	Vol (L)	Wgt (kg)	Price
8	CPU - linear	0.04	0.2	0.1	500
9	CPU - parallel	0.10	0.5	0.1	10000
11	CPU - synaptic	0.02	0.1	0.1	50000
8	Storage - standard	0.05	0.5	0.1	250
10	Storage - removable	0.05	0.5	0.3	500
11	Storage - synaptic	0.01	0.1	0.05	25000
8	Brain Interface	1.0	2.0	1.0	1200

The percentage of the brain consisting of synaptic units is restricted by TL as follows:

TL	Reliable Synaptic %	INT TL modifier
8	0%	-4
9	0%	-3
10	0%	-2
11	0%	-1
12	10%	+0
13	15%	+1
14	25%	+2
15	40%	+3
16	60%	+4
17	85%	+5
18	95%	+6

2 Fundamental Logic

The Fundamental Logic program is an analog to the operating system for the Robot Brain. A Robot Brain *must* have a Fundamental Logic program installed. Choose from the following table. Note that Emotion Simulation and higher Command programs require better Fundamental Logic.

		Processors				Price	Dex
TL	Type	Total	Parallel	Synaptic	Stg	(Cr)	Mod
8	Low Data	2	0	0	10	400	+0
9	High Data	8	5	0	10	3000	+1
12	Low Auton.	15	10	1	25	7000	+2
13	High Auton.	20	12	3	25	10000	+2
17	Low AI	25	4	21	25	20000	+3
18	High AI	30	2	28	25	50000	+3

This table lists the total processors that must be dedicated to the Fundamental Logic program chosen, and the minimum number of these that must be Parallel or Synaptic processors. The required dedicated storage is also listed.

3 Fundamental Command

The Fundamental Command program allows a robot to interpret the commands given it. Each robot must have a Fundamental Command program installed from the following table.

Command Type	CPU	Stg	Price (Cr)	Min Logic	INT
Limited Basic	1	1	500	Low Data	+0
Basic	2	2	1000	High Data	+1
Full	3	5	5000	Low Aut.	+2

4 Other software

Install other software as desired, selecting skills from Step 8b on the next page. Note that higher level skills require that the storage and cost listed be multiplied by a factor as listed there.

5 Brain Evaluation

Total the power, weight, volume and price of the brain including fundamental logic and command. Intelligence must be computed at this stage as it is used in later steps.

The intelligence rating of the brain starts with the number of CPU's installed. Total up the intelligence as follows.

CPU type	Base Intelligence
Linear	+1 if 20 or more units installed
Parallel	+1 for every 5 units (maximum +10)
Synaptic	+1 for every 2 units (no limit)

Next, add TL-12 to INT. Note that the net modifier is listed for reference on the TL synaptic percentage / TL INT modifier table.

Finally, add the INT modifier from the Fundamental Command program installed for a final intelligence rating.

Control Point Multiplier: Robot Brains have a CP multiplier in the same manner as computers. The CP multiplier is 250 for every point of intelligence. Thus, a robot brain with an intelligence of 2 has a CP multiplier of 500. Robot brains with an INT rating of 0 have a CP multiplier of 10 times the TL of the brain.

1 Skills

A level one in any of the following skills consumes the following CPU / Storage space and costs the amounts as follows. Unless otherwise noted, only a level one of a skill must be assigned to CPU space, the rest can be assigned to storage.

Skill	*Space*	*Cr*
Administration [1]	4	400
Aerospace Combat [4]	6	500
Agriculture	4	300
Air Cushion Vehicle / Hovercraft [2]	1	400
Animal Handling	4	500
Architect [1]	6	400
Armour Ground Combat [4]	6	500
Artisan [1]	8	1000
Athletics	3	400
Biology	8	500
Brawling	3	400
Bribery [1]	6	700
Broker [1]	4	400
Cargo Handling	2	200
Chemistry	8	500
Cinematography [1]	2	400
Combat Engineering	4	400
Communications	2	400
Construction	2	400
Demolition	2	400
Drafting	3	200
Electronics	2	400
Emotion Simulation [3]	2	500
Engineering	4	400
Equestrian	4	500
Fleet Tactics [4]	8	800
Forensic	5	800
Forgery	1	300
Forward Observer	2	400
Gambling [1]	4	400
Genetics	10	1200
Grav Vehicle [2]	2	400
Gravitics	4	400
Guard / Hunting Beasts	4	400
Gunnery	2	400
Helicopter	4	300
Herding	4	500
History	10	500
Hunting	2	400
Infantry Ground Combat [4]	5	400
Instruction [1]	10	700
Interrogation [1]	3	500
Interview [1]	3	500
Intrusion	2	400
Janitorial	2	200
Jet-propelled Aircraft [2]	4	400
Lab Tech	2	400
Language	5	600
Large Water Craft	4	400
Legal [1]	8	700
Liaison [1]	4	600
Lighter-than-air Craft [2]	4	400
Linguistics	10	500
Mechanical	2	500
Medical	4	500
Musical	6	500
Naval Architect	4	600
Navigator	4	500
Nautical Combat [4]	5	400
Performer [1]	3	300
Physics	8	500
Pilot	4	500
Propeller-driven aircraft	4	400
Prospecting	4	500
Psychology	12	1200
Recon	2	400
Recruiting [1]	5	600
Rescue	4	200
Security	2	200
Sensor Ops	2	400
Ship's Tactics [4]	8	800
Ship's Boat	2	400
Small Watercraft	4	400
Space Combat ****	6	500
Stealth	2	400
Survey	4	600
Survival	1	300
Steward [5]	2	300
Tactics [4]	8	800
Trader [1]	6	400
Tracked Vehicle	4	400
Vacc Suit	1	200
Valet [1]	2	300
Weapon (any one weapon) [6]	2	300
Wheeled Vehicle	4	400
Zero-G Environment	4	400

1 This skill requires Emotion Simulation.

2 These skills are compulsory for robots with these locomotions. The entre space must be allocated from CPU not storage for these skills for such robots.

3 These skills require a minimum Fundamental Logic of Low Autonomous

4 These skills function better with Low Autonomous Logic

5 These skills operate better with Emotion Simulation

6 The entre weapon skill must be assigned to CPU space

2 Skill Levels

For each skill, select the skill level required, and multiply the space required and cost by the multiplier listed in this table.

Skill Level	*Multiplier*
1	1
2	4
3	9
4	16

8D - BRIDGE

1 Control

Control points required must be calculated in exactly the same way as the normal Craft Design Sequence.

Robot brains supply a control point multiplier as calculated in Step 8b.

If total Control Points required divided by the Robot Brain Control Point Multiplier is less than 0.05 then no further electronic control is needed; the robot brain itself supplies sufficient control.

In all other cases, sufficient control panels must be installed. Only linked panels may be installed in robots. Fractions of control panels may be installed where a craft is entirely controlled by a robot brain with no sophont crew, but the minimum fraction is one litre of control.

2 Master / Slave Control

A robot may be remotely controlled ("slaved") by installing Slave Units. A communicator must also be installed for both slaved robots and master robots or sophont controls. Communicators must be of the same type - e.g. a master robot with a radio cannot control a slaved robot that has only laser communications installed.

If Slave Units are installed, a Robot Brain is not necessary; Slave Units supply control points and multiple units can meet control requirements.

A slaved robot can be controlled by a robot with Master Units installed equal to the number of Slave Units installed on the robot. A master robot must have an INT rating of at least 3. Install this many Master Units per Slaved Robot that will be controlled by the Master. The maximum number of slaves in the network is the total INT of all robots in the network divided by 2.

A slaved robot may also be controlled by a sophont with master units installed and power provided. This is often the case with remote-controlled probes handled by starship or vehicle crews.

TL	*Unit*	*CP*	*Pwr (kW)*	*Vol (L)*	*Wgt (kg)*	*Price (Cr)*
9	Master Unit	-	1	3	2	400
9	Slave Unit	0.16	1	2	2	200

9 - ACCOMMODATION AND CREW

1 Basic Crew

Robots can be built as vehicle sized, small craft sized, starships or spacecraft. Determine the type of craft as for the Craft Design Sequence, and calculate crew required for the robot.

2 Robot Brain replacements

Crew Members: Each robot brain installed can replace one crew member.

For *Vehicle or Small Craft* size robots, use the Robots CP multiplier instead of the computer CP multiplier for calculating redundant vehicle commanders and gunners.

For *Starships and Spacecraft*, robot brains can directly replace Bridge, Gunnery and Command crew. Autonomous human-sized robots with appropriate software and appendages can replace Engineering and Maintenance crew. Flight crew will not be relevant if subcraft are themselves crewed by robot brains.

Where *Starships and Spacecraft* have autonomous robot crew, a robot maintenance crew must be provided, calculated as for Medical Crew but using total number of robots.

Computers: On *Vehicle or Small Craft*, the robot brain one computer in addition to a crew member.

Starships and Spacecraft still require the installation of a ship computer - robot brains cannot replace ship computers. This is because shipboard computers provide many sub-systems and calculation power needed for complex ship systems. This is a different function to the robot brain.

10 - FUEL AND OTHER

1 Fuel

Fuel for power plants is calculated exactly as for the Craft Design Sequence. Fuel Cells are a popular choice for robots under 2000 litres. If such robots are to be used in hostile environments, multiply fuel consumption by 9 to account for the liquid oxygen that must be stored with the liquid hydrogen.

2 Cargo

It may be desirable for robots to have cargo bays for storage of collected samples or transport of goods. It is allocated exactly as in the Craft Design Sequence, although units are usually litres and kilograms rather than kilolitres and tonnes.

UNIVERSAL ROBOT PROFILE

Once all components are chosen, power calculated, and software installed, the robot must be evaluated. Robots use a modified form of the Universal Craft Profile.

The text that follows modifies the Craft Design Evaluation to calculate features distinctive to robots.

EXAMPLE ONLY - NOT A REAL DESIGN	
Robot ID:	Porter Cargo Droid, TL 12, Cr76,000, STR=10, DEX=5, INT=3, EDU=1
Hull:	1/2, Size=100 L, Config=4USL, Armour=4D, Unloaded=400 kg, Loaded=420 kg
Power:	1/2, FuelCell=50 kW, Duration=1/3 (30 hours)
Loco:	1/2, Tracks, P/W=4, GP=7, Road Speed=10 km/h, Off- Road Speed=5 km/h
App. and Tools:	Medium Arms x 2
Commo:	Radio=Distant
Sensors:	Basic Sensor Package
Off:	List weapon profiles here
Def:	+/- difficulty level, this one is unmodified
Environment:	Basic Environment
Brain:	Processors=Linear x 3, Parallel x 3, Synaptic x 1, Storage=Standard x 10, Synaptic x 2, FundLogic=HighData, FundCommand=Basic, Skills=Cargo Handling-3, Janitorial-1
Control:	Computer Linked=0.1, Slave Unit=1
Accom:	most robots won't have any
Other:	Fuel=10 L, Cargo=20 L (garbage container), Janitorial Tool Package, Objsize=Average. EMLevel=Faint

ROBOTID

List robot name, type, final price (indicating discount if available), and apparent UPP characteristics. Apparent UPP characteristics are listed individually as robots frequently exceed sophont norms. These UPP characteristics are used in UTP tasks in the same way as for sophonts attempting tasks. Do not calculate UPP characteristics for robots above Vehicle size - that is, Small Craft or Spaceship / Starship size.

Calculate the UPP elements as follows:

Strength (STR): Take the volume in litres and divide by 20 (drop fractions). Add the strength modifiers for each installed appendage.

Dexterity (DEX): The base dexterity is determined from locomotion type.

BASE DEXTERITY

LOCOMOTION TYPE	BASE DEXTERITY
Legs	TL - 8
Wheels	2
Tracks	3
Grav	6 x Grav Vehicle Skill
Air Cushion Vehicle	4 x ACV Skill

This is modified by given by the robot's Fundamental Logic given in the Fundamental Logic table. Lastly, add the Dexterity Mod for each installed appendage.

Endurance (END): This is rated as Duration in the Power section instead. However, robots with Emotion Simulation can act fatigued - the designer can set this digit to any value less than duration in hours divided by 3.

Intelligence (INT): Take the base intelligence supplied by the types of CPU installed. Add all installed CPU intelligence together.

BASE INTELLIGENCE

CPU TYPE	BASE INTELLIGENCE
Linear	20 or more units - +1
Parallel	+1 for every 5 units - maximum of +10
Synaptic	+1 for every 2 units (no limit)

Add the modifier given by the robot's fundamental command program, and add TL-12 (that is Tech Level minus twelve) as a modifier.

Education (EDU): Divide the robot's total storage units by ten, rounding down. This is the robot's education. Robots with synaptic storage can improve their education; this is detailed later.

Social Standing (SOC): This value is irrelevant because robots are considered property.

HULL

List the hull damage points, size (in litres), displacement (for comparison), configuration, armour rating and type, unloaded weight, loaded weight, and burdened weight (in kg). Unloaded weight is the total weight of all components excluding fuel and cargo . Loaded weight includes the weight of fuel and cargo. Burdened weight is the loaded weight plus the full carrying capacity of all appendages. Unloaded weight is an assessment of how much weight is to be taken into account in mass transport of unloaded models. Loaded and burdened weights are more important for evaluating locomotion performance.

POWER

List the power plant damage points, power plant output (in kW), and duration of operation. Rate the duration in 24-hour days / 8-hour days, with actual hours in brackets.

LOCOMOTION

List locomotion identically to the Craft Design Evaluation. It is optional, but recommended, to list speeds for a robot at its burdened weight as well as at its loaded weight. Also list Ground Pressure for role playing purposes - e.g. is the robot allowed on golf greens?

APPENDAGES AND TOOLS

List all arms, and identify any equipment installed in them. This may replicate equipment listed in other sections. List all tool packages installed.

COMMUNICATIONS

List each installed communications device and its range.

SENSORS

List each sensor and its range. Also list the robot's sensor profile as for other craft.

OFFENCE

List all installed weapons, but not with weapons the robot carries using appendages. It is useful to spell out the full profile of each installed weapon.

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DEFENCE

List the robot's defensive DM based on its size. If the robot is 10 L or smaller, +1 difficulty level to hit in personal combat. If the robot is 500 L or larger, -1 difficulty level.

ENVIRONMENT

List all environmental components here (e.g. basic environment).

CONTROL

List all control panels installed if any. List any slave or master units. If no slave or master units are installed and no control panels are necessary beyond the brain, list "none necessary" here.

BRAIN

Describe the robot's brain. List all CPU's and storage units, and other brain components.

SOFTWARE

List Fundamental Logic, Fundamental Command, and all skills.

ACCOMMODATION

Only include this section if the robot has space for a living being. This will be a rare occurrence.Possible usage will be larger robots with some sophont crew, or observers that can be carried.

SUBCRAFT

Only include this section if the robot has space for subsidiary craft (or robots).

OTHER

List the cargo capacity of the robot in litres, its fuel capacity in litres, the emission level, size class, and any other pertinent information not noted elsewhere.

The robot can improve its education and skills, if it has at least *High Data* logic. This is normally a time-consuming process, although constant supervision by a sophont with Robotics skill can speed it up.

Because a robot's skill set forms such a large part of its value, an older robot with improved skills is usually more valuable than a younger robot with only the factory-installed programs. As robot's improve their education and skills they often develop minor quirks such as unique ways of responding to commands that render them more valuable to their owners.

EDUCATION

If a robot has synaptic storage and has at least *High Data* logic, it can improve its education.

There is a limit to this process: divide the total number of storage units by 3 (drop fractions) and add the number of synaptic storage units. For example, a robot with 10 synaptic storage units and 10 standard storage units would have a maximum possible education of 12 (20 divided by 2 plus 10).

Improving a robot's education is a lengthy process. If the robot is in active use, confronted with new situations and supervised by a sophont with Robotics skill it can be accomplished in a shorter time. Improving a robot's education is a task.

To improve a robot's education:
Difficult, Robotics, Int (of robot), 1 month
Referee: Robotics skill is that of the supervising sophont, who must spend at least half of the time in communication with the robot. The results of the time roll indicate the months of active operation the robot must experience before its education is improved by +1.

SKILLS

A robot increases its skills in the same manner that a sophont does: by practice. Any robot with at least the High Data logic program can increase its skills. Unlike sophonts, however, most robots cannot practice skills they do not already have. A robot without AI Logic cannot learn a new skill, only improve one it already has. A robot with AI Logic can attempt to learn new skills.

As noted earlier, a robot is constrained by the same limitation on skills as sophonts. That is, total skill levels may not exceed the sum of intelligence and education.

There are two methods of increasing robotic skills. The referee should use the one that is appropriate to the circumstances.

A robot involved in active adventuring - for example, one owned by a player character - should be awarded ATs in the same manner as the players.

At the start of every adventure session it can attempt to increase a skill using the following task.

To increase a skill:
Formidable, Off=Robotics, Int (of robot), ATs, Def=current skill level
Referee: Robotics skill is that of the supervising sophont, who must spend at least half of the time in communication with the robot.

A robot not involved in active adventuring - for example one owned by an NPC - but still exposed to unusual situations should use the following task.

To improve a robot's skill:
Formidable, Off=Robotics, Int (of robot), Def=current skill level, 1 month
Referee: Robotics skill is that of the supervising sophont, who must spend at least half of the time in communication with the robot. The results of the time roll indicate the months of active operation the robot must experience before its skill is improved by +1.

ROBOT OPERATION

Robots attempt UTP tasks in MegaTraveller in a similar manner to sophonts. They will obey orders but within the parameters set by their logic and skill set.

There are two kinds of ways to operate a robot.

Command: A robot may be given a simple command and have it obeyed immediately. Such commands must be limited to one sentence, and must contain a clear specific action. For example, yelling "shine a light over there" and pointing is a simple command.

To give an explicit command to a robot:
[varies], EDU, Robot's INT or EDU, 6 seconds (absolute)

Referee: The Referee must judge the command and it's inherent limits. The robot must be able to hear the command and see any gestures. The command must be consistent with robot skills and within command program constraints. Difficulty varies according to the robot's Fundamental Command program:

Limited Basic:	Routine (uncertain)
Basic:	Routine
Full:	Simple

Instruction: To effectively use their skills, robots must have available tools and equipment and be effectively instructed.

To instruct a robot on a skill it has:
Routine, Robot Ops, robot's skill, 1 minute (uncertain)

For example, a mechanic robot might be ordered to carry out vehicle repairs. The vehicle has suffered Major damage.

The Referee determines the following tasks based on general damage and repair.

To diagnose the problem:
Routine, Mechanical, DEX, 2min. (uncertain)

To repair a diagnosed problem:
Difficult, Mechanical, DEX, 1 hour

If our mechanic robot does not have the applicable skills, the Unusual Situations rules apply (see below). If the robot lacks a mechanical tool kit or does not have a Mechanical Tool Set available, the difficulty is raised one level.

Determination: a robot does not need to make a *Determination* test to retry a task. Instead, the operator must simply issue a Command to re-try the task.

UNUSUAL SITUATIONS

Robots are skilled and tireless workers when performing tasks they are programmed for. However, they are not very good at improvising, or transferring skills and knowledge from one situation to another. To prevent accidents, most robots will not attempt tasks for which they have no skill.

Before a robot will use one of the skills it has under different circumstances (eg. use Navigation-2 as SensorOps-1) it must first make a task roll. Supervision by a sophont skilled at Robot Operation will greatly increase the chances of success.

To enable a robot to use a related skill:
Difficult, Robot Ops, Int (of robot), 10 sec

Referee: Successfully completing this task enables the robot to use one of its skill in a related capacity; for example, Pilot-1 as Ship's Boat-0.

Difficult as transferring skills to related areas is, performing without skills is even more formidable. Before a robot will attempt a task for which it has no skill it must first make a task roll.

To enable a robot to try a task for which it has no skill:
Formidable, Robot Ops, Int (of robot), 10 sec

Referee: Successfully completing this task enables the robot to attempt the task, but treated as if totally unskilled, increasing one difficulty level unless it is *Unskilled OK.*

For example: Mairhe is taking inventory in a warehouse late at night when she notices two shadowy figures. She is unarmed, but there is a cargobot next to her. She cannot command the robot to "attack those men" because the command is not within the robot's normal programing. She could *instruct* the bot "attack those men"; but she must first roll a formidable task (cargobots are not programmed for close combat), and spend valuable time clarifying her instructions to the robot.

Alternately, she could *command* it to "shine a spotlight on those men" and "move towards those men" hoping to distract them while she ran for help at no task penalty, because both these tasks are within the robot's normal programming.

ROLE PLAYING A ROBOT

The greatest difficulty in playing a player character or NPC robot in a Traveller campaign is coincidentally one of the greatest difficulties in playing any sophont.

The tendency for a character to know everything that the player knows is difficult to avoid. Characters do not have access to Traveller rule books, or extensive maps and library data. They do not have a pre-determined knowledge of task difficulty success chances. A character may properly have gut feeling about how good he is and how difficult some task is, but have no idea like "I need an 11+ and I have a total DM of +1, so that gives me a 17% chance of success".

For the most part, robots are not creative, and it is neither as enjoyable nor as proper to play a robot as such. However, robots are expert at creating "decision trees" in their memories by quickly genaratlng a complete list of alternatives to a situation. Sometimes this ordinary feat can seem like creativity, but looking inside the robot's brain reveals how this actually works. It is just thoroughness. combined with the ability to weigh alternatives and then choose the best one, that yields "creative" thlnking in robots.

ROBOTS ON STARSHIPS

The crew requirements for starships already include a lot of assistance from robotic subsystems and expert programs in the computer. If desired, robots can be used to replace sophonts to reduce crew salaries and life support costs, provide hard-to-find skills, or reduce the risk of mutiny.

Although robots are attractive on strictly economic terms, they also have several disadvantages.

First, a skilled robot is expensive, and requires a heavy up-front investment of money which might be better spent elsewhere.

Second, and more seriously, a robot has less initiative than a Newt bureaucrat. Although a robot can perform routine tasks flawlessly, it requires supervision and guidance to handle unusual situations such as space combat.

To reflect this, increase the difficulty of performing an interrupt by one level for every 25% (or fraction) of the ship's crew replaced by robots. A fully robot ship can fight, but it will be slow to respond to the ebb and flow of battle.

This rule allows robot-crewed ships, while still preserving an edge for sophonts. Merchant ships can save money by using robots, but will be at a disadvantage if attacked by pirates. Navies can also save money, but will pay for it in combat.

In Starship combat, all Sensor Ops tasks become "unskilled OK". This is because all robot brains have sufficient software installed as part of their Fundamental Logic to understand information from any sensor on board.

Lastly, for all Starship Combat tasks that use the Computer Model number as a DM, robot brain skills may not be used to modify the task. This is because the Computer Model DM - whether a positive DM or as a negative DM in an opposed check - already builds in the full capacity of the relative ship's electronic power. This means that it is rarely useful to install more than Gunnery-1 for any robot, and that Ships Tactics and Fleet Tactics roving DMs are reserved for non-weapons tasks in combat.

ROBOTS IN GROUND COMBAT

Robots in ground combat operate as any other craft. Combat speed is determined by taking their speed appropriate to the setting (flying, on-road or off-road) and dividing by ten as for other craft.

Robots take damage as vehicles - or as aircraft if they are designed using COACC. Where the vehicle damage tables call for damage to "crew" and there is no crew, the resulting damage to crew is ignored. Note that the vehicle damage table indicates a 50% chance of a hit not damaging the superstructure but rather hitting a particular component that might disable the robot without destroying it.

Robots will carry out orders according to how intelligent they are and the skill set they are given.

Any robot with a weapon skill can be used as a warbot. But it is worth noting the limitations based on software on robots in combat

Dumb Warbots: Robots who are equipped with weapons and the appropriate weapons skill will engage targets only with an explicit *command* issued by someone with Robot Ops skill. Note that this covers fire combat, blade combat, and brawling.

To order a robot to engage a target:

Routine, Robot Ops, Robot's INT, 6 sec. (absolute)

Referee: This means a delay of one turn for the robot to fire at the desire of the controller. The robot must be able to see the target. If LOS is lost, the robot will only re-engage the target if it senses it again.

An identical *command* must be issued to switch targets or cease firing.

Security Robots: Robots with Security (perhaps in addition to an appropriate weapon skill) may be given broader security-related *instructions*. Robots may be ordered to patrol and given instructions to respond to intruders (challenge, fire upon, activate alarms, or other actions). Use the standard task for instructing a robot.

For example, in a high security area in a military installation, an armed security robot may be instructed: "Patrol around the perimeter fence at regular random intervals. Challenge all persons entering the area to show a security pass. Warn those who do not produce a pass to leave in 10 seconds or be fired upon. Fire upon individuals who do not produce a pass between 10 and 15 seconds."

Note that security robots do not necessarily need to be armed - instructions might be as simple as tripping an alarm switch on seeing an intruder.

Regular Warbots: To avoid the limitations of Dumb Warbots, a robot must be given Infantry Ground Combat (robots less than 2000 litres in volume equipped only with personal weapons); Armour Ground Combat (robots of at least 2000 litres or armed with vehicle mounted weapons), Aerospace Combat (robots who are aircraft from COACC), Nautical Combat (robots designed for Nautical use), or Space Combat (robots designed for space combat).

Such robots may be given broad military orders using the standard *instruction* task above. Treat the robot being instructed as an NCO being given an order per page 12 of the Mega Traveller Referee's Companion.

In brief, an order to a regular warbot must be: specific (allowing little freedom of action), include movement (direction, objective and speed), fire (who to fire on - this can be general such as 'any enemy units'), a rally point, and optionally a delay of execution.

A robot who is a master robot in a master / slave network may be ordered to control other robots in helping them carry out their orders.

An example order to a Regular Warbot:

"Control warbots 101-231, 102-101, and 101-232. Move to Hill 328 at fastest speed. Fire upon and destroy all enemies on Hill 328 and defend it from attack until relieved. Fire upon enemies attacking our units at Fort Bravo if no enemies attacking Hill 328. Rally point is Hill 121. Execute in 30 minutes or earlier on my mark."

A robot may be given multiple orders to be triggered on a code word. A robot may store a number of orders equal to its EDU rating.

Robots with sufficient programming may be delegated tasks with reasonable autonomy in this manner. An additional advantage is that robots never take morale tests. They will continue executing their last order until given further orders or are incapable of continuing to carry out orders.

Note that each of these skills is "treated as" Tactics minus 1. Thus, if the robot is given at least *Low Autonomous* logic, then the character that has issued the order to the robot may use a roving DM to support the robot's orders. The Referee will arbitrate the precise boundaries of where this lies, but as a guide it must be applied to actions by the robot themselves or other robots they control.

But even programmed Warbots cannot show high initiative. They may not perform interrupts, and they may not exceed their orders, even to take advantage of tactical openings. They may be re-ordered at any time, but the time taken is usually prohibitive in tactical situations.

Advisory Warbots: Often robots in combat are equipped with an array of sensors - or have a direct interface with the starship - and can provide comprehensive intelligence.

Robots may be programmed with Fleet Tactics, Ships Tactics or Tactics but not have *Low Autonomous* logic. In these cases, the warbot is an advisory warbot to a sophont who possesses the skill themselves. The sophont must succeed at the following task:

To benefit from an Advisory Warbot:
Routine, Robot Ops, *Tactics*, *one combat round* (absolute)
Referee: this task represents a sophont evaluating the advice. The relevant sophont's Tactics, Ship's Tactics or Fleet Tactics skill is used as well as their Robot Ops skill. It is one combat round for the relevant environment - 6 seconds for ground combat, or 20 minutes for space combat. Raise level of difficulty to Difficult for robots with a Fundamental Logic of Low Data.

If the Advisory Warbot possesses at least *Low Autonomous* logic, then there is no need to roll this task; the roving DM automatically applies, so long as the robot is still supervised by a sohont and both are in contact with any unit that might benefit from the DM. This includes Regular Warbots who possess additional levels of their relevant skill or Tactics in addition to their skill.

If a shipboard Advisory Warbot possesses at least *High Autonomous* logic, then the roving DM applies whether or not any sophont operator is present, although the robot must still be in contact with relevant systems.

ELECTRONIC COUNTER-MEASURES

Robots will come under electronic attack in combat. Attempts will be made to jam their communications, disrupt master/slave networks, and they will attract homing missiles whether radar or infrared.

All robots equipped with a radio will automatically attempt to "burn through" any radio jamming. The robot will conduct the following task at the same time as following any instructions given to it:

To burn through radio jamming:
Difficult, Commo, EDU, 6 seconds (absolute, unskilled OK)
Referee: Add one difficulty for every range band range that the jammer exceeds the radio power of the robot. Subtract one difficulty level for every range band range that the radio exceeds the jammer.

A robot will attempt to break a lock from a radar or infrared homing missile in the same way an aircraft will attempt to do so.

To break an Infrared Homing Missile lock:
Difficult, Vehicle*, Tactics, (unskilled OK)
Referee: DM +2 if robot has an Infrared Counter Measures package. Use appropriate vehicle skill for robot's locomotion.

To break a Radar Homing Missile lock:
Difficult, Vehicle*, Tactics (unskilled OK)
Referee: Reduce difficulty one level if robot has a radar jammer on board. Use appropriate vehicle skill for robot's locomotion.

INFORMATION STORAGE AND RETRIEVAL

A robot has a sustained memory and if it has at least High Data logic, it can improve skills and education over time.

Storage can also be used to store information from all sensors present on a robot. If a robot as a brain interface, that information can be retrieved onto other systems such as starship computers.

Removable storage can also be used to examine logs of sensor information.

Removable storage and the brain interface are compatible with other robots or ship computers of at least the same tech level, and of the same manufacturing sophont species. The lines are blurred with regard to compatibility across space, however: some Imperial systems are incompatible, but Solomani systems are often built to Imperial specifications and vice versa. The Referee must adjudicate on such matters.

At TL8, each unit of standard storage can hold 24 hours worth of sensor data - video, audio, passive and active EMS, olfactory, touch and taste. At TL10, this becomes 48 hours.

The introduction of synaptic storage is an enormous breakthrough at TL13. If the robot contains at least one synaptic unit, multiply the possible storage of data by 2. For example, with 1 synaptic storage unit and 9 standard storage units at TL15, total storage would be 480 hours normally but is doubled to 960 hours because of the presence of the synaptic storage unit. In this manner, by TL13 and above, robot brains can routinely store weeks of sensor information for retrieval.

By way of comparison, all starship or vehicle computers are considered to have sufficient storage for one year's worth of sensor information times the model number of the computer.

ROBOT ECONOMICS

Like starships, robots can be financed as well as bought for cash. Of course adventure situations may yield robots as assets (whether 'stolen', 'long term borrowed' or 'liberated' depending on one's view point).

As robots are often used as a replacement for sophont labour, financing their purchase is an important consideration.

Like starships, robots may be financed with a 20% deposit of the purchase price, paying off the remainder over the term of a bank loan as follows.

ROBOT LIFE EXPECTANCY

TL	LIFE IN YEARS	MAX BANK LOAN TERM
10	10	5
11	25	12
12	40	20
13	55	27
14	70	35
15	85	40
16+	100+	40

To work out monthly repayments, look up the maximum bank loan term in the table above. Multiply this term by 6, and then divide the purchase price by this number. In effect, the total financed cost will be 220% of the purchase price of the robot. To pay out a loan early, work out the total cash amount of monthly repayments left. Sixty percent of this amount will pay out the rest of the loan, which includes an early exit fee for the bank.

For example, a cargo bot at TL12 is purchased for Cr40,000. A deposit of Cr8,000 is required. The maximum bank loan term is 20 years. We multiply 20 by 6 for 120. The purchase price of Cr40,000 divided by 120 is Cr333 per month.

Extending this example, let us imagine that the robot purchaser's business went very well, and she wished to pay out the loan to save on future interest. Let us say this happened exactly 11 years after the purchase date. That leaves nine years of monthly payments, or a total cash amount of Cr35,964. The owner can pay this out immediately by paying Cr21,578.

MAINTENANCE

All robots additionally require annual maintenance. This can be provided on a world of the TL of the robot with sufficient workshops.

To find a robot maintenance workshop:
Routine, (Int+Edu), (TL ÷ 5), 10 minutes
Referee: Use the world TL divided by five as a positive DM for success and a negative DM on time spent. Minimum time is 10 minutes. Raise task difficulty by one level for each population level less than 6. Three consecutive failures indicates the world does not have facilities.

Annual maintenance costs 1% of the purchase price. Half of this cost can be saved by maintaining the robot using character skills.

To complete annual maintenance of a robot:
Routine, Robotics, Edu, 30 min. (uncertain)
Referee: the uncertainty can be removed by attempting this task twice. On two consecutive results of at least "some truth" the maintenance has successfully been completed.

DESIGNING AND BUILDING ROBOTS

A group of players might want to design a dream robot based on their experience in the game or to solve a task.

Players should feel free to come up with a design based on technology level, budget, volume and weight constraints. However, a Referee for a given game has the final say over the availability of any design.

The specifications created by players characters may be taken to a robot architect who will lay out designs. The task to find a robot architect is the same as finding a robot workshop.

The robot architect will put together plans and charge 4% of the notional total cost of the robot for doing so.

A workshop may construct a robot for a player character group. The first model is at 150% of total notional cost; subsequent models are made at 120% until at least 10 are made, at which time the normal cost for each subsequent model applies.

Note that a workshop will not usually build a robot that includes weapons that exceed local law levels. The Referee may determine in the circumstances whether bribes, threats or other inducements may change this.

Players may undertaken Robot Architect activities themselves as follows:

To design a robot from specifications:
Difficult, Robotics, EDU, 1 day (uncertain)
Referee: on total truth the design is certainly complete. On two or more results of at least some truth, the character is confident in the design.

Robot building may also be conducted by player characters, so long as a workshop with appropriate tools is found, they hire the workshop for Cr1000 per week, and they are in a world with appropriate technology levels and have available parts. The Referee can determine this based on the circumstances of the world. As a rough guide, non-Industrial worlds will not have spare parts.

To build a robot from a detailed design:
Routine, Robotics, EDU, [varies]
Referee: Increase difficulty one level if only results from specification task above was "some truth". Time increment is 1 week for robots of 1000 litres or less, or 2 weeks if greater. Task becomes impossible without a workshop and appropriate parts and tools.

ELITE VALET

Robot ID: Elite Valet, TL15, Cr1,157,678, STR = 21, DEX = 13, INT = 9, EDU = 11

Hull: 1/1, Disp = 0.011, Volume = 221.5 litres, Config = AUS, Armour = 4F, Unloaded = 162kg, Loaded = 162kg, Burdened = 172kg

Power: 1/2, Batteries = 40.5kW, Duration = 0/1 (14 hours), Power Interface = 40kW

Locomotion: 1/2, 2 Legs, P/W = 63, Road = 222kph, Off-road = 155kph, (Burdened: P/W = 59, Road = 218kph, Off-road = 153kph)

App & Tools: Light Arms x 2

Commo: Voder, Radio = Distant

Sensors: Basic Sensor Package, +1 light intensifier eye, +1 telescopic eye, +2 extra sensitive ears, +extra sensitive olfactory, Taste Sensor, Touch Sensors, TL15 holorecorder (3D)

Offence: None

Defence: None

Environment: Basic Environment

Control: Computer Linked x 1 litre

Brain: CPU–linear = 20, CPU–parallel = 3, CPU–synaptic = 12, Storage–Standard = 110

Software: Logic = High Autonomous, Command = Full, Medical-1, Extra Language-1, Emotion Simulation, Valet-2, Instruction-2, Firefighting / Rescue-1, General Vehicle-1, Close Combat-1, Security-1

Accomm: None

Subcraft: None

Other: None

Only found in the richest households, the Elite Valet has a wide variety of software for family safety and security. It is an imposing contoured thick-set metal human in appearance, standing at a height of 2.5 metres.

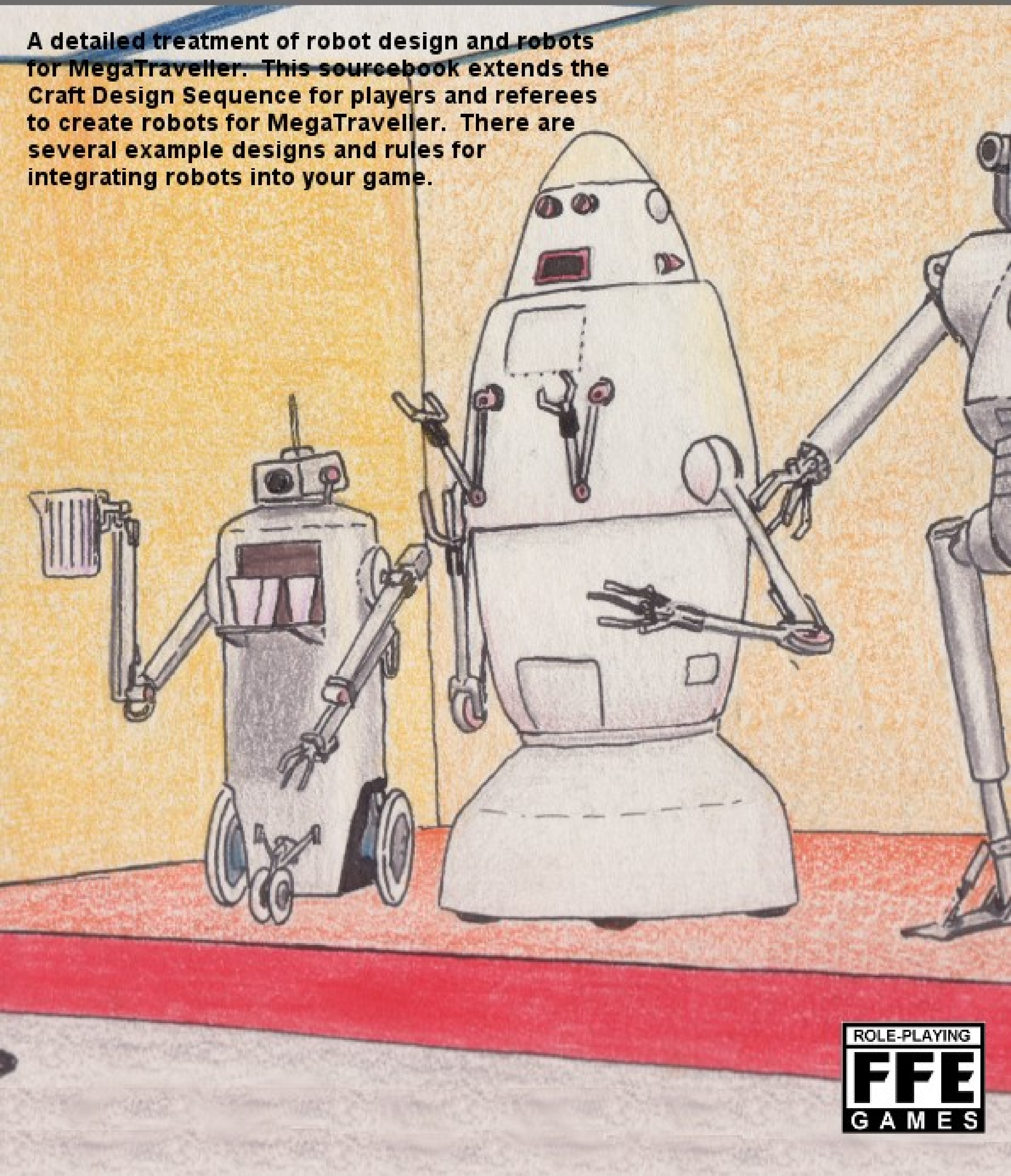
This makes the robot impractical in small buildings or onboard most starships. It is sometimes encountered on board luxury cruisers or on the wealthiest nobles' estates.

MEGATRAVELLER

ROBOTS

SHUDUSHAM CONCORDS REVISITED

A detailed treatment of robot design and robots for MegaTraveller. This sourcebook extends the Craft Design Sequence for players and referees to create robots for MegaTraveller. There are several example designs and rules for integrating robots into your game.



ROLE-PLAYING FFE GAMES