HOSTILE TECHNICAL MANUAL

Technology Fit For An Alternate Retro-Future

How Does It Work?
Your questions answered ...

ZOZER

CEPHEUS ENGINE COMPATIBLE

The HOSTILE TECHNICAL MANUAL is a gritty science-fiction roleplaying add-on for the Cepheus Engine – and for Zozer Games' Hostile setting.

Authors
Richard Grove, Shawn Fisher and Paul Elliott

12

Publisher: Zozer Games

Visit Zozer Games at www.paulelliottbooks.com
Find me on Facebook as Zozer Games

HOSTILE: https://www.paulelliottbooks.com/hostile.html

LEYLAND-OKUDA 2225
LOK-0293-2-2224-D

Recipient	V.N.Carter	Date	5-3-2225
Position	ass. engineer	Branch	Engineering
Module	module 2b	GIF/GDS	1106651DC8
Official Use Only			
Returned	6-23-2225	PSSS	J.B Jenoe

Pages 17, 19 and 20
Mainly Hyperdrive stuff
Exam – Monday the 12th
See Chief Nichols
Do it!

HOSTILE TECHNICAL MANUAL

A Technical & Engineering Manual for Off-World Personnel

Leyland-Okuda

"Forward Thinking. Innovative, Relentless"

LEYLAND-OKUDA

CONTENTS

HOSTILE is a gritty setting for Cepheus Engine and all other Classic 2D6 SF RPGS, based on the late-70s and early-80s movies we grew up with.

https://www.paulelliottbooks.com/hostile.html

ORIENTATION

The universe of HOSTILE is not our universe – set in the future. It is a genre and an assumption, a future that was outdated within years of its creation in the late-70s and early-80s. And of course the setting is essentially a cinematic one. These factors have shaped the technological assumptions of the **HOSTILE** setting. Artificial gravity onboard starships is there because it costs less to film, hyperdrive-equipped starships are used, quite literally, as vehicles with which to move the plot along. With a universe of possibilities out there in deep space, we want to 'get *out* there!'

But we are roleplayers, suspending our disbelief and we like to know how and why things are the way they are, even if the art director on a film had no clue. Quality concept artists and designers have often worked on these movies however, people like Syd Mead and Ron Cobb and Chris Foss. Ron Cobb is responsible for the extremely realistic interiors of the Nostromo in Alien (1979). He described his approach in an online interview:

My problem with designing Nostromo's interiors, the control bridge, corridors, auto doc (or med lab), bulkhead doors, the food deck, etc., was that I grew up with a deep fascination for astronomy, astrophysics, and most of all, aerospace flight. My design approach has always been that of a frustrated engineer (as well as a frustrated writer when it came to cinema design). I tend to subscribe to the idea that form follows function. If I'm to arrive at a cinematic spacecraft design that seamlessly preserves, as in this case, the drama of the script, the audience has to experience it as something impressive and believable.

My method for designing the Nostromo interiors was to emulate the engineering of the entire [ship] as though it were real, from the interior to the exterior and back again. So, while I was not supposed to be spending any time deriving exterior designs from my all-encompassing technique, I did produce them if only as a personal guide to making the interior sets more interesting.

Our setting must not just look and feel realistic, it must act realistically. Of course much of this technology is imaginary, yet we still want a sensible degree of engineering logic to back it all up. If the player characters want to disable all the anti-gravity on a ship's deck, were do they go? What kind of infrastructure will they be sabotaging? It's these practical in-game problems that depend on what would normally be considered the totally theoretical and frivolous assertions appearing within the HOSTILE Technical Manual.

RETROTECH

Look at those cathode-ray tube monitors in Alien and Outland, marvel at the lack of flat-screen technology, touch-screen computers, cell-phones and a hundred other modern marvels. Why aren't they in that setting? Well, firstly because some of the technology we have now just wasn't available in the late-70s and early-80s, and secondly, people like Ridley Scott chose to eschew far future wonder gadgets in favour of an industrial reality that the movie-going audience would recognize – because we're supposed to be interested in the alien/exotic problem/conspiracy, and not be distracted by the advanced technology of the future. Scott had seen the flat screen computer monitors of 2001: A Space Odyssey (1968), but chose instead to go with 1970s CRT monitors, 'for the look'. But, how do we rationalize a future, some two centuries hence, where cell-phones, plasma screens and wi-fi just don't exist?

An Alternate Future

As in our timeline, technology in **HOSTILE** looked on the verge of a virtual electronics developmental explosion as the 1970s gave way to the 1980s but a series of seemingly minor circumstances and major historical events hampered what might have been a wondrous new age and changed the course of human history. As President George Bush gave his now famous Space Exploration Initiative speech on July 20, 1989 and launched an enterprise that would send mankind out into the solar system and beyond, there were already factors affecting the technologies that would take them there.

The Decline of Moore's Law - Moore's Law is "the observation that the number of transistors in a dense integrated circuit doubles about every two years." In April 2005, Gordon Moore stated that the projection cannot be sustained indefinitely: "It can't continue forever. The nature of exponentials is that you push them out and eventually disaster happens." The ongoing miniaturization and improvement of integrated circuits therefore slowed dramatically as the 20th century came to a close. Dreams of micro-electronic components and palm-sized super computers crashed as improvements in computer technology were slaved to large main-frame processors and bulky terminals. Now, mechanical and electrical engineering would have to take up the slack and become the main agent of technological progress.

Network Insecurities – Rampant security breaches and the hacking of civilian, commercial, industrial and governmental data networks cost those affected billions and on more than one occasion threatened world-wide economic collapse. As a result a compartmentalizing and decentralization of databanks was instituted as well as a shift from risky wireless connectivity to a more secure hard-wire format. Transmitted data, when necessary for a given application, was sent by tight-beam data-burst or secure carrier frequencies.

While wireless networks are common today, in the retrofuture of **HOSTILE** such technology is just too risky. Wireless networks can be too easily spied on, jammed and spoofed, etc. This makes a smartphone full of personal information a liability, not an asset. The open trading of computer files on a network is not something that the governments, corporations, or other organizations support. There is an increased reliability on material memory disks instead of virtual data storage as a high-security means of data management. If someone buys or sells music, video, or software, it's typically in person with a disc, not via the network. Network engineers, hackers, and technicians may use a computer tied into a network, but the average person does not, except to use email or videophones.

The Flight 926 Incident – On May 12th, 2009 an Emirates Boeing 777 exploded just off the cost of Qatar en-route to Cairo. The 1.7 megaton nuclear device vaporized the 378 passengers and crew, contaminated thousands with far-spreading fallout, and devastated the region's power grid and electrical services for months. Long term casualty estimates were nightmarish and the effect on petroleum production and trade from the EMP alone was a universal calamity. The radical religious zealots responsible for the tragedy were identified and brought to justice but the effects of the disaster were far reaching. The vulnerability of solid state technology to EMP emissions on such a wide scale prompted a manufacturing frenzy towards more secure, EMP resistant and dependable alternatives. The resulting technology succeeded in these aims but at a cost of performance, power requirements and most of all size.

The revolution began a design and developmental trend that would see heavier, bulkier and sturdier electronic devices in every application and a closer symmetry with mechanical alternatives. The limited but still catastrophic East Asian Nuclear conflict in 2047 only served to entrench the need for such an institutional shift and established manufacturing principles for the next century.

Development of the Vacuum Channel Transistor – At the onset of the 21st century, NASA engineers tinkered with an odd new technology, the Vacuum Channel Transistor (VCT) which was essentially a high-tech version of the old vacuum tube that had been all but made extinct by the onset of solid state electronics in the 60s. The VCT utilized a field-emission principle and was faster, more powerful and lacked many of the vulnerabilities of its electronic rivals including operation at high temperatures and tolerance to high dose radiation. When coupled with developments in carbon nanotube heat transfer the new technology sparked a subtle revolution as processing operating frequencies in the terahertz range became possible. The answer to the failing solid state market had been found with one major disadvantage. VCT technology was bulky and heavy and required additional supportive hardware that ended the steady migration to smaller and lighter electronics that had dominated for decades. The future of electronics would be bright and unimaginably efficient, but it would be big.

As a result of these and other lesser factors electronic design and development in the **HOSTILE** setting took a decidedly different direction to our own. As man took his first major steps into space and Earth embraced the challenges of the new century the tools, vehicles and devices they held dear took on a new dimension, one formed by the nature of their construction.

Solid and well-made was the new design format. Perhaps heavy and unwieldy by the standards of the late 20th century, the new designs were simply accepted as a matter of need, and embraced as the next generation of electronics. Style followed purpose and as the decades passed the new 'industrial' appeal became common place. A certain, popular, 'retro-tech' trend spread throughout the world's key manufacturers and design choices were quick to reflect it. Chic, streamlined, stylish consumer electronics in glass and minimalist-style cases were never popular, gaining the instant reputation as cheap toys, gimmicks and gifts. Consumers wanted their equipment to look like it was up to the job, and so the mantra went: "if it looked right then it *was* right!" Patterns of construction emerged and the manufacturing climate took on a distinct, workaday tone. Electronic development vaulted ahead and with the space-race fuelling innovation, technology enjoyed a new renaissance but snuggly within the blueprint set by those early years of re-innovation. Mechanical contrivance rivalled the electronic for the first time in decades and the offspring of the two would carry human kind to the stars.

Mechanical alternatives to electronic applications were popularized and control schemes returned to concepts thought to be on the way out. Buttons, dials and toggle switches replaced touch screens and keyboard commands while gauges and meters took the place of multi-purpose LCD screens and computer based monitoring. Pneumatics and hydraulics surged ahead of magnetic engineering as cost effective and efficient alternatives to the now almost as bulky electronic versions. Engines once dominated by computerized regulation were designed with auto-mechanical management instead, increasing performance and reliability but size and weight as well. Almost forgotten elements of modern society driven out decades earlier by modern tech were here and there revived.

Retro-Engineering

Following a world-wide trend manufacturers and developers began designing and building with larger, heavier and mechanically domineering elements to offset the decline of micro-electronics. Servos, motors, ventilation equipment, pumps, coolant and heating, engines, batteries, power generation, product delivery lines and every component in modern engineering began to take on this initially subtle but increasingly imposing aspect. Solid-state construction principles gave way to a combination of new bold electronics and mechanical engineering converting the once minute and fragile to sturdy and imposing devices.

Hydraulic and pneumatic equipment is everywhere, replacing electric motors in many applications. Motorized power equipment, run by internal combustion motors or separate generators is also prevalent with many industrial applications perpetually accompanied by the hum, drone or rumble of a supporting motor. Electrical lines are larger, thicker and carry more current and many more are necessary for a single application. Manually powered back up provisions are also plentiful with crank-capacitors, hand pumped hydraulics and the like present on most critical equipment. The structures built to support this technology are heavier, industry grade designs, sporting massive frames, thick insulating material, extensive venting and sizeable access spaces. Lighting is sparse, inefficient and often unreliable. Confined to outdated construction methods fluorescent, Zenon and even incandescent fixtures still predominate with LEDs and other advanced lighting equipment left behind with the transistor. The pale luminescence of back lit readouts and instrumentation are often accompanied only by the flicker of a failing fluorescent overhead.

In general the electrical and mechanical technology of the 22nd century and beginning of the 23rd resembles that of the heavy industrial construction prevalent in the late 20th in most respects, despite enjoying the developmental improvements in principle and function of the years that followed. This is as much a feature of necessity and purpose as it is one of style and custom. There were clear reasons for the shift in the beginning but after a generation design followed design and as the decades passed new trends followed old ones without any clear motivation to change and every reason to build on established methods.

Off-World Needs

While the retrofuture of the **HOSTILE** setting makes certain specific stylistic choices in a nod to the source material from which it takes its inspiration, it is a game largely focused on the lives of workers, explorers, and space-farers in the regions of space far from Earth. That is, on life off-world. This is an incredibly difficult environment for computers and electronics, which might be exposed to radiation, solar flares, gravity fluctuations, and other elements of utterly alien environments. Silica, dust, methane gas, or a thousand other substances could ruin a machine in a matter of minutes or even seconds. The gadgets need to operate in the most unforgiving environments that humans will encounter. This means that the equipment used off-world needs to be 'over-engineered' in comparison to electronics on Earth. While a citizen of Tokyo might enjoy comparatively light and handy consumer electronics, the platform workers on Tau Ceti will have little use for such items.

Off-world devices are, above all, robust, easy to use, and easy to repair. If a critical device breaks it could cause injuries or even deaths. Heavy cabling, thick cases, and simple displays are the name of the game. If everything looks like it belongs in an industrial setting that's because it does! Likewise, the software and repair support for consumer electronics is just not available. Smartphones and their apps may be ubiquitous in 2018, but in a distant colonial world without easy connectivity and the servers and upgrades to keep them working, such devices are all but useless, and mostly unnecessary. Old fashioned, hard-wired phones work perfectly fine, even when the electromagnetic environment would block a cell phone call. Better to have a powerful backpack radio or satellite link that can reach across a continent, even during a thunderstorm or ionospheric flare-up, than a tiny pocket radio that needs an expensive radio tower network to carry a message.

POWER

The power requirements of humans on Earth, in space and on the Off-World colonies is huge, and provided by a variety of technologies. Foremost for the populations of Earth and for those of the larger core colonies, fusion powerplants are utilised. The first fusion reactor began supplying electricity to customers in 2060.

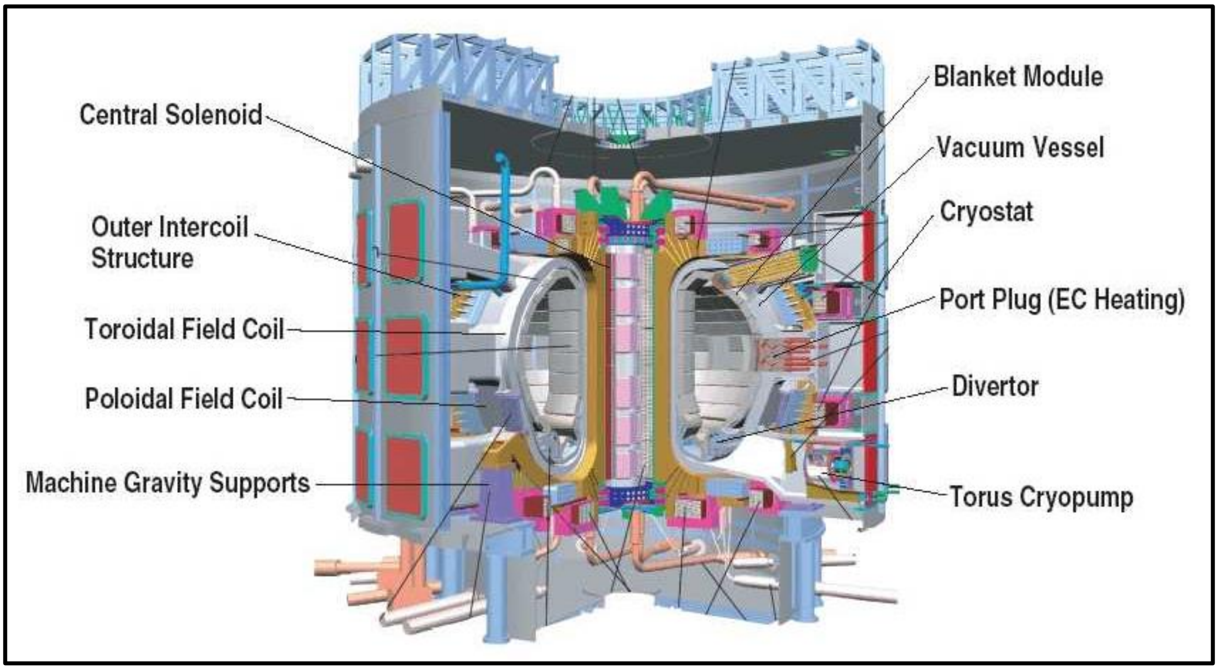
Origins of Fusion

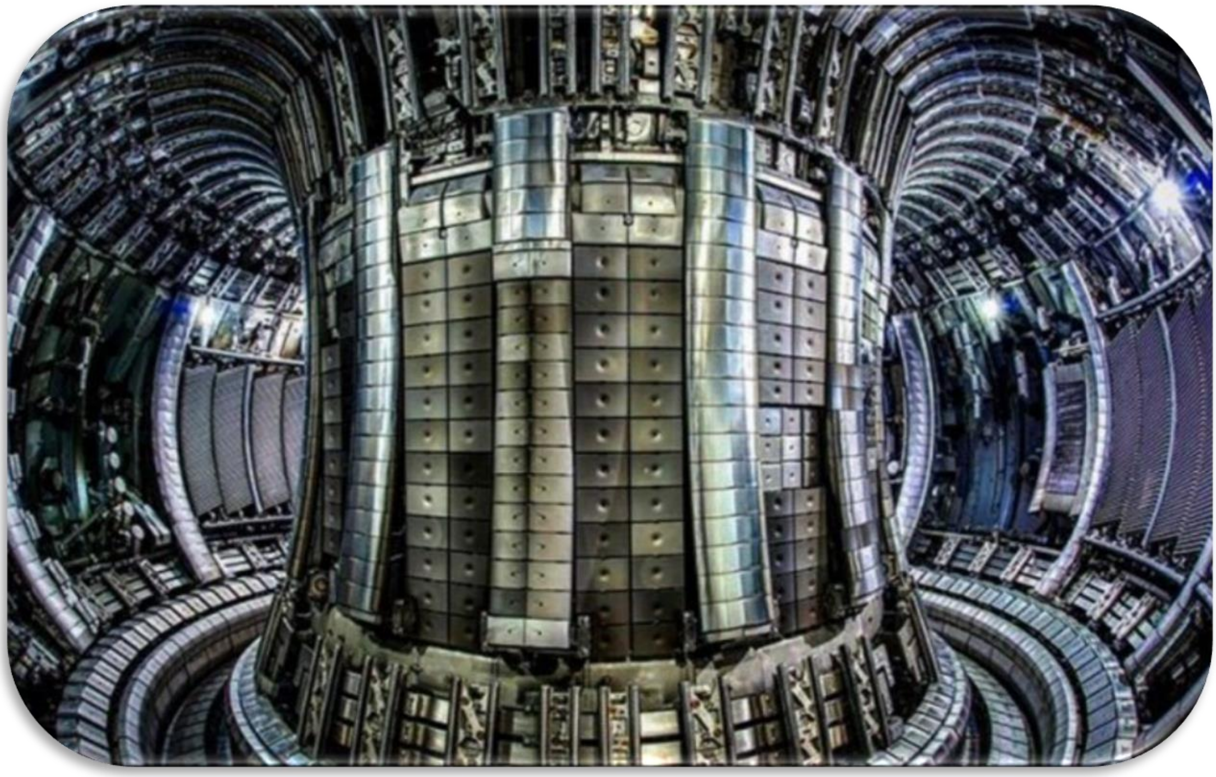
Back in the 21st century, Earth found a way to shake-off its dependence on Luna solar power energy when the first fusion reactor came online in 2060. The 'miracle powerplant', fusion reactors produced very little radioactive waste but incredible amounts of power. Various fuels are needed, such as deuterium and tritium, but the most sought after was helium-3. Although small amounts can be gathered on Earth, the greatest concentrations were in the solar system, waiting to be collected. This helium-3 was blasted into rocky surfaces by the solar wind and found on Mercury, the Moon and on the gas giants in the outer solar system. Earth had to secure a source of He-3 and it set its sights on Mercury, sending an initial colony to the Sobkau region in 2067. It wasn't to be. Expensive operations were sponsored that began to mine helium-3 from the Sobkou basin, but where was it all? To the shock of all concerned, it seemed that Mercury had very little of the precious material. It was now the dash for Saturn, and the vast amounts of helium-3 there, that quickly turned the Sobkou debacle into a forgotten memory.

The great expansion into the outer solar system began apace in the early 2070s. New rockets, nuclear thermal drives that were based around a fission gas-cored reactor using liquid hydrogen or water as a reaction mass, powered those long range missions. Fusion powerplants at that time were far too large to scale down enough for use as a space drive and so fission reactors remained the powerplant that allowed the exploration of the solar system. It was in 2084 that explorers from Earth arrived at Saturn with everything they needed to begin mining helium-3 from the gas giant's rich atmosphere. It established bases on the twin planetoids of Janus and Epimetheus; and there began a fusion industry that has continued into the present day. Helium-3 is extracted from Off-World colonies and shipped to Earth on multi-megaton starships to feed Earth's fusion reactors.

The Tokamak Reactor

Helium-3 is a stable isotope of helium that is missing a neutron, with this missing neutron allowing for the production of clean energy. Two types of fusion reactions make use of Helium-3 to produce clean energy. The first uses deuterium (deuterium is hydrogen with a neutron) reacting with Helium-3, to produce helium and a proton. The second type of reactions uses two atoms of helium-3 to create helium and two protons. The protons created during this last reaction are the crown jewel of Helium-3 fusion. One of the best parts of the Helium-3 reaction is the complete lack of radioactive by-products. No neutrons are emitted and no isotopes are left as products that could radioactively decay. The proton is a particularly nice side product, since clean energy can be harnessed from this stray proton by manipulating within in an electrostatic field. Traditional nuclear fission reactions used to create heat, which was then used to heat water. The boiling water forced turbines to spin and generate energy. In the helium-3 fusion process, energy is created via the reaction itself, with no nasty radioactive material for future generations to monitor.





While industrial-grade super-conducting magnets arranged as toroid (a 'tokomak') suspend the fuel and hold it in place, the reactor uses a process called radio-frequency heating to ignite the nuclear fuel. Antennas outside the tokamak use a specific frequency of radio waves to excite the particles. The radio waves are specifically calibrated to target the helium-3 ions. Because the helium-3 accounts for only a fraction of the fuel's total density, focusing the radio-frequency heating on the minority ions allows them to reach extreme energy levels. The excited ions then slam into the reactor's outer shell, generating heat and electricity. In order to overcome the electrostatic repulsion between the nuclei, they must have a temperature of several tens of millions of degrees, under which conditions they no longer form neutral atoms but exist in the plasma state.

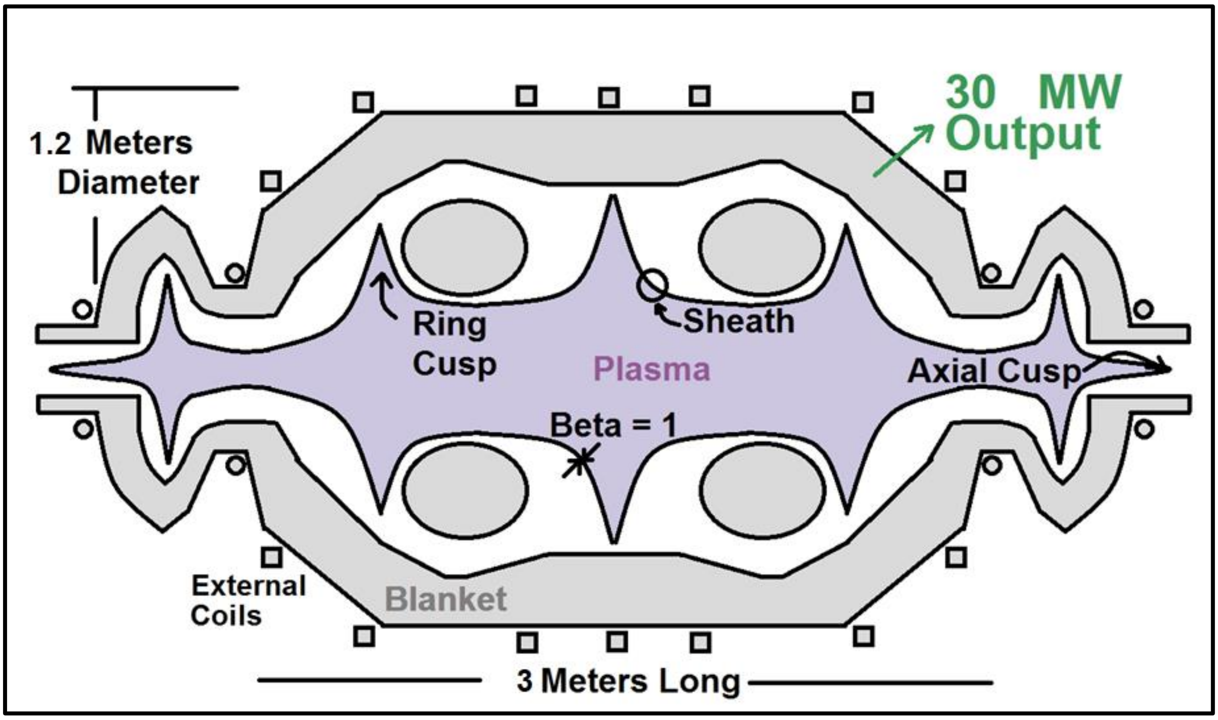
At these temperatures, no material container could withstand the extreme heat of the plasma. **HOSTILE** fusion tokamaks utilise magnetic confinement to create these conditions. They use the electrical conductivity of the plasma to contain it with powerful magnetic fields in the form of a hot plasma in the shape of a spinning torus. Meanwhile the tokamak's superconducting magnets and support structure must be chilled close to absolute zero and so most reactor's require a steady supply of liquid hydrogen as a coolant. Tokamaks are the workhorses of fusion - solid, symmetrical, and relatively straightforward to engineer.

Space-Based Reactors

Whilst large-scale, planet-bound reactors utilise helium-3 as their reaction fuel, space-based and starship reactors may use deuterium, tritium or helium-3, expanding their fuel choices when isolated from abundant fuel sources. The fusion powerplants still require small amounts of liquid hydrogen as a coolant to function efficiently. The standard rules for powerplants in Cepheus Engine are used. A starship powerplant rating must be equal or higher to either the hyperdrive or *half* the ship's maneuver drive. Although it has no effect on game-play and serves only as set-dressing, starship powerplant ratings can be thought of as being equivalent to Giga Watts of power output; meaning that a Powerplant 4 starship produces 4 GW.

Micro-Fusion Plants

Extremely small fusion reactors are in production, suitable as mining power sources or the powerplants for shuttles and small craft. None have been licensed for use within air or ground vehicles due to the dangers of radiation following an accident. The larger marine ships do, however, utilise fusion power. As a setting detail, we can assume that each micro-fusion powerplant rating is equivalent to 10 Mega Watts of power. A shuttle with a level 3 powerplant then, has a 30 MW rating. The micro-fusion plant is not simply a scaled down tokomak, that would be an impossibility due to size and weight considerations. Instead of confining the plasma within a doughnut-shaped ring, a series of superconducting coils generates a magnetic-field in which plasma is held within the broader confines of the entire cylindrical reaction chamber. Superconducting magnets within coils generate a magnetic field around the outer border of the chamber. The system is therefore regulated by a self-tuning feedback mechanism, whereby the farther out the plasma goes, the stronger the magnetic field pushes back to contain it. Micro-Fusion plants currently range in size from 1.2 to 10.5 tons of displacement (6,000 – 52,500 kg).



Shutting Down Or Detonating A Reactor

A reactor has four modes: OFF, LOW-POWER, CONSTANT POWER and OVERHEAT.

OFF – Procedures to turn a fusion reactor off are lengthy, requiring up to six hours. This mode is used when undergoing lengthy repairs or long-term storage. Switching the reactor back on to LOW POWER requires up to six hours worth of checks and procedures. The reactor will be totally unpowered.

LOW POWER – The reactor is not generating electricity, has no plasma and is safe. It will still require some monitoring, since it is still on, but it is not producing electricity. Whilst in LOW POWER mode, a ship equipped with a fusion reactor will be running bare minimum electronics from batteries only. Going into LOW POWER or coming out of LOW POWER to CONSTANT POWER takes only 10 minutes. This is typically done at the engineering control room (if on a starship or space station).

CONSTANT POWER – This mode is the standard electricity generating mode for a reactor, with plasma being created within the tokamak. Going from LOW POWER to HIGH POWER or vice versa requires takes only 10 minutes.

OVERHEAT - As has already been noted, fusion reactors require a modest amount of liquid hydrogen coolant that will require replacing frequently. Should this coolant run out, through either a malfunction, impact on the coolant tanks or through the shut-down of the coolant pumps, then the reactor will enter an OVERHEAT mode and explode in ten minutes or so, with a significant blast radius equivalent to an atomic bomb. If the reactor is in OFF or LOW POWER mode than there should be no real problems. However, if the reactor is in CONSTANT POWER mode, then significant and urgent action must be taken.

To put an OVERHEAT reactor into LOW POWER mode and prevent a catastrophe, the engineer must load four emergency nuclear bolts into hydraulic riser heads from an Emergency Reset System. The engineer will have to open up the floor-mounted coolant access panel, by unscrewing various emergency bolts. Once the panel is opened instructions for the Emergency Reset System are printed on its underside. Clearly marked will be the warning that, upon activation, the reactor will detonate in T minus 10 minutes. Moreover, the Failsafe Cut-Off System will not operate after T minus 5 minutes. The instructions to follow are:

1. Punch NUCLEAR BOLT CODE No 1
2. Verify BOLT CLAMP release
3. Perform INSERTION of BOLT No 1 to HOLD No 1
4. Remove NUCLEAR HEAD
5. Activate PUSH BUTTON SWITCH
6. Replace NUCLEAR HEAD
7. Verify SECURED
8. Verify SHUT-DOWN ACTIVATED
9. Repeat for HOLDS 2, 3 & 4

After the fourth NUCLEAR BOLT enters the fourth HOLD, a digital timer accompanied by an automated voice, begins the countdown to T minus ten minutes. The procedure can be halted and reversed by simply following the checklist in reverse – as long as the timer has not reach T minus five minutes. After that point the containment field within the tokamak will wind down and cannot be restarted. Micro-Fusion reactors do not have any facility for emergency destruction, and if they do explode due to coolant leak, the blast is the equivalent of a typical 1000kg high-explosive bomb.

In roleplaying game terms, the task may take more time then the character might actually have. Each bolt must be screwed in to the top of the riser, pulled up to its start position then a button pressed on the riser's side. The hydraulics then lift the riser out, simultaneously shutting down part of the tokomak. Because of the coolant problem and overheating, safety interlocks will continue to try to re-engage, thwarting the engineer's efforts, making this job quite difficult. Make an Average (0) Engineering roll taking 30 seconds to activate hydraulic riser #1. Continue with risers 2, 3 and 4. However. Each time a new bolt is inserted and riser activated, there is a chance those already set will drop back down (check each one with a D6 roll, and on a result of '1', it trips again and still needs to be reset).

This might be a time consuming and frustrating task, especially as those 10 minutes are almost up. Up to two characters can work on the risers simultaneously (a limit of sheer physical space). Electronics can be substituted for Engineering if desired. Meanwhile, the control room will be hot, venting steam and may even be kicking out radiation (1 rad per 2 minutes of exposure). Stuff might explode (and the player character involved might be forced to make an Average [0] Dexterity roll or suffer

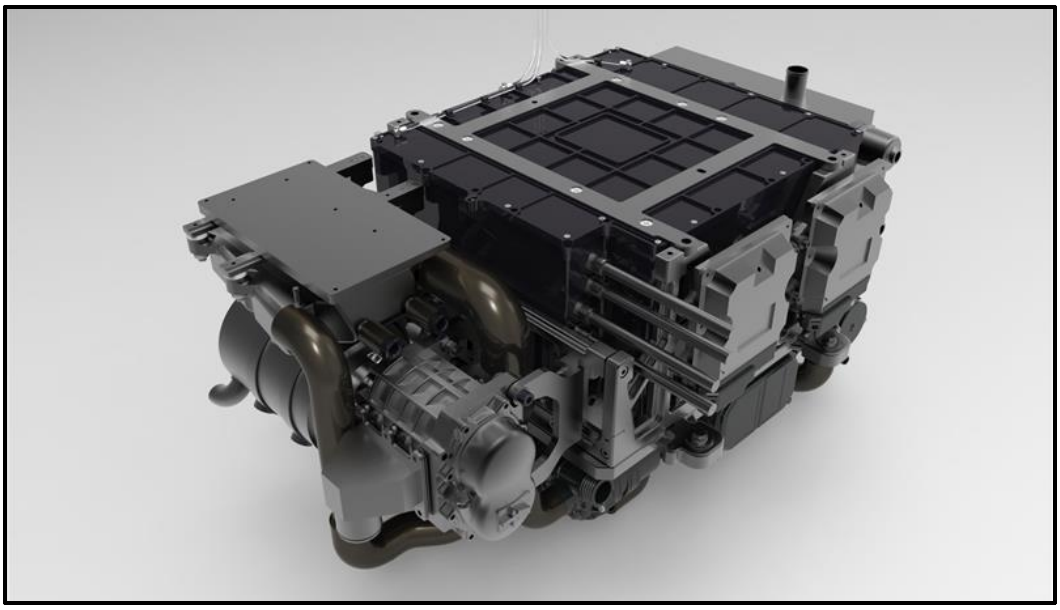
1D6 damage). Once in LOW POWER mode, the reactor will stop producing electricity.

Emergency Destruction!
It may be that the reactor is in CONSTANT POWER mode, but or whatever reason, the operators need to cause it to OVERHEAT. This procedure is identical to that of shifting from OVERHEAT to LOW POWER.

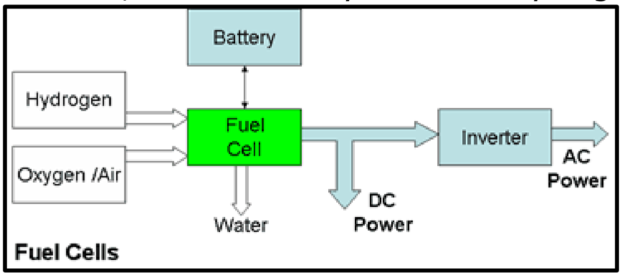
Fuel Cells

Petroleum is abundant, shipped to Earth via huge space-faring oil tankers, but much of this oil supplies the plastics industry. On Earth and in the Off- World colonies, too, hydrogen fuel cells are the dominant form of vehicular power generation. Where oxygen exists within an atmosphere, then some colonial societies operate gas turbine vehicles, such as rovers, tractors, container lifters and trucks. Gas turbines require a petrochemical fuel, and kg. for kg. this still provides more power than an equivalent-sized fuel cell. Virtually all medium to large aircraft are also powered by gas turbine jet engines. The US military had relied on a gas turbine or petroleum-driven vehicle fleet until the 2120s, but deployments to the newly established Off-World colonies soon highlighted a glaring shortcoming – gas turbines are air-breathing engines, useless on vacuum worlds, or planets with poisonous and alien atmospheres. Within the next ten years, much of the US military switched to closed fuel cell vehicle powerplants that do not require sources of external oxygen – the vehicles carry liquid oxygen tanks with them to supply the required oxidizer.

A fuel cell is an electrochemical cell that converts the chemical energy from a fuel into electricity through an electrochemical reaction of hydrogen fuel with oxygen or another oxidizing agent. Fuel cells are different from batteries in requiring a continuous source of fuel and oxygen (usually from air) to sustain the chemical reaction, whereas in a battery the chemical energy comes from chemicals already present in the battery. Fuel cells can produce electricity continuously for as long as fuel and oxygen are supplied.

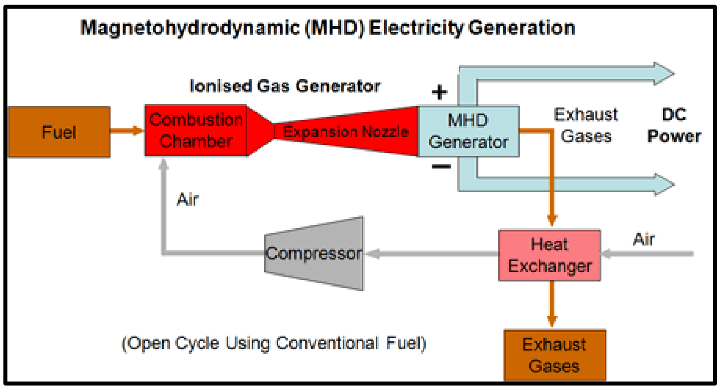


There are many types of fuel cells, but they all consist of an anode, a cathode, and an electrolyte that allows positively charged hydrogen ions (protons) to move between the two sides of the fuel cell. At the anode a catalyst causes the fuel to undergo oxidation reactions that generate protons (positively charged hydrogen ions) and electrons. The protons flow from the anode to the cathode through the electrolyte after the reaction. At the same time, electrons are drawn from the anode to the cathode through an external circuit, producing direct current electricity. At the cathode, another catalyst causes hydrogen ions, electrons, and oxygen to react, forming water. Fuel cells are classified by the type of electrolyte they use and by the difference in startup time ranging from 1 second for proton exchange membrane fuel cells (PEM fuel cells, or PEMFC) to 10 minutes for solid oxide fuel cells (SOFC).



Magnetohydrodynamic Generators

A magnetohydrodynamic generator (MHD generator) is a magnetohydrodynamic converter that transforms thermal energy and kinetic energy into electricity. MHD generators are different from traditional electric generators in that they operate at high temperatures without moving parts. MHD power plants create a plasma by burning liquid hydrogen and oxygen, pushing the resulting plasma into the turbine where it creates electricity just like a regular generator, except that the plasma takes the place of the spinning coils in the regular generator. The fuel needs to ignite the fuel, to start the process, just as a spark is needed to start an internal combustion engine - thereafter the turbine will produce net power.

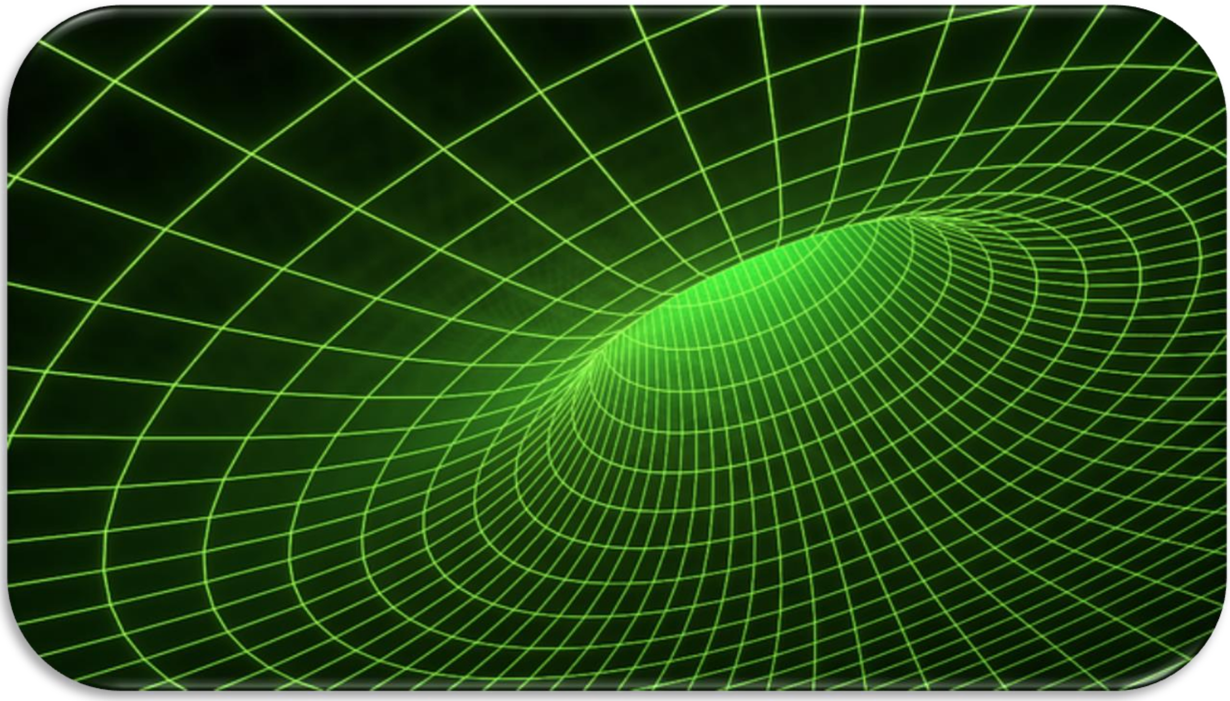


The working fluid in a closed cycle MHD is circulated in a closed loop. Hence, in this case inert gas or liquid metal is used as the working fluid to transfer the heat. The liquid metal has typically the advantage of high electrical conductivity, hence the heat provided by the combustion material need not be too high. Contrary to the open loop system there is no inlet and outlet for the atmospheric air. Hence, the process is simplified to a great extent, as the same fluid is circulated time and again for effective heat transfer.

Magnetohydrodynamic powerplants are becoming more popular as sources of power for large machinery, such as ships, hovercraft, trains, oversized trucks, submarines and tanks etc. Currently, PEM fuel cells are struggling to supply the energy required by these power hungry pieces of machinery. MHD powerplants are poised to fill that huge gap between fuel cell and micro-fusion.

HYPERDRIVE

Starships in the **HOSTILE** setting use a type of hyperdrive. A hyperdrive does not have a maximum range – instead, the ship's drive rating (1, 2, 3, 4, 5 or 6) indicates the number of parsecs crossed per week of travel. Speeds are rated at 'parsecs per week'. Hyperdrives do not consume additional fuel, but use electrical power, therefore the ship's powerplant must equal or exceed the rating of the hyperdrive. A starship can remain in hyperspace until either its coolant or its life support needs replenishing.



Discovery & Exploration

Faster than light travel is made possible by the discovery of a pseudo-dimension, one apparently co-existing with our own but possessing natural laws that are vastly different and for the most part void of scientific understanding. This altered reality was given several designations in the laboratory but is widely known simply as hyperspace, as a plane of existence separate and yet coinciding with the natural universe. The discovery was the culmination of decades of research based on the original postulates established by Burkard Heim, who coined the phrase 'hyperspace' in the mid 20th century, as one of several additional dimensions, above and apart from the physical three and Einstein's fourth. Heim's Unified Quantum Field Principles On Electro-Gravitational Energy Conversion and later the work of Walter Droscher and his colleague Jochem Hauser would lead to a century of study and ongoing scientific experimentation. The eventual result was two major breakthroughs assisting mankind's exploration of space; artificial gravity and the hyperdrive.

The first 'hyperspace' breech was generated by Yana Shuli Hurtz, a professor at the Technion Institute in Haifa, Israel in 2103 during experiments directed at developing a method for the generation of artificial gravity. The initially unstable and potentially dangerous Paragravity Dynamo utilised a massive amount of electromagnetic radiation generated from the spinning of a superconductor and temporarily stored within kilometres of superconducting coils. This energy was directed through contrabaric emitters to create a massive gravitomagnetic field initially in the 60-85 Tesla range. The field, although failing to produce the intended artificial-gravity results, instead propagated the first inter-dimensional breech. The effect was transient, with the unstable breech or 'shunt' collapsing immediately when interrupted by the presence of the Earth's own gravitational field - but the implications were astounding. For 0.06 seconds the dynamo and its support structures had not produced gravity, they had ceased to exist. Where they had gone was a mystery but it spurred an entirely new branch of scientific research, one that would dwarf the eventual benefits of artificial gravity.

Three years later (2106), at the Helstrom Research Laboratory on the asteroid Hygeia, a working prototype of a hyperdrive was constructed, the experimental navigational equipment brought online and a series of performance tests begun. The first passengers to visit hyperspace were instrument packages and scientific apparatus, carried within the hull of the Red Shift III test vehicle as it engaged in a series of increasingly distant hyperspace 'jumps'. As the vessel was 'shunted' into the hyperspace breech it encountered a quantum tunnel effect which extended from the departure jump point to the preprogrammed arrival point somewhere ahead. Without a designated beginning and end to this hyper-dimensional conduit the breach simply closed after a few seconds, the tremendous electromagnetic radiation dissipating into space. When correctly configured however the tunnel not only enveloped the vessel but exposed it to a torrent of accelerated hyper-resonant 'ripples' in the tunnel's activity stream. These ripples propelled the vessel forward, through the tunnel, at an incredible yet non-Newtonian velocity. The vessel itself experienced no sign of this velocity, no sense of movement at all and its conventional engines lay dormant throughout, a natural acceleration driving her through hyperspace as a ship caught in a strong current. The speed of this passage was dependent both on the mass of the vessel and the power of the 'shunt' generated as these factors correlated directly to the velocity induced by the resonant ripple effect.

Red Shift VII would have the distinction of successfully carrying the first human into and through hyperspace on June 28, 2106. The jump was only 135 million kilometers but the Red Shift (Christened 'Snark') arrived at the designated arrival point in only 6.4 minutes.

Effects of Hyperspace

Snark's astounding feat marked man's freedom from the confines of his system of birth and the start of his race to the stars. Less advertised, however, was the condition of the flight's test pilot, US Navy Captain Michael Squires. Animal test subjects had been utilized in previous tests and they'd returned with alarming behavioural disorders. The physicians believed these side effects could be overcome by a human being's understanding of the bizarre experience and that they were for the most part the result of the subject's stress. They proved to be wrong however and eleven human pilots suffered horrendous mental and emotional disorders after their exposure before researchers proclaimed hyperspace unfit for conscious passengers. When subjected to the hyperspace environment while in cryosleep or 'hypersleep' as it came to be called, travellers were unaffected by the neurosis and occasional coma-like symptoms experienced by the early test pilots. It became common protocol, therefore, to put passengers and crew into hypersleep and to assign monitoring duties on hyperspace voyages to the ship's computer or (on military craft) to an android.

Hyperspace itself appears as a vast, starless, and foreboding blackness, whatever light sources exist appear blue, shifting into invisible ultraviolet, except for directly in front and behind where the background microwave radiation in the path of the approaching ship blue shifts to the front and red shifts behind, providing a glowing, intensifying azure or magenta visual reference to the tunnelling phenomena at work.

Plotting a hyperspace run into the unknown, no matter how exacting the preliminary astronomical data, is incredibly dangerous and costly. Faster-Than-Light probes are sent out first to explore and map and then return with the data with which future hyperspace co-ordinates are plotted. These have to be very short trips however, the probes only jumping a fragment of a light year each time. Together with the analysis required to establish jump coordinates, it takes many months to establish even a single light year hyperspace run to a new location. Because of this, all crews in known space are using established routes and the nav-routes they work on to prepare their journey are more or less modifications of the program for current celestial movements, etc. Navigators are basically updating the pre-plotted hyperspace routes with 'at the moment' specifics.

Within the ship the drain on even the most overpowered reactors is sufficient to leech power from most onboard systems so lights are dim, many tertiary systems and crew luxuries inoperable and the temperature uncomfortably cold, some inherent element of hyperspace leeching the heat even from a wide open reactor.
When the hyperspace shunt opens a region of space roughly equal to the dimensions of the vessel, visually it blurs slightly then begins to glow blue from the localized light beginning to accelerate therein. A minute spark of flashing energy forms at the region's centre then expands in a vortex like pattern for a little over 2 seconds before dissipating in a sudden flash. When the light fades the vessel is gone. The reverse is true when an FTL vessel emerges only the ship's appearance is announced by a red-shift of approaching hyperspeed light and subsequent flash instead.

Hyperdrive Operating Parameters

Apparent Velocity: A hyperdrive does not have a maximum range – instead, the ship's drive rating (1, 2, 3, 4, 5 or 6) indicates the number of parsecs crossed per week of travel. Speeds are rated at 'parsecs per week'. A drive rated '1' will take 7 weeks to get to a destination 7 parsecs away.

Fuel: Hyperdrives do not consume additional fuel, but use electrical power supplied by the ship's fusion reactor. Therefore ship's powerplant must equal or exceed the rating of the hyperdrive.

Endurance: A drive can maintain its presence within the hyperspace tunnel indefinitely, it is limited only by the amount of coolant carried on board and the life support needs of the crew. Typically enough coolant is carried for 12 months of reactor operation, equal in displacement to the fusion reactor itself.

Entering Hyperspace: Gravity and hyperspace have a very uneasy relationship, and entering hyperspace is best done away from any major gravitational field (such as the system's star). Pre-existing hyperspace points (HSPs) have been charted in all explored star systems, all of which exist well beyond a star's habitable zone. The bigger the star (the more luminous the star is) – the further out these HSPs are. Hyperspace points are surveyed locations beyond a star's habitable zone, they are the perfect confluence of gravity, dark matter, orbital mechanics and fluctuations through time that allow easy access to hyperspace. There are scores of HSPs in any one star system, each one is an invisible 'bubble' of 'hyperweak' space in the outer system that is several thousands of kilometres in diameter.

Leaving Hyperspace: Due to the serious risk of emerging within or adjacent to a large moon or planet, hyperspace jumps are by necessity terminated at pre-mapped, pre-surveyed hyperspace points within the destination star system. Starships emerge with the same velocity with which they entered hyperspace and on a preferred pre-planned course to the system's mainworld. It must decelerate to enter orbit around that world.

Communications Within Hyperspace: FTL communications (both sending and receiving) using a hyperwave transceiver is possible both while the ship is in hyperspace and when it is in 'real space'. Messages are brief (see next chapter, Communication).

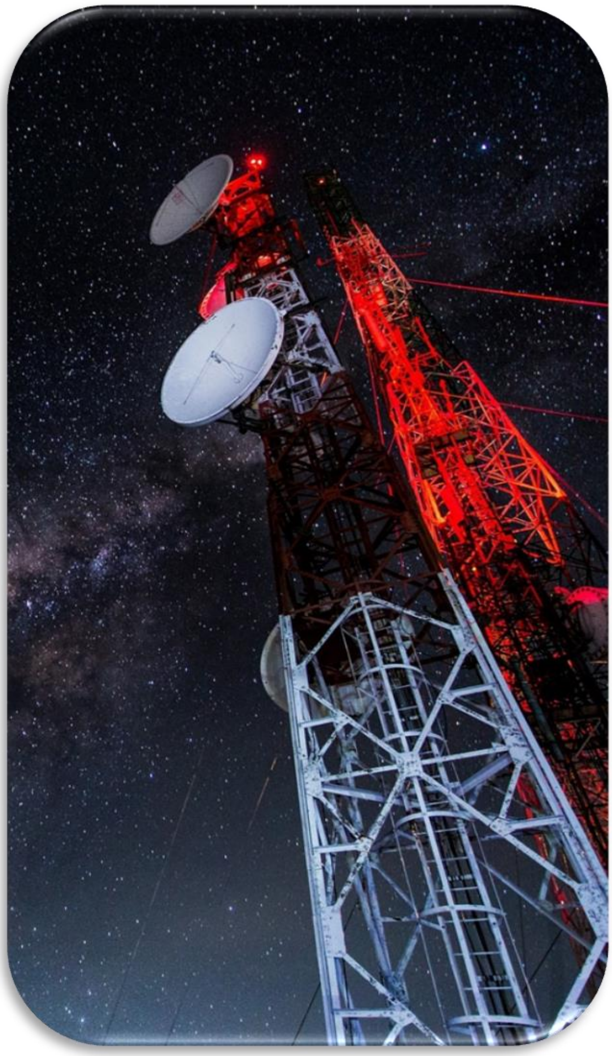
Sensor Operations: There are no sensors currently suitable for use in hyperspace. Distance travelled is measured purely by reference to elapsed time and hyperdrive-calibrated frequency.

Medical Effects of Hyperspace Exposure: Humans feel uncomfortable (see main text) if awake during hyperspace transit. In addition, roll 3+ on 2D6 each week to avoid a serious indefinite symptom (increase difficulty by +1, each week after that). The 6 most serious symptoms include : amnesia, stupefaction, violent paranoia, tremors & fits, self-harm, terrifying hallucinations.

COMMUNICATION

There are five primary means of communications in use in the 23rd century.

Hard Copy – A misnomer that has come to describe any form of data-holding object from a data-disk to a sheet of paper. The use of courier services to manually deliver such information is still popular, accompanying parcel delivery as a safe, albeit slow, alternative to other means of transfer.

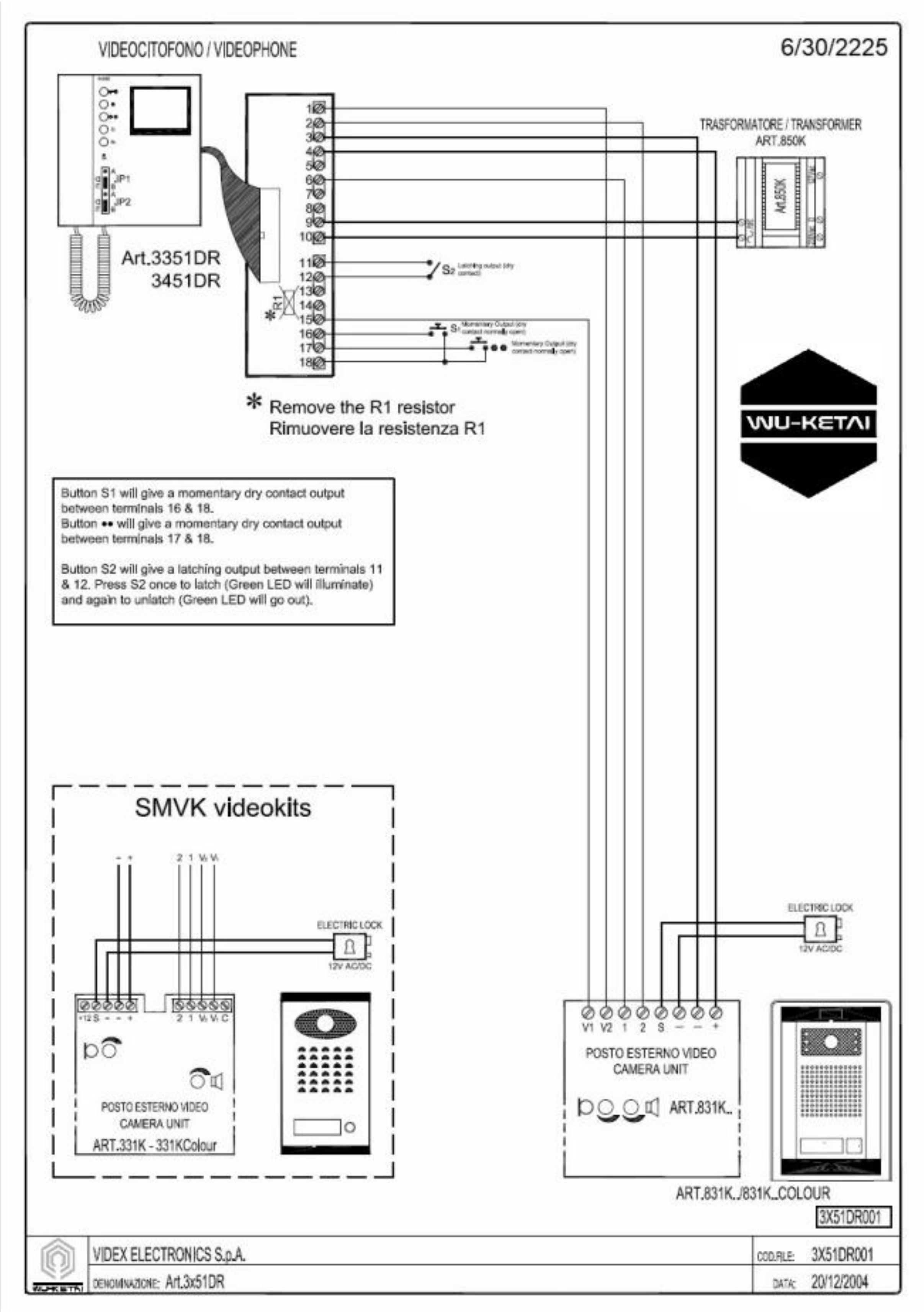


Fibre Optics – A direct hard-wired connection between communication devices is still the most prevalent method of distant communication on any world or vessel. Reliable and secure, a 'land line' avoids many of the pitfalls of wireless communications and is by far the more cost effective solution. Networks of fibre optics web every habitable zone and are capable of transferring massive amounts of data as well as video and audio communiques.

Radio – Electromagnetic transfer of information is still a favourite form of communication in the universe. Improvements to bandwidth, wavelength stability and transmitting power have kept this technology current, although larger equipment packages have become necessary to manage it. Despite the advances in signal strength, now capable of interplanetary distances, the radio wave is still limited by light speed and steadily degrading efficiency over distance. It remains however the preferred medium to broadcast audio and video as well as attached data bursts. Microwave based communications are still utilized but typically for secure, short-range transmissions only. They are particularly common in ground to orbit or inter-orbital comms. Maser sets are common equipment in any comm suite.

Tight Beam Laser – Using lasers to carry information to a specific target is a highly secure and efficient, if expensive, medium. Capable of tremendous distance and pin point accuracy Free Space Optical Communication (FSOC) has been in use for a century or more but has come into its own. Powerful carrier frequencies 'piggy backed' on laser emissions can deliver data packs and large memory caches at incredible speeds. A series of laser-linked satellites make the Integrated Data Network within well-travelled space possible.

Hyperwave Transceivers - Faster-than-light communication exists, although it certainly is not instantaneous. All starships equipped with hyperdrive have FTL communication capability *by default*, as do most large outposts and colony worlds. The system requires a space-based hyperwave satellite to relay the signal from one star system to another – it cannot be done from a planetary or moon surface. Typically an uplink tower sends the message up to the hyperwave satellite which then powers up to send it on its journey through hyperspace. As would be expected, these satellite relays are incredibly expensive and only the larger colony worlds with populations in the millions can afford to maintain more than one of them. Communication on the Network takes 1 parsec per day. Hyperwave bandwidth is small, allowing only a short burst of text (200 characters maximum; without spaces), much like an ancient telegram. Private use is very costly, the Network will charge you, your company or your colony administrator $50 per character (spaces are not charged). A 200 character message costs $10,000!


VIDEOCITOFONO / VIDEOPHONE
6/30/2225
TRASFORMATORE / TRANSFORMER
ART.850K
Art.3351DR
3451DR
JP1
JP2
R1
S2
S1
* Remove the R1 resistor
Rimuovere la resistenza R1
WU-KETAI
Button S1 will give a momentary dry contact output between terminals 16 & 18.
Button •• will give a momentary dry contact output between terminals 17 & 18.
Button S2 will give a latching output between terminals 11 & 12. Press S2 once to latch (Green LED will illuminate) and again to unlatch (Green LED will go out).
SMVK videokits
ELECTRIC LOCK
12V AC/DC
POSTO ESTERNO VIDEO
CAMERA UNIT
ART.331K - 331KColour
ELECTRIC LOCK
12V AC/DC
V1 V2 1 2 S — — +
POSTO ESTERNO VIDEO
CAMERA UNIT
ART.831K..
ART.831K../831K..COLOUR
3X51DR001
VIDEX ELECTRONICS S.p.A.
COD.FILE: 3X51DR001
DENOMINAZIONE: Art.3x51DR
DATA: 20/12/2004

Utilizing hyperdrive methodology a hyperwave transceiver opens a minute nano-singularity hyperspace shunt and transmits a isomodulated, narrow beam LnK2 (Link) laser through the tunnel. Similar to hyperspace navigation the carrier beam is configured to respond to hyper resonant ripple effects, speeding towards the plotted destination and breaching there, normally in proximity to another subspace satellite receiver. The message is then forwarded by conventional means on through whatever network is available. Hyperwave satellites are extremely expensive and maintenance intensive and only the most profitable or established locations can hope to be assigned on. The equipment is truly huge in scale with the typical orbital transceiver weighing in at several tons and the dish measuring several dozen meters in diameter. These satellites are truly immense apparatus and require equally extensive support equipment. FTL capable vessels however are already equipped with the lion's share of the process and typically have a hyperwave transceiver as part of their communications suite. This module is linked to their hyperdrive and can facilitate FTL transmissions at a fraction of the energy cost and electronic complexity of a standalone unit.

The relay system of the Network is operated by the United Corporate Combine and is more formally known as the Integrated Data Network. It is headquartered on the Earth's Moon. The Network operates a small fleet of platform support vessels that it uses to deploy new satellites, repair or decommission old ones and to ferry personnel from site to site. The organization is also tasked with scanning local star systems for communications, and is particularly concerned with distress signals from both civilian and military starships.

Starship Communications

Standard comm suites on spacecraft, orbital platforms and both space-based and planetary installations allow for radio and free-space optical laser communications system wide. Radio transmitters are capable of narrow and broadband transmissions while laser communication rigs require precise target location data to connect. Trafficked systems incorporate FSOC linked satellite networks to facilitate regular comms while almost any orbital body of corporate or governmental interest is seeded with a few communication satellites. Commercial com gear permits operations on a number of approved frequencies and emergency bands while restricted frequencies are utilized by military and private entities. All such comm traffic is of course at light-speed only with the associated delays at interplanetary distances.

Videophones

In **HOSTILE**, the revolution in communications wasn't the cellphone, but the videophone. There are videophones in cars, on office desks, in bars and clubs, railway stations and airports, space stations, starship corridors and apartments. And of course they exist in public phone booths, too. But don't think that these phones are all simply dial-and-talk interfaces, most can also accept data cards. Some of these are business cards that, when slotted into the phone, ring the employee at the business automatically.

Fone cards are more commonly used by individuals to store all of their encrypted personal details, very much like a modern-day SIM (Subscriber Identity Module) card. A person slots their fone card into the video phone and this brings up a menu on screen of that person's contact list and their numbers, which the phone can then dial. Included on the data card is an electronic diary. These fone cards can be slotted into a bank terminal and topped up with funds.

The Retro-Radio

Instrumentation is typical of the technology of the time. Cathode screens, manual key boards, toggles, rotary knobs, dials and switches are prominent with hand held receivers, microphones and wall mounted intercom panels the norm. Readouts are backlit indicators and needle deflection gauges. Hard copy printers are common place, providing printed format message translation or performance analysis. Quality of audio or visual communications is highly dependent on signal strength but in general is moderate to poor, with the quality of the receiving display equipment potentially degrading quality further. This is especially true in space applications. Transmission of teletype - hard copy written messages is an ongoing and popular alternative as signal strength requirements are minimal and even outdated equipment reliable that mode.

ARTIFICIAL GRAVITY

Developed almost simultaneously with Faster-Than-Light (FTL) travel, early research in artificial gravity actually spurred progress in that related field but found success itself only after embracing fundamental changes in design theory. The eventual result, after nearly a decade of experimentation and countless programme failures was an operating graviton generator. The Faraday Primary Induction Emitter (FPIE), as it was first coined after Michael Faraday, originator of electromagnetic theory in the 1800s, utilized a superconducting stator and ultra hi-speed electromagnetic induction rotor suspended in a cylinder of pressurized ladium gas. Together they produced a localized but powerful gravimetric field using controlled angular accelerations with a correlation factor of a modest 0.94G. The effect was a steady stream of gravitons emanating from the stator which were then repolarized and shaped into a singular linear projection. When trapped between a pair of field matrices a short-ranged non-Newtonian gravitational effect was induced.

This effect was limited, the field reaching only a 3 or 4 meters and displaying a hard cap of 1.022157 standard Earth gravities. However, when confronted with counter gravitational or inertial energy the matrix repolarized, inverted the counter energy's potential and was able to, in effect, nullify this influence to a much higher 6G to 8G threshold. The dreams of gravimetric drives, tractor-beams and anti-gravity lifts were dashed, such marvels relegated to future projects perhaps after years of research but the Faraday Emitter in its current state proved perfect for two critical applications. When properly calibrated the emitters provided comfortable gravity aboard ship and could to some extent counter the effects of acceleration/deceleration on the crew when linked to the ship's accelerometers. After barely 18 months of initial trials, Faraday Primary Induction Emitters and their corresponding graviton field matrices (together named an Artificially Induced Gravity Assembly - AIGA) were being included in the design of almost every new spacecraft and were being retrofitted into hundreds of older models as well. Polytarizine capacitors were soon added to all extant models that maintained gravitational control for several hours in the event of power loss - but no solution was immediately forthcoming to avoid 'Damper Lag'. This brief period of unsettling and sometimes dangerous unprotected inertial reaction occurred during the first few seconds of a marked inertial change as the dampening field adjusted. A number of accidents lead to standard operating procedures requiring all personnel to be strapped in during manoeuvres. This prevails today.

Space travellers could, with the newly developed Artificially Induced Gravity Assemblies (AIGAs) systematically placed throughout the vessel, operate without the rigors of zero-G and better endure the stresses of high G manoeuvring. The improvement to the safety and efficiency of space operations was dramatic, although the equipment was still optional however and expensive. Small orbital transfer vehicles, shuttles, military attack craft and many semi-automated ships with limited crew service areas endured or utilized established counter methods such as spin-habitats, vectored thrust gravity, accelerator couches and pharmaceutical high-G tolerance regimes. The AIGA technology was improving however and few doubted it would replace such measures within a generation. On all big ships, AIGA technology, providing a comfortable 1G approximate environment, is standard.

The AIGA generators that house the FPIEs (each roughly the size of a refrigerator) are fitted on each deck in a symmetrical layout, each with an accompanying spider web of graviton matrices woven throughout the hull decking. Larger ships would require more generators, certainly at least three per deck but perhaps one per large section as well. Sections requiring their own Artificially Induced Gravity Assemblies might include Command, Crew Services, Engineering, Crew Quarters, Lab and Medical, Cargo Area, etc. The limitation is that a matrix must be installed above and beneath the area of artificial gravity. Outdoor basketball games on zero G worlds or on the exterior hull of the ship are not feasible!

HYPERSLEEP

As already discussed in the Hyperdrive chapter, human beings have struggled and failed to retain their sanity whilst travelling through hyperspace. To that end targeted temperature management (TTM), or 'therapeutic hypothermia' was put into practice specifically for interstellar travel. TTM reduces a patient's core body temperature, cooling vital organs and slowing metabolic rates similar to those of hibernating mammals, such as the arctic ground squirrel. This space-faring technology is called statis or hypersleep, but is also known (erroneously) as cryogenic freezing or 'cryo'. This hibernation mimics the natural hibernation of bears and squirrels in the wintertime when food is scarce. Crew-members in stasis sleep and breathe very slowly, whilst food is administered by an intravenous pump. The and crewman still ages, albeit at a slightly slower rate.

Hypersleep Pods

Hypersleep stasis pods (or 'tubes') must be included for every human being onboard a hyperdrive-equipped starship; epilepsy, madness, insanity or coma will affect any living creature passing through hyperspace that is not protected by stasis. One hypersleep pod carries one crewman or passenger, costs $50,000, and displaces one-half ton. The pods are typically laid out in rows within a dedicated stasis or hypersleep chamber. The walls of the chamber house lockers for clothing and personal items, and the berth typically includes a toilet and shower for last minute ablutions.

The hypersleep chamber is made up of a contoured bed with heatable pads, fitted within an enclosed capsule. These have transparent and fireproof lids. The chambers are programmed by the starship computer to initiate, maintain and terminate hypersleep stasis of crew based on the length of the mission. Zero-loss lithium ion batteries within a backup system support the chamber's function for up to 100 years in case of emergency.

While individuals in status are removed from the effects of timeand incurable insanity, long periods of hypersleep can cause muscle tone to weaken, often leading to cramps and the diminishing of physical abilities upon waking. Even so, stasis tubes are effective to the point of being able to sustain and suspend an individual for decades, although waking from such a lengthy period of stasis carries with it minor side effects, including nausea, exhaustion and dizziness, that may last for several days. Being removed from stasis abruptly without a proper wake-up procedure is dangerous, and while not usually fatal, it can lead to damage.

Stasis Systems

Passengers or crewmen entering stasis are actively cooled to a mild hypothermic state (defined as a core temperature between 32 to 34 °C). Shivering (a muscle activation response that tries to rewarm the body) is commonly suppressed with a very low-level infusion of propofol and fentanyl, with the intermittent treatment of benzodiazepine. The ship's medic typically administers this first shot, whilst carrying out a quick medical check to ascertain the suitability of the subject for stasis. He or she then helps the subject get settled in the chamber and inserts both a feeding drip, a urine catheter and the all-important cooling line. In most cases this cooling catheter would be inserted into the crew's femoral vein or into the chest. A double lumen, cooled saline solution is then pumped through a metal coated cooling line inserted into the subject's femoral vein. The saline cools a crewman's whole body by lowering the temperature of their blood through conduction cooling. No cooled fluid actually enters the patient's blood stream. The Haruna K560 Cool-Line is the most common version of the stasis cooling system in use today.

All of the nutrition and hydration requirements of a crewman are provided by a liquid solution that is administered via an intravenous (IV) feeding drip directly into the body. This aqueous solution contains all nutrients that the body needs to maintain full physiologic function and is fed slowly through the IV.

Once the ship's computer (or the android on-board) drops the ship out of hyperspace, it will initiate the crew wakeup procedure, pumping warm water into the veinal lines, and shutting off the feeding lines. It will also activate heating pads inside the seat cushion.

Unlike in the standard Cepheus Engine rules, there is no danger of death, unless being resuscitated in an emergency.

OPTIONAL STASIS TIME PERIODS

From Wake Up - To Standing Upright

- Standard: Double Endurance subtracted from 35 minutes (av.21 minutes)
- Emergency: 1D6 minutes; crewman also makes a Difficult (-2) Endurance roll or suffers 1D6 damage and -1 to all tasks for 3 hours.

From Undressing – To Going Unconscious

- Standard: If Medic makes Routine (+2) Medicine roll, time is 5 minutes. If failed, or without a medic, time is 20 minutes.
- Emergency: If Medic makes Average (0) Medicine roll, time is 2 minutes. If failed, or without a medic, time is 12 minutes. Any crewman undergoing emergency stasis risks permanent physical damage. Successfully make a Routine Strength roll or reduce Str, Dex *or* End permanently by 1 point (player chooses).

Passenger Ticketing Options

Standard-Class Starship Ticket ($1,000)

This is a ticket on a commercial liner. With a standard-class ticket the passenger is frozen at the starport and shipped to the starship like freight. He or she has a meagre 10kg baggage allowance that fits into the locker at the foot of the hypersleep pod. Equivalent to Cepheus Engine's Low Passage.

Elite-Class Starship Ticket ($8,000)

This is also a ticket on a commercial liner. The elite-class ticket has more perks, however, reflecting its higher price tag. Passengers are given a drink and snack before being put into hypersleep on board ship, and they are woken on approach to their destination, giving them time to shower, dress, eat and acclimatize themselves to 'normal space' before deboarding the starship. In short, they are treated more like privileged crew than freight. Elite-class tickets include a generous 1000 kg baggage allowance that is carried in the ship's hold. A 10 kg 'carry-on bag' is also allowed that is stowed into the locker at the foot of the hypersleep pod. Equivalent to Cepheus Engine's Middle Passage.

COMPUTING

Fitting the retro-tech setting of **HOSTILE**, computing more resembles the systems of the late 1980s than those of the early 21st century. Key differences are a lack of wi-fi cable-less technology and the absence of ultra-miniaturization of computing. There are no palm computers or smart phones and touch screen technology does not exist (apart from the advances made in the Hosaka Memex, see later). None of this means to say the computers in 2225 are not powerful and versatile machines, it's just that they have a number of minor limitations which we in the twenty-teens, are no longer familiar with. Forget full-colour LCD or plasma screens, too, the cathode-ray tube (CRT) monitors in **HOSTILE** are monochrome, typically green, although amber, blue and even white displays are in use (the actual colour depends on the type of phosphor being used to create the display.

The computers of the 22nd and early 23rd century certainly are wonders of technology, the culmination of decades of improvements in processing speed, data storage and in recent years, user interface and artificial intelligence. They are however bound mechanically by the electronic construction methods of the society they serve and in this regard computers have become faster, smarter and more intuitive but also larger, and more demanding of power and cooling. Even computerized sub-systems, control modules and monitoring equipment, along with a million other subtle applications in modern technology, must contend with the restrictions of their component parts. Chief among these is size. For all their sophistication and capability the computers of 2225 AD are solid, bulky and for the most part ugly. These are incredibly powerful machines but equally power hungry, frail, maintenance demanding and super-heated.

Mainframes

Mainframes, the true work horses of the computer world, are large with spacecraft and naval shipping models requiring entire sections of the ship to commit to several tons of memory storage and processing equipment. Permanent ground installations in office blocks and corporate HQs can be even bigger with CPU speed and capability limited only by sheer acreage, power supply and coolant. Main frames are sealed behind ventilated metal shielding and sprout kilometres of electrical conduit, fiber optic cable and coolant lines. Temperatures must be continually controlled to keep CPUs at peak performance and mainframe berths are kept extremely cold, as a rule. Backup generators, redundant coolant equipment, fire suppression and other support machinery surround mainframes increasing their bulk and complexity. The tonnage assigned to the starship's bridge typically incorporates both avionics and much of this extensive computing infrastructure.

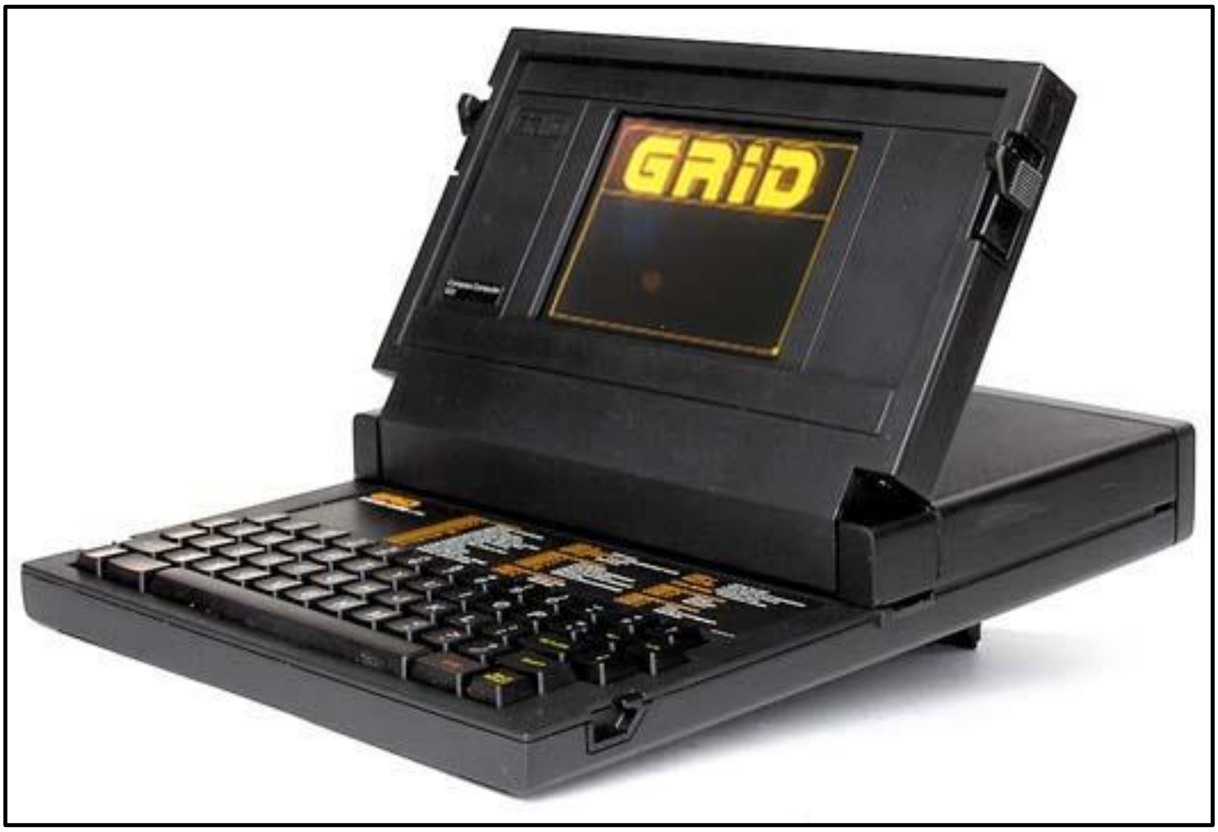
Workstations

Hard-wired workstations are the user portals into the computer brain of the mainframe. They are used to provide outputs from the mainframe and to allow access to its capabilities. Workstations are often used in factories, on colonies and on board starships and space-stations. Used to access a mainframe, the workstation has a rating of Model/0 (it does not run its own programs). Workstations, however, can also be stand-alone computers, much like modern-day PCs. They have integral processors and memory hard drives with their own dedicated software. Workstations in some installations or businesses will often be connected to one another via a wired network and can be rated as a Model/1 to a Model/4. A workstation weighs around 10kg (without chair and console unit) and costs $250.

Construction of a ‘computer room’ is de rigeur when a mainframe is installed, in a building, starship or colony complex. This 6 metre-square room houses a master workstation which allows an operator to see every active monitor on the computer network, it allows deep-level programming to be carried out and must be used in those cases where the administration password is required. Typically the room requires a coded pass to enter, either via an ID card slotted into a reader or a numeric keypad.

Portable Terminals

Portable computers are available but provide a minimum of processing power and memory and weigh in at around 5kg. These stand-alone computers resemble modern laptops with hinged cases and they often run dedicated software; however they must be connected to the hardware they control via a cable. Controls for complex field equipment require these dedicated laptops, often supplied in tough,



anti-shock cases with integral carry handles. Portable terminals like this are supplied along with remote sentry guns, uplink transmitters, portable radars and drones – (amongst other things). Portable terminals weigh 5 kg and are rated from Model/1 to Model/4.

Interfacing

Computer screens are monochromatic cathode screens for the most part, simplistic and purely functional in design with little thought to user appeal. Keyboards are the primary control interface for users, spring-loaded keys clacking loudly when entering data or command prompts. Some expert-system keyboards feature integral trackballs for the precise targeting or activation of commands or for interfacing with graphical displays. Voice recognition modules are available of course but are rarely utilized at workstations or remote terminals. Only direct communication with the central CPU typically warrants such a luxury and then only on top-of-the-line models. Peripherals such as memory storage disk drives and printers are common, with hardcopy printouts of critical data lines regular procedure for many users.

The Data Network

Working in an orbital hab, an outpost or in the science bay of a starship, a character will have access to a Local Area Network (LAN) which constantly monitors machinery, environmental readings and subsystems using telemetry – things like ATVs, vacc suits and drones – all in real time. Of course the LAN also features extensive memory files and scientific software, but it is mainly concerned with monitoring and controlling a complex piece of machinery. Some corporations and other organisations run their own LANs known as intranets, closed systems that allow access to wider nets only through established data gateways.

A data network exists in 2225 that not only covers the entire Earth, but stations throughout the Solar System and all of the Off-World Colonies and outposts as far as the Outer Rim. It exists where communication exists, data piggy-backing on com-lines to allow computers to transfer data and to communicate with one another. Today we call this the Internet, in **HOSTILE** it is known as the Integrated Data Network (IDN, or simply, 'Network'). Because communication is greatly delayed by the great interplanetary and interstellar distances involved, the Network employs a new set of protocols and technologies that are tolerant to large delays and errors. Data requiring transfer is bundled, stored and then forwarded and this means that instantaneous net usage is impossible. The Network across the Solar System is broken up into separate Planetary Area Networks (PANs), such as Earth-Net, Titan-Net and so on. Likewise, the separate interstellar colony and outpost worlds have their own PANs (such as Hiroshima-Net). The huge communication time lag between worlds effectively closes these PANs off from one another and communication between them is effectively via text, voice or video email, forwarded data transfer packets and bulletins.

Data Storage

Data Cards are the main method of mobile information storage and resemble modern-day smart cards. A data card resembles a credit card in size and shape but it is more than a piece of plastic. The inside of a data card contains an embedded microprocessor. Data cards may have up to 1 gigabyte of RAM as well as a 16-bit microprocessor; they use a serial interface and receive their power from the card reader they are currently connected to. Their weight is negligible and their cost is $5 each.

Optical Discs are used as a more powerful file storage platform and are also the central format for playing media (video and audio). The standard Baumann GmbH MiniDisk series holds up to 15.9 gigabytes of data and each glass disc is permanently mounted within a small, rectangular plastic case. The disc itself can withstand extreme temperatures and pressures and is predicted to hold its data internally for millennia. Their weight is negligible and their cost is $15 each.

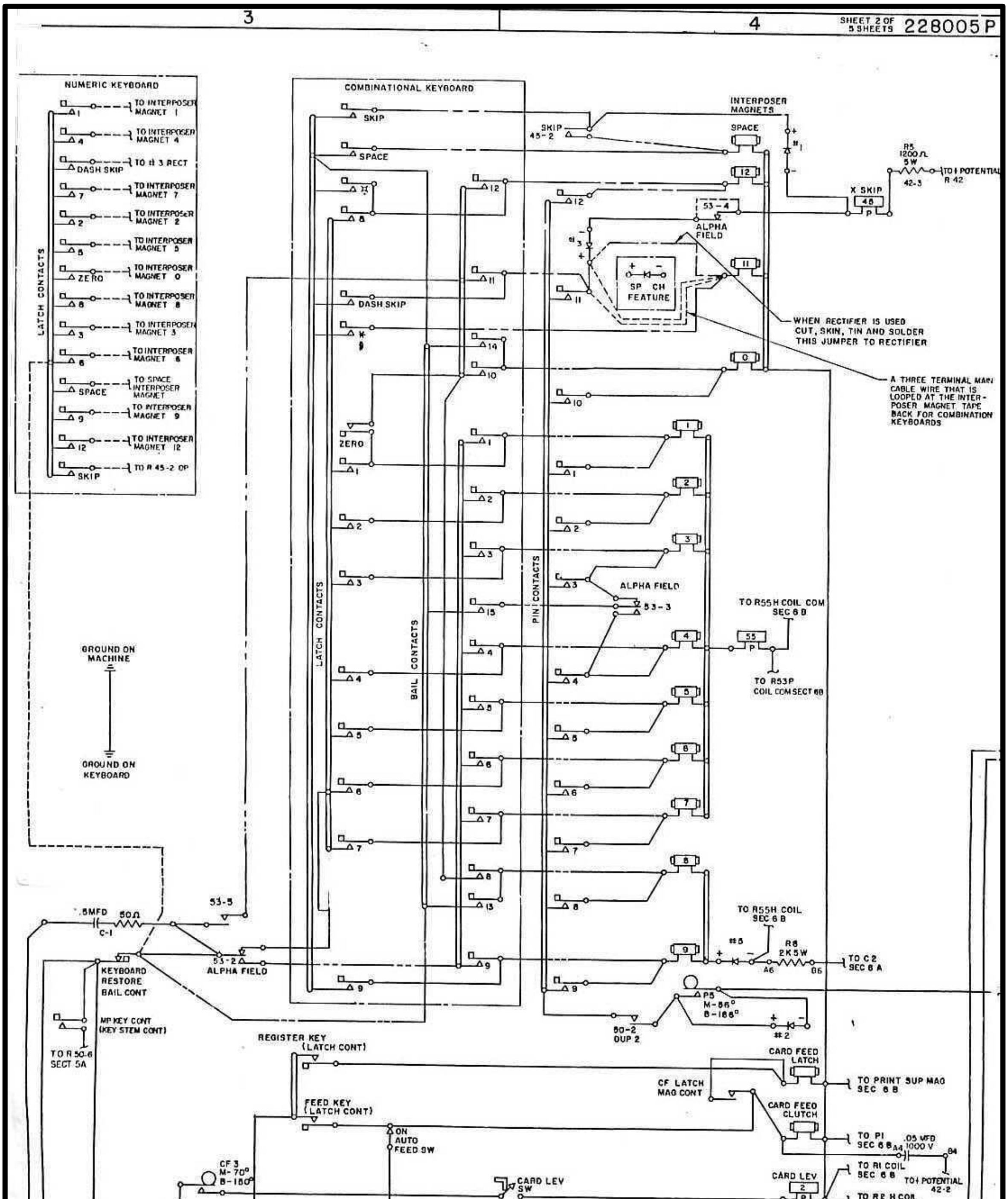
Software

While **HOSTILE** provided a limited number of software options for starship computers, its sister RPG, **Zaibatsu** provides many more options. **Zaibatsu** also provides a system for hacking into mainframes, computer networks and other parts of cyberspace.

Personal Electronics

There are a variety of small, personal electronics, but nothing comes close to the modern smart phone or tablet. There are digital cameras, as well as card readers and optical disc readers, for example, which are used for reading or editing data cards or watching videos, respectively. Beyond the portable terminal (the **HOSTILE** equivalent of the laptop) sits the memex, a single-use electronic data handling clipboard.

Hosaka 4 Memex: A handy, clipboard-sized Model/0 terminal running administration and record-keeping software. It features a monochromatic screen with an in-built stylus. The memex is quite rugged, and it features a spring-loaded jack cable for plugging into any videofone unit that enables it to access the Network. It can plug into the Network physically and in a world like **HOSTILE** where wireless computing does not exist, the memex may play a much bigger role. Cops can use it to check in to HQ to search through mugshots or licence plates, small amounts of data can be downloaded by cable into the memex memory. Data cards are used to add more data to the functionality of the memex, and any accounts or records that the device creates can be stored on data card. Starship crews, courier firms and corporations around the world use the memex to record, track and confirm cargos and packages. Its record-keeping software is popular around the world, the memex even being used by the US Marines and other military services. This electronic clipboard ('e-board') weighs 2 kg and costs $250.



Part of the Architecture of a Model/1 CRM Basic Workstation

ANDROIDS

Advances in bioelectronics throughout the 21st century saw the birth of the first androids but these marginally reactive semi-automatons only barely deserved the distinction. Confined by the same electronic principles that hindered their electronic cousins they were little more than programmable machines in human form. It was not until startling developments in wetware science and accompanying biorobotics emerged in the mid-22nd century that the dream of a true android became a reality. Through bioengineering specific cell structures, programming individual neurons and artificially sequencing DNA strands, a biological element was introduced into the otherwise electromechanical construction of the first android body and then the brain. The result was more than an advanced CPU, it was a fully functional bio-computer - a synthetic organism. Technically it was a cyborg, as it contained both organic and synthetic components - these androids, released for sale in 2170, were an entirely new construct, the offspring of a whole new technology, all the way down to the cellular level. Transdyne Cybersystems led the research and development in this new field for decades and was quick to seize both legal copyright and a manufacturing and marketing monopoly on the technology. All legally manufactured androids are Transdyne models without exception.

Programming has steadily improved from the earliest Alpha models that could acknowledge and respond to a limited list of verbal commands only, to the fully interactive and emotive *Gamma* models of the 2190s. It was in 2209 however that the first sentient computer was brought online, not by Transdyne however but by a rival. Four years later the rival company was forced into bankruptcy and all of their assets, research and the prototype AI became the property of TDC. The move was not swift enough to stop the appearance of a number of sentient computer core designs with various corporate labels (Leyland Okuda, for example) but it assured TDC was at the forefront of new AI development. In 2214 the new *Epsilon-series* was launched as the first truly sentient, synthetic life form.

The *Epsilon-series* android was not simply a self-aware computer, however. Several models of AI-CPU had earned that distinction first and were already performing services in a number of applications, from industry to research and even spacecraft mainframe monitoring and control. These fully responsive and intelligent machines were marvels in their own right but the unique nature and construction of the Transdyne androids took this technology to an amazing and truthfully unexpected apex. When coupled with the wetware convergence of machine and organic construction the android became more than aware, it was sentient, for all pretences, alive. What the bio-electronic brain lacked in conventional memory and processing, it expanded in ways even the technicians could not have anticipated. Each android began to develop, immediately upon activation, as an individual. Attempts to install


Clarice 4 – A *Gamma-series*

the android consciousness into traditional computer roles proved disastrous, the subjects developing destabilizing neurosis or simply shutting down from the stress. When given the opportunity to perform as an individual however, they often exceeded their programming, achieving a level of sophistication that what not unlike the beginnings of personality.

The *Epsilon-series* is now in its 7th model and has performed beyond all expectations. Androids have found a place not only as functional assistants but have demonstrated the ability to act independently, form relationships and enhance their initial programming. They remain somewhat restricted in the area of expressed emotion and it is still believed by most that what the android may express as preference, opinion, or creative thought is still just a matter of programmed behavioural algorithms. There is a movement by some however to grant androids status as living beings as with generations the distinction between artificial and actual life form becomes more blurred.

Android Construction

The modern android is a human-like, electro-mechanical cyborg designed for harsh conditions or monotonous tasks (or both). Built around a sturdy carbon fiber skeleton is a complex system of silicon muscles that stabilizes and controls. An outer covering of bio-plastic sheeting is built up on top of a layer of flexible collagenous fibers. The most modern androids operate with a Model/4 computer running either a level 1, 2 or 3 Intellect program. To calculate an android's Intelligence in comparison to a human, add 5 to its Intellect program level (giving it a character Intelligence characteristic of 6-8). An android's social standing stands at a default level of 0.

Power is provided for around three months by a 25 kW fuel cell requiring a liquid hydrogen fuel. Obviously, androids do not need to breath, drink or eat, but they do occasionally ingest a pale-coloured, semi-organic nutrient suspension in a silicon-based liquid medium; this serves as a lubricant for the system's micro-hydraulics. Some attempt to 'fit in' to their mission teams by eating and drinking at meal-times, these nutrients will pass through the system harmlessly until emptied by the android. Such an ability allows an android to blend in seamlessly, even covertly.

The machinery, processor, fuel cell and carefully designed outer skin can be damaged, so it is prudent for androids to wear vacc suits or hostile environment suits. Vacuum, high pressure, high temperature and aggressive atmospheric chemical constituents can all irreparably damage an android. The cost of a single unit precludes the avoidable and wasteful use of an android in such an environment. Most androids are competent and of average human intelligence. They are generally programmed with passive, non-aggressive personalities and are typically given the likeness of a mature (30-40 year-old) male or female. The aim is to blend in, to join in, to be a team-player within a group of humans, supporting the leadership and providing useful options and advice without being forceful. Androids cannot harm humans and follow Asimov's Three Laws of Robotics. See the chapter titled Hiring On and Skills for more guidelines on roleplaying androids.

Fifth generation (*Epsilon-series*) androids can be bought as stock models for a competitive price, or the customer cn customize his android from parts available at the factory. This only applies to the most recent series of TDC androids. Custom-made units are ready for delivery within 6-10 months. Buyers must specify their preferred options. To build an android, begin with a chassis, add software and then any preferred options as directed in the **HOSTILE** rulebook.

Repair Station - Androids require an upright repair station, massing around 200 kg into which the android itself, steps. A transparent lid then closes, and the android plugs in, and undergoes a diagnostic and lubricant change; the fuel cell is topped up with liquid hydrogen also, if needed. Typically, androids will require a check-up every month or so, or after sustaining damage. Minor damage (that damage marked as 'First Hit' on the Cepheus Vehicle Damage table) can usually be repaired in 1-6 hours.

Next Generation Androids

AI technology - such as that found in androids - is a biological computer or wetware core processor which creates a volitional thinking machine, a neural network with a high level of cognition. For the incredible complexity of free thought, creativity, problem solving, and volitional action to work reliably and stably over time, it was found to work most efficiently in a form which mirrored the neurological structure of the human brain. The Transdyne android brain is formed around artificially constructed neurons and electrode pairs. It uses electrical signals to read and write to the neurons, which are kept at a stable temperature and PH level, etc. A fully sapient android brain has billions of these artificial neurons, with numbers approximating that of a human brain. Lower levels of complexity can create sentience, even primitive reasoning, but fifth generation Transdyne androids (and perhaps others) possesses truly human-like levels of brain power. This makes them appropriate for PCs, but they aren't the only types of androids in the **HOSTILE** universe:

Android Generation	Remarks	Characteristics	Typical Price
Alpha [2170]	Simple tasks, novelty and curiosity value; crude appearance.	Computer/1 Intellect 1 Chassis 70	5,000
Beta [2186]	Smarter and more versatile, but suffering instability problems; human-like, but obviously synthetic.	Computer/2 Intellect 1 Chassis 70	10,000
Gamma [2190]	More stable behaviour; human-like, but obviously synthetic.	Computer/2 Intellect 1 Chassis 90	40,000
Delta [2200]	Complex and flexible in approach, almost indistinguishable from humans	Computer/3 Intellect 2 Chassis 90	60,000
Epsilon [2214]	Most complex to date, almost indistinguishable from humans. Also available also as a custom-build option.	Computer/4 Intellect 3 Chassis 110	80,000

First generation (*Alpha-series*) androids were the earliest to use the wetware core processors that produced sentient machines. These experiments could feel and think, though they were suitable only for the simplest tasks. Many found uses as performers and expensive curiosities. Second generation androids (*Beta-series*) were much smarter, but occasionally suffered stability and learning problems. While all androids were programmed to avoid violence against humans, second gen androids occasionally 'lost their marbles' and lashed out at humans around them. This process fault was not fully understood, perhaps linked to poor quality control, but it caused a quick third generation android release (*Gamma-series*) which were generally stable. TDC had found the right balance, and the *Gamma-series* machines, which came online in 2190, proved very popular as mining employees, rescue workers, logistics and support soldiers, and so forth. In fact, the old standby 'third-gens' are still big sellers for Transdyne – though they are unsuitable as PCs.

Purchasing Your Android

Prices given in **HOSTILE** are for the custom-built *Epsilon-series.* Pre-built off the shelf models, with no customization and a processor with reduced initiative, cost around half of that value. The referee would need to create a few of these off-the-shelf designs. Not everyone is buying the most up-to-date *Epsilon-series*, though, there are thousands of good delta and gamma models out there. The gammas look obviously artificial ('a talking crash-test dummy' as the riggers on one Erebus installation joke) and many use very limited skills such as loading, stacking boxes, driving a front-end loader, operating mining machinery, etc. Unlike the newer series, the deltas and gammas are a little less advanced, more impersonal, quirky, and subtly artificial - but hey, at only $40,000 (compared to $425,000 for an off-the-shelf *Epsilon-series* Carol model) you can't go wrong … can you?

Each series of androids offers a range of pre-built options, called models. Each model has a designatory number (the Epsilon 5 has skills as a starship pilot and engineer, for example, whilst the Epsilon 9 is fully equipped for combat). It is likely that a company will purchase multiples of an android model and these individuals are given identifying names, that are paired with the model number as a suffix. Braniff Starlines bought six Epsilon 5s for their VIP fleet, designating them Carol 5, Mary 5, Ron 5, David 5, Hampton 5 and Veronica 5. As a side-note, the author noted that the two androids named in the recent Alien prequel movies carry the Christian-names of Alien producers, David Giler and Walter Hill. Perhaps this is a naming scheme worth pursuing…

LEGAL

The Following Is An Important Notice

Open Game License Version 1.0a

IMAGES

By NASA (Mariner-Venus 1962 Final Project Report) [Public domain], via Wikimedia Commons
By Jafet at English Wikipedia [Public domain], via Wikimedia Commons
Grid Computing By jmdo (propia) [GFDL (http://www.gnu.org/copyleft/fdl.html) or CC BY-SA 4.0 (https://creativecommons.org/licenses/by-sa/4.0)], via Wikimedia Commons
Torpor Image: SpaceWorks Enterprises
Other Images: Pixabay Open Content Imagery