SECOND EDITION

DP9-104

HEAVY GEAR™



TECHNICAL MANUAL

TERRANOVAN TECHNOLOGY

COMPLETE TECHNICAL & VEHICLE CONSTRUCTION RULES

TECHNOLOGY OF HEAVY GEAR • BASIC ENGINEERING • MATERIALS AND STRUCTURES • ELECTRONICS • CERAMIC CHIPS • NEURAL NETWORK • MUNICATIONS • SENSORS • MEDICINE IN THE 62ND CENTURY • THE NEUFELDT AXIOM • GENETICS • PROSTHETICS • WEBBLING • BIO-ENGINEERING RIME KNIGHTS • GRELS • MILITARY TECHNOLOGY IN THE 62ND CENTURY • COMMAND, CONTROL AND COMMUNICATION • AERIAL WARFARE • NAVAL WARFARE PACE WARFARE • THE MODERN COMBAT VEHICLE • HEAVY GEAR • STRIDERS • GROUND VEHICLES • HOVERTANKS • LANDSHIPS • AIRCRAFT • SPACECRAFT NGINEERING NOTEBOOK • DESIGNING VEHICLES IN HEAVY GEAR • PERKS AND FLAWS • THREAT VALUE • WEAPON SYSTEM CUSTOMIZATION • AMMUNITION ES • PRICES AND AVAILABILITIES • TECHNICIAN'S CORNER • VEHICLE MODIFICATIONS • SCRATCHBUILDING VEHICLES • VEHICLE MAINTENANCE • HNICAL SKILLS • NEW ARCHETYPES • WORK DRONE • HUNTER KILLER DRONE • RECON DRONE • TECH BLUEPRINTS • GEAR DEVELOPMENT CHARTS

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Soldat Beringer winced as the heat from the melted circuits penetrated his insulated gloves. The Long Fang Naga's surviving field gun's heat damper had been damaged and excess heat had poured into the weapon's articulation circuitry when they last fired.

"Hurry up. They're almost here." Beringer knew Soldat Hennan could see the approaching Jaguars on her sensors. He ripped out the melted wiring.

"One minute," he mumbled into his helmet comm. Taking out a standard pack of replacement wiring and a surplus cerachip control board, he jury-rigged the connection back together again.

Explosions boomed over the ridge behind which they were hiding as the Iguana in their cadre tried to slow down the incoming Gears. Beringer knew he wouldn't last long without fire support. He climbed over the massive gun to get at the cooling vent.

"Merde!" The vent had been fused shut by autocannon fire during the last attack. Beringer took out his plasma torch and began cutting.

"I've got them tagged! They're going to make it inside the minimum range." If the Jaguars got in close, the Naga didn't stand a chance. The twisted square of metal finally fell off and Beringer scrambled to his cockpit. "Go!"

The field gun opened up with a deafening blast and the leading Jaguar vanished from Hennan's sensor screen.

Nothing drives technological advancement quite like warfare, and Terra Nova has seen more than its fair share. Almost every aspect of technology has greatly advanced, from new armor-grade materials and deadly Heavy Gears, to computers that learn by themselves and extensive genetic manipulations. The Technical Manual 2nd Edition examines the technology of the world of Heavy Gear and provides full background and development information, technical illustrations and complete rules for using, repairing and modifying technology in Heavy Gear games.

Includes the complete Heavy Gear Vehicle Construction System (VCS).

:1936

TERRANOVAN TECHNOLOGY

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TERRANOVAN TECHNOLOGY

Second Edition Tech Manual — Back to the Workshop

The original Technical Manual began as a simple chapter of the Heavy Gear rulebook, which was supposed to give the reader some insight into the technology of the setting. Things are never so simple with Dream Pod 9, though, and the lonely chapter soon turned into a full-fledged supplement of its own.

The Technical Manual has always stood out as one of the favorite Heavy Gear sourcebooks, both through sales and by the fans. The advanced technology that helped to power the stories set on the distant world of Terra Nova could at last be examined, touched, even tinkered with.

So why mess with it, after all this time? The answer is, simply, to keep one of Heavy Gear's core books to date with the rest of the line and upgrade it to the present standards, which are much higher than they were when the first edition was released. Along the way, we've used the opportunity to expand and add to the material contained within these pages, clarifying rules, reorganizing chapters and sections to make the Players' life easier.

So what's new, you may ask? A lot of things. The Silhouette Vehicle Construction System, which was first found in the original Heavy Gear rulebook and then subsequently removed from the second edition to make room for more background information, has found a new home here. All the rules relating to the design and construction of vehicles and other tools are now in one place, rather than being scattered across six or seven books.

Old rules have been revised to make them more realistic and remove loopholes and unclear statements, and new rules added to give more options. But the book is not all about rules and game play, however; we've also written down a lot more information on the world of Heavy Gear, including numerous new topics that may come in the spotlight a few months from now...

So, grab your datapad and your favorite wrench, and let's take a look at what makes these Gears tick!

DREAM POD 9

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TABLE OF CONTENTS

Dream Pod 9 Team

WRITING

MARC-ALEXANDRE VÉZINA	LINE EDITOR/DEVELOPER
ÉLIE CHAREST	ADDITIONAL WRITING [1ST ED.]
GENE MARCIL	ADDITIONAL WRITING [1ST ED.]
PHILIPPE BOULLE	STORYLINE EDITOR
HILARY DOOR	COPY EDITOR
PIERRE OUELLETTE	CREATIVE DIRECTOR

PRODUCTION

PIERRE OUELLETTE	ART DIRECTOR/DESIGNER
JEAN-FRANÇOIS FORTIER	LAYOUT ARTIST
GHISLAIN BARBE	ILLUSTRATOR/COLORIST
NORMAND BILODEAU	COMPUTER ILLUSTRATOR/COLORIST
CHARLES-EMMANUEL OUELLETTE	COMPUTER ILLUSTRATOR/COLORIST

ADMINISTRATION

ROBERT DUBOIS	MARKETING MANAGER
STEPHANE BROCHU	SALES MANAGER

SILHOUETTE

GENE MARCIL	SYSTEM DESIGNER
STÉPHANE I. MATIS	SYSTEM DESIGNER

SPECIAL THANKS

TO ALISTAIR GILLIES, PRABAL NANDY, GREG PORTER, JON M. TUFFLEY, LEE BRIMMICOMBE-WOOD



CHAPTER 1: INTRODUCTION 4
1.1 THE TECHNOLOGY OF HEAVY GEAR 5
1.1.1 TECH LEVELS 5

CHAPTER 2: BASIC ENGINEERING 6
2.1 MATERIALS AND STRUCTURES 7
2.1.1 METALLIC ALLOYS 7
2.1.2 CERAMICS 7
2.1.3 POLYMERS 8
2.1.4 COMPOSITES 8
2.1.5 FASTENERS 9
2.2 ELECTRONICS 10
2.2.1 CERAMIC CHIPS 10
2.2.2 NEURAL NETWORK 11
2.3 COMMUNICATIONS 12
2.3.1 SHORT RANGE 12
2.3.2 LONG RANGE 12
2.3.3 REMOTE CONTROL 13
2.4 SENSORS 14
2.4.1 OPTICAL SYSTEMS 14
2.4.2 RADIATION-BASED SYSTEMS 15
2.4.3 SPECIALIZED SYSTEMS 16
2.5 TECH-RELATED RULES 16
2.5.1 SMART GLUES 16
2.5.2 ELECTRONIC CHIPS 16
2.5.3 NNETS EVOLUTION 16
2.5.4 SENSORS & COMMUNICATIONS 17
2.5.5 REMOTE CONTROL OPERATIONS 17

CHAPTER 3: LIFE SCIENCES 18
3.1 MEDICINE IN THE 62ND CENTURY 19
3.1.1 A BRIEF HISTORY OF MEDICINE 19
3.1.2 THE NEUFELDT AXIOM 19
3.2 GENETICS 20
3.2.1 GENETIC MANIPULATION 20
3.3 PROSTHETICS 21
3.3.1 TYPES OF REPLACEMENTS 21
3.3.2 POWER SOURCES AND MAINTENANCE 21
3.3.3 DESCRIPTIONS AND RULES 22
3.4 WEBBLING 24
3.4.1 GAME EFFECTS 24
3.5 BIO-ENGINEERING 25
3.5.1 PRIME KNIGHTS 25
3.5.2 GRELS 25

CHAPTER 4: MILITARY SCIENCES 26
4.1 MILITARY TECHNOLOGY IN THE 62ND CENTURY 27
4.1.1 THE INFLUENCE OF STEALTH 27
4.1.2 ACCURACY AND DAMAGE 27
4.2 OFFENSIVE TECHNOLOGY 28
4.2.1 PERSONAL WEAPONS 28
4.2.2 VEHICULAR WEAPON 28
4.2.3 AMMUNITION TYPES 29
4.3 DEFENSIVE TECHNOLOGY 30
4.3.1 ARMOR 30
4.3.2 STATIC DEFENSES 31
4.3.3 ELECTRONIC DEFENSES 31
4.4 COMMAND, CONTROL AND COMMUNICATION 32
4.4.1 COMMUNICATION IN THE FIELD 32
4.5 AERIAL WARFARE 33
4.6 NAVAL WARFARE 34
4.7 SPACE WARFARE 35

CHAPTER 5: VEHICLES 36
5.1 THE MODERN COMBAT VEHICLE 37
5.2 HEAVY GEAR 38
5.2.1 DEVELOPMENT 39
5.2.2 COCKPIT 41
5.2.3 SENSOR SYSTEM 44
5.2.4 MECHANICAL SYSTEMS 46
5.2.5 ARMOR 49
5.2.6 WEAPONS 50
5.3 STRIDERS 51
5.3.1 COCKPITS AND SENSORS 52
5.3.2 POWERPLANT 53
5.3.3 TRANSMISSION 53
5.3.4 WEAPONS AND ARMOR 53
5.4 GROUND VEHICLES 54
5.4.1 COCKPITS 54
5.4.2 POWERPLANT 54
5.4.3 TRANSMISSION 55
5.4.4 WEAPONS AND ARMOR 55
5.5 HOVERTANKS 56
5.5.1 DEPLOYMENT 57
5.6 LANDSHIPS 58
5.6.1 POWERPLANT 58
5.6.2 TRANSMISSION 59
5.6.3 COKCPITS AND SENSORS 59
5.6.4 WEAPONS AND ARMOR 59
5.7 AIRCRAFT 60
5.7.1 CONVENTIONAL AIRCRAFT 61
5.7.2 VTOL AIRCRAFT 62
5.7.3 ROTARY WING AIRCRAFT 63
5.8 SPACECRAFT 64
5.8.1 BASIC LAYOUT 64
5.8.2 OFFENSIVE AND DEFENSIVE SYSTEMS 64
5.8.3 AEROSPACE VEHICLES 65

CHAPTER 6: ENGINEERING NOTEBOOK 68
6.1 DESIGNING VEHICLES IN HEAVY GEAR 69
6.1.1 THE BASIC VEHICLE CONCEPT 70
6.1.2 CREW 70
6.1.3 MOVEMENT SYSTEMS 71
6.1.4 MANEUVER 72
6.1.5 DEPLOYMENT RANGE 73
6.1.6 ARMOR 74
6.1.7 WEAPONS 76
6.1.8 FIRE CONTROL 110
6.1.9 SENSORS 110
6.1.10 COMMUNICATIONS 111
6.1.11 PERKS AND FLAWS 112
6.1.12 THREAT VALUE 132
6.1.13 DEFAULT SIZE AND COST 134
6.1.14 ACTUAL SIZE AND PRE-PROD. COST 134
6.1.15 PRODUCTION TYPE AND LEMON ROLLS 135
6.1.16 FINAL COST AND NAMING 136
6.2 SPECIAL CASES 136
6.2.1 SMALL VEHICLES 136
6.2.2 LARGE VEHCILES 137
6.2.3 EMPLACEMENTS 138
6.3 WEAPON SYSTEM CUSTOMIZATION 138

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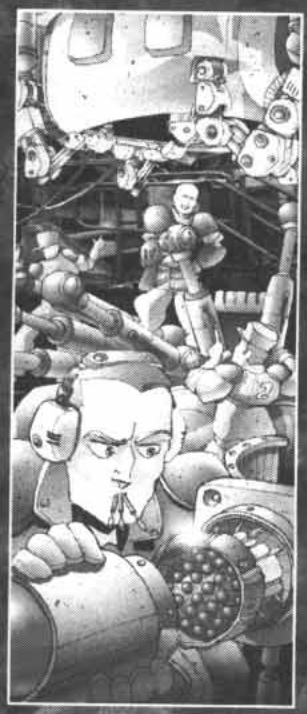
TABLE OF CONTENTS

6.3.1 ACCURACY 138
6.3.2 DAMAGE 138
6.3.3 RANGE 138
6.3.4 RATE OF FIRE 139
6.3.5 POOR WORKMANSHIP 139
6.4 AMMUNITION TYPES 140
6.4.1 COMMON AMMUNITION 141
6.4.2 UNCOMMON AMMUNITION 142
6.4.3 AMMUNITION FEED 144
6.4.4 AMMO PRICES AND AVAILABILITIES 145

CHAPTER 7: TECHNICIAN'S CORNER 146
7.1 MODERN TINKERERS 147
7.1.1 EDUCATION 147
7.1.2 CUSTOMS AND TRADITIONS 147
7.2 VEHICLE MODIFICATIONS 148
7.2.1 STRUCTURE 148
7.2.2 PERKS AND FLAWS 148
7.2.3 WEAPON SYSTEMS 149
7.2.4 ARMOR SYSTEMS 149
7.2.5 MOVEMENT 149
7.3 SCRATCHBUILDING VEHICLES 150
7.3.1 MAKING PLANS 150
7.3.2 GETTING PARTS 150
7.3.3 BUILDING THE VEHICLE 151
7.4 VEHICLE MAINTENANCE 152
7.4.1 BREAKDOWNS 152
7.4.2 WEAPON MAINTENANCE 152
7.4.3 FUEL AND DEPLOYMENT RANGE 153
7.5 REPAIRS 154
7.6 TECHNOLOGICAL SKILLS 155
7.7 NEW ARCHETYPES 156

APPENDIX
TECH BLUEPRINTS 160
GEAR DEVELOPMENT CHARTS 180
GLOSSARY 186
INDEX 188





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The use of the male gender throughout this manual should in no way imply the exclusion of the female gender or suggest that the game is intended exclusively for a male audience. It is our hope that the female gamers will find this book just as interesting as their male counterparts.

Dream Pod 9 can also be reached through the internet. Check the rec.games.mecha conference for support and information about Heavy Gear. You can also visit our World Wide Web page at http://www.dp9.com/

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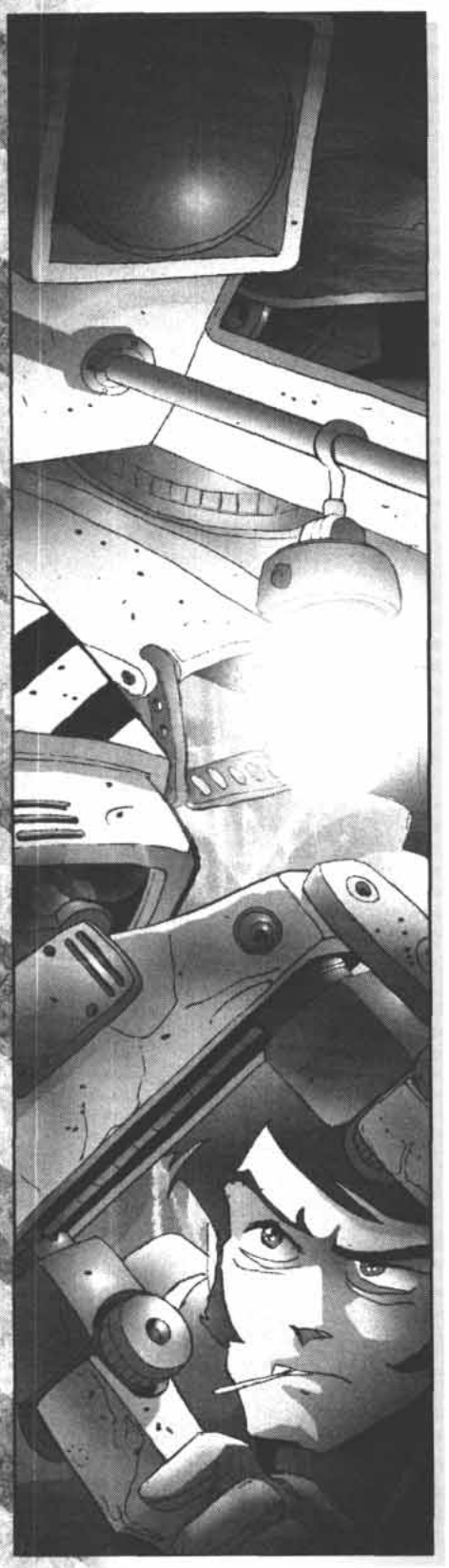
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INTRODUCTION

1

BITS AND PIECES



Jak whispered a quick prayer and pushed the ignition. For a few glorious seconds the V-engine purred and roared as it should. It all went downhill from there.

First came a vague gurgling, the engine seeming to choke on too much fuel. Jak hoped against hope that the purr would come back. Next, the gurgling changed pitch, becoming a wheezing and soon a screech. Before Jak could reach for the switch, the constant high pitched wail turned into a staccato pulse of metal on metal sounds, until both drive shafts halted with a resounding klunk. Then smoke started billowing out of the engine.

Jak doused the fire with his extinguisher, trying his best not to curse — at least, not too loudly. Once the flames were out, he took a moment to look around his shop. The chassis of the Groundhog he was working on was mounted on the winch in the center of the garage. Several desert bikes, water filtration processors and even a few home appliances stood about in various stages of disassembly.

Doing his best to forget that the engine parts he had just heard tear apart would not be replaced before the next caravan came through the area, Jak looked over the rest of the damaged work machine.

"Let's see," he took out a notepad computer and started taking notes. "One shot engine, one jammed pincer, one dead laser torch. All in all, one sorry looking machine."

The pincer looked like it was clogged with sand; a common and frustrating problem, but one he could solve in an hour or two. The laser torch, on the other hand, was a more serious issue. Peering into the forearm casing, he saw that the main focusing array had been fractured. He winced — more valuable parts to order.

Accessing the caravan schedule menu, Jak tried to figure out how long it would take to get all the components he needed. The Oxford caravan was coming through at the beginning of the next season and they always had a good selection of machine parts. But a season was an awfully long time to wait without a Gear.

Juggling the schedules, he found that the Zeras caravan would be in Hopespring in three weeks. He could probably take a trip out there to get some parts. Still fumbling with the notepad, he went over to the local-band radio in the other room.

"Echo Seven, this is Zulu Niner. Come back." The radio crackled to life a second or two later.

"Echo Seven here." Echo Seven was the call-sign for the Garnet homestead. Gil Garnet had brought in the Work Gear two days earlier when he came to town. Jak knew he must have been anxious to get his machine back, for the harvesting season was getting nearer. "What's the word, Jak?"

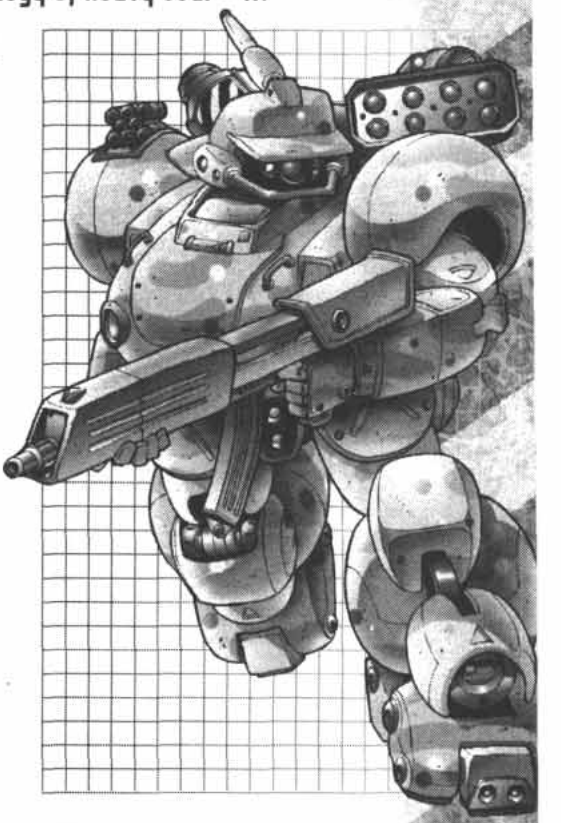
"Not good, Gil. The engine's a write-off and it'll take me three weeks to get the parts. I can machine the pistons myself, but I'll need a new combustion chamber." Jak heard his friend groan. "But you still got a Prairie Dog, don't you? Can't you make do for a few weeks?"

"I could if the damn Dog's NNet hadn't shorted out last night. The cursed thing is totally frozen up. Can you come and take a look?"

Jak closed his eyes and took a deep breath. It was going to be a long three weeks, he could feel it.

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The Technology of Heavy Gear - 1.1



Heavy Gear is a science fiction game universe, so it is only natural that technology, in its many forms, is omnipresent in both its history and its legends. This technical manual was originally part of the main rulebook, but it grew so large that it became a book of its own. While there is game-related information throughout the book, this manual's main function is to provide additional atmosphere and flavor to **Heavy Gear**. This second edition incorporates material and details that have evolved over the years, making this sourcebook the perfect reference guide for questions relating to technology and science in the **Heavy Gear** world.

One of the limiting factors that became readily apparent when first designing the game's background was the fact that it is impossible to accurately predict the future. Warfare in the early part of the twentieth century was very different from the warfare of today. Trained military advisers can barely predict what equipment we will be fighting with in fifty years, let alone in four thousand! Future wars may well be boring affairs with robots and decoys flying and crawling all over the place in an electronic fog, operating on computer-defined strategies. The human factor will probably be reduced to intuition, some tactics and cannon-fodder — not a very exciting environment for roleplaying. Consequently, some of today's latest technological developments were simply disregarded or reduced in importance, and a few new ones were theorized instead to create a unique, more playable technology base for **Heavy Gear**.

The technology presented in this manual is obviously inspired by twentieth century science. The descendants of today's scientists will probably find some entirely new ways to approach technical problems that haven't even been considered yet. For all we know, humans could be using flying saucers in a few decades. Despite this, many of the **Heavy Gear** technological assumptions are based on scientific postulation/theory, and the authors have attempted to remain accurate whenever possible. This approach was chosen simply because it makes the game feel more true to life, and thus easier to relate to. It should be kept in mind that many subjects had to be simplified in order to keep the rules fast and playable — this is a game, after all, not an engineering course. Players wishing for scientific accuracy can still calculate exact values with other, more accurate manuals and transfer them to Silhouette stats directly.

Technology Levels - 1.1.1



Technology and science march to a strange drummer. In the course of their adventures in the **Heavy Gear** universe, the Player Characters are as likely to see an advanced, miniaturized computer terminal on the wrist of a lizard-riding peasant as they are to see two military officers fight out an old-fashioned honor duel with computer-designed composite/ceramic swords. They will be given the opportunity to pilot a 5-meter tall humanoid machine that emulates the human body — and runs on ordinary gasoline.

The presence of many coexisting technological levels in every walk of life is one of the main features of **Heavy Gear**. While this concept is nothing new in science fiction, it does take some getting used to from players expecting to have high technology at their beck and call. Just because the technology exists for a given task does not mean that it will automatically be available. Terra Nova is still mostly a frontier planet and the basic necessities of survival will override any other concerns. It is no use knowing how a tractor works when you do not have the tools to build one, or the fuel to operate it. People use what works for them.

In general, the level of technological sophistication is at its highest in the city-states that form the centers of civilization on Terra Nova. With the proper connections and contacts, almost any item that is known to the Terranovans of the 62nd century is available in the streets — some more than others, obviously. Technology is also more visible within the walls and defensive lines of the city-states: personal electric cars, holographic advertisement, simple domestic robots, etc.

As we move into the surrounding countryside, the technology becomes more rugged, adapted to the rigors of everyday use. Surfaces are not shiny and neat anymore: items show the marks of constant use. There are fewer luxury objects and repair facilities for the more advanced items become harder to find. In some of the most remote or poor areas, people may hand-manufacture most of what they own, trading only for the things they absolutely cannot build by themselves. The Koreshi Sand Riders are one example of such people.

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DIAMONDS AND STEEL



The diamond looked dull now, trapped between Lamar's stubby and grease-laden forefinger and thumb. The stainless steel band appeared almost mundane until the single stone caught the light, glinting with blue fire. Maybe not the romantic ideal for an engagement ring, but he had thought Mara would like it. Emphasis on the "had."

A horn-blast from a Camel truck snapped him out of his reverie and he put the ring back on top of Mara's letter. Walking out of his small office and into the massive repair hangar, he tapped on the remote attached to his tool belt to open the main door.

"Okay, bring her in!" Lamar motioned the driver towards one of the hangar's empty work stations. Heavy Gears and other vehicles in various states of disrepair were scattered about the room. The truck driver swore several times as he tried to navigate through the maze of metal carcasses. Lamar barely noticed.

"Too much, too soon," her letter said. Lamar felt a stabbing sensation somewhere in his chest at the memory. They had met two cycles ago and had been living together almost three seasons. They had been happy. He loved her so much it hurt; she supposedly loved him. What was wrong with marriage, for Mamoud's sake?

He barely stepped out of the way as the Camel backed into the designated spot. The massive hulk of a damaged Hunter-class Heavy Gear was strapped to its rear deck. It was difficult to tell what was wrong with the war machine since it was half covered by a heavy green tarp, but from the smell of burnt metal, Lamar was sure it would not be pretty.

The driver stopped the truck just under the ten-ton autoloader. Lamar grabbed the remote hanging on a nearby support pillar and directed the robot arm to lay the Gear on the work platform. Heavy clamps secured it against the frame with a dull clank. Overhead, powerful lamps came on, bathing the wounded machine in bright white light. Lamar signaled the driver with a dull shrug and turned to his work, hoping to become lost in a world of simple technical problems.

He shook his head. The Gear had holes the size of a human fist in its lower body. Enemy fire had destroyed part of the machine's movement system. Pieces of the ceramic and composite layers showed through the broken and shattered outer covering. Repairing the Hunter would mean long hours of grueling work. Just what he needed.

Grabbing a power drill from a nearby rack, Lamar unfastened the damaged leg cover. Using a lever, he attempted to pull back the armored panel, only to discover it was half fused to the neighboring sections. A short blast from his plasma torch cut loose the last of the melted material and the heavy plate fell to one side with a loud "thud," exposing the damaged inner mechanisms.

Part of the leg's alloy skeleton had been shredded by a shell, and metal fragments lodged in every nearby internal surface. Lamar took down a hand-held electromagnet and passed it over the machine-works, picking up the loose fragments. He watched as they caught the light, glittering like little diamonds at the end of the magnetized rod.

Lamar hated diamonds.

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Materials and Structures - 2.1

Research constantly develops new and useful materials. Most of the work is centered on finding new ways to improve the qualities of the existing alloys and composites while simplifying the manufacturing processes involved in their creation, in an attempt to meet the high demand. Few Terranovan items and vehicles use unmodified natural materials in their design.

Construction materials are generally divided into four broad categories: metals, ceramics, polymers and composites; and three main physical states: solid, liquid and gaseous. However, with the advancement of metallurgy and other material technologies throughout the centuries, the distinction between these categories has blurred somewhat. For convenience and ease of reference, they will be retained for this text.

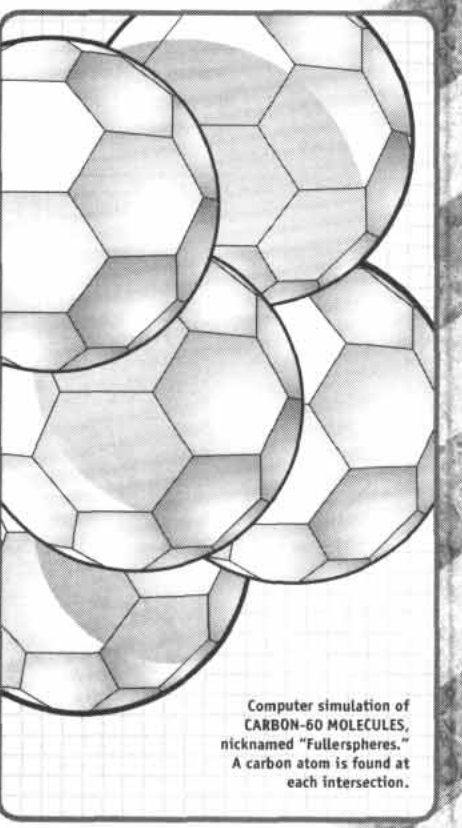
Metal Alloys - 2.1.1

For simplicity, any metallic material composed of a mix of two or more different elements is now called a metal alloy, regardless of its contents. Alloys have the remarkable property of being more than the sum of their constituent parts; for example, iron and carbon are brittle, but steel is fairly ductile. Each element brings different properties to the alloy.

Iron was one of the greatest discoveries of all time, but it was not until the iron/carbon alloy commonly known as steel appeared that this metal became vital to Man's industrial society. Since then, steel — the generic name for an alloy whose main component is iron — has been one of the most widely used construction materials. 62nd-century steels are composed of a multitude of metals, each mix tailored for maximum performance for a specific use. The internal frame of many Heavy Gears is made out of Flexite, a steel alloy that is both tough and flexible (see text below).

The twentieth and twenty-first centuries were the first to see the advent of new kinds of metal alloys made possible by the zero-g conditions of the space stations. Metals that would not normally mix well suddenly seemed more cooperative, creating materials of incredible strength. Further research in the centuries that followed showed that proper manufacturing techniques could yield similar results without the expense of sending the material into space and bringing it back. New molecular-level shaping techniques, using a combination of heat treatments, magnetic field generators and particle beams, can force completely new crystal structures into existence.

Metal alloys are commonly used in the 62nd century for all sorts of engineering functions. They are known for their high tensile strength, electrical conductivity, ductility and isotropic properties. Rare metals are used in alloys for specific purposes. Iridium, vanadium, beryllium and other such metals are often found in the resilient alloys required by military technology.



Computer simulation of CARBON-60 MOLECULES, nicknamed "Fullerspheres." A carbon atom is found at each intersection.

Flexite ◆

Flexite is a steel alloy created by advanced molecular forming techniques. Unlike standard steel, Flexite's carbon content consists partially of Fullersphere-type molecules that impart additional strength and greatly stabilize the alloy. Flexite also contains several other metals, such as iridium and vanadium, in minute quantities to improve its resistance to corrosion and surface abrasion.

Ceramics -2.1.2

These crystalline materials were originally thought unsuitable for load-bearing functions since they were too fragile and brittle. With the discovery of new manufacturing techniques in the early centuries of the third millennium, ceramics, now stronger, saw use in a variety of items.

Most ceramics have the advantage of being extremely resistant to high temperatures. For this reason, many modern armor materials include layers of ceramic. Some armor types are specifically intermixed with ceramic compounds to be even more resistant to energy-based weapons such as shaped-charge warheads and laser beams.

Ceramics are used in internal combustion engines and other high-heat applications. They also see wide use as shielding and heatsinks for fusion reactors and spaceship hulls, particularly those equipped for atmospheric re-entry. Special ceramic coatings and glazings can also be manufactured to improve the durability of spaceships.

Natural ceramic materials, such as several varieties of rock, are also used extensively on Terra Nova. In the early centuries of colonization, most of the buildings were made out of the local variety of rock — limestone, granite or quartz — because it was cheap, available in large quantities and easy to work with. With proper care and a thin external polymer coating, rock also proved to be a fairly durable material, and many buildings are still standing after centuries.

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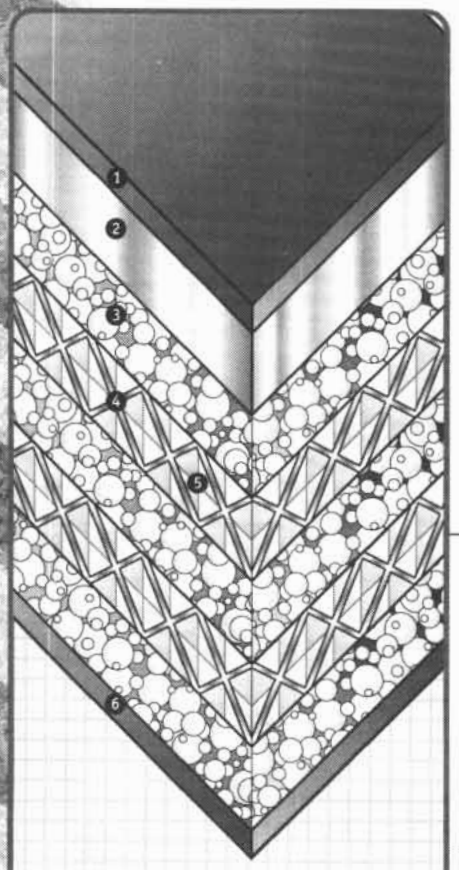
2.1.3 - Polymers

Polymers are long strings of organic molecules artificially attached to one another. This structure yields a wide variety of possible material qualities. Polymers can be molded, extruded, shaped, machined, etc. They are generally light and adaptable and are used in many everyday items. Polymers are also used in the weapons industry for light gun casings and missile outer shells. An extremely tough ballistic plastic called Armoplast is used in several kinds of laminated armor, especially the personal "turtleshell" armor worn by front-line infantry. Ceramics and polymers are often used as a matrix for composite materials because they are easy to shape and contribute properties which complement those of the metallic alloys which most often constitute the fibers (see Composites, below).

Most polymers are created from strings of carbon molecules secured together through various industrial process. Compounds are added during synthesis to give the resulting material specific properties. In addition, special chemicals are used to plug "holes" in the chemical structure of the polymer, considerably improving its strength and heat resistance. A polymer material can often be designed to fit a specific job or application, though there are limits: few polymers can resist extreme work conditions, such as very high or low temperatures or mechanical stress.

Some advanced molecular-shaping techniques can produce memory plastics, polymers whose molecules can rearrange their position and internal structure when placed under certain conditions (heat, pressure, etc.) and transform into shapes that are "programmed" within the plastic's structure. These bizarre shape-changing materials are used in very specialized functions since they are somewhat limited in their versatility and structural strength.

2.1.4 - Composites



1- Upper surface glazing
2- Ceramic layer
3- Polymer foam buffer zone
4- Flexite fiber network
5- Armoplast II matrix
6- Anti-spalling polymer

Composites, as their name indicates, are a combination of two or more different materials. Most often, this means a fibrous material encased in a matrix of some sort, the fibres providing tensile strength and the matrix providing structural integrity to the whole. Wood is a typical natural composite, a structure of cellulose fibers in a lignite matrix. Ferrocrete, a ceramic compound reinforced with metallic fibers, is another example of composite.

Composites are widely used in the 62nd century because they can be designed for almost any load and/or use. Any combination of materials — plastic, resin, ceramic or metal — may constitute a composite. Often, more than one type of fiber is used for additional strength or properties. The fibers are aligned within the composite during manufacturing, providing increased structural strength only in the desired direction(s). This allows the designers to reduce the amount of material required, greatly reducing the overall weight of the part. For that reason, composites are widely used in the vehicle industry, particularly in aerospace manufacturing procedures.

Composites are custom designed for specific applications, creating materials with the perfect balance of strength, durability and weight. Unfortunately, composites are more expensive to prepare and much harder to repair since the damage, if any, is usually deep within the composite structure. Stress-induced core delamination, where micro-layers become separated within the material, is one such problem. In these cases, complete replacement of the affected piece is recommended.

Durasheet Armor ◆

Durasheet is a flexible but tough composite that is used in a wide variety of applications. The fiber networks used in its construction are composed of Flexite and one or two other alloys, depending on the grade and intended use of the Durasheet variant. The matrix is made of Armoplast II-D, a more supple grade of the well-known ballistic plastic. The finished Durasheet is about one millimeter thick and can be worked to almost any shape. It is highly resistant to tears and punctures.

Several such sheets are necessary to create a plate of armor; often, layers of ceramic and foamed polymer are added in between for additional heat resistance and durability. The top layer, barely half a millimeter thick, is made of an anti-corrosive metal alloy or a ceramic glazing. These layers are resin-bonded together according to the required armor panel shape. Generally, a thin ballistic polymer sheet is placed behind the armor plate to absorb any spalling or fragments that may splinter off.

Whenever an attack strikes the plate, the outer layer shatters or vaporizes to absorb part of the energy. The next layer, always a rigid ceramic, shatters or tumbles the projectiles, forcing them to lose more energy. The polymer foam buffer then catches any debris or slows down kinetic penetrators by deforming instead of yielding. It is also the main line of defense against energy weaponry, vaporizing to diffuse the beam and absorbing fast particles cascading from the impact. The Durasheet then stops and absorbs the rest of the attack. Several alternating layers of foam and Durasheet can be used for increased protection, though this increases the cost, weight and bulk of the plate.

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Fasteners - 2.1.5

"Fastener" is the name given to any material or object(s) that hold(s) a given structure together. Early examples of fasteners include knotted ropes, wood nails and tree resin. As the level of technology rose, fasteners kept pace: metal nails, screws, glues, etc. 62nd-century engineering makes use of these and several others, somewhat more advanced tools. For example, many vehicles have systems that are literally welded at the molecular level by advanced resin compounds.

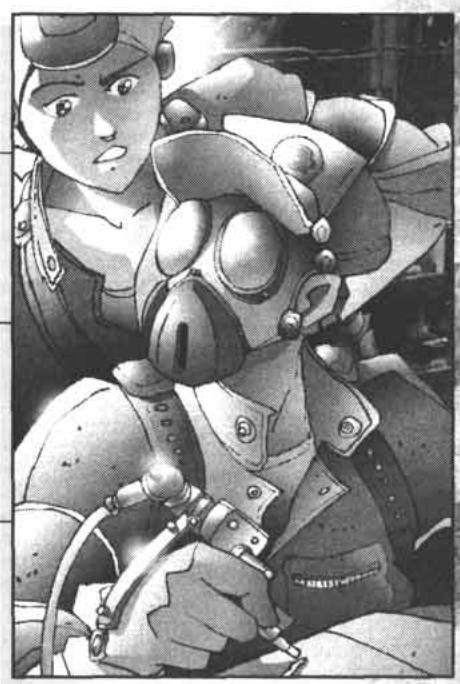
Smart Glues ◆

The development of polymers and composites has given rise to a whole line of structural glues that not only bond two surfaces, but also serve as a proper load-bearing path. Most modern glues are rapid-forming composite types, usually epoxy-like resins with specialized filler. The proportions are mixed at the factory, or in the workshop, to vary the glue's properties according to the task at hand. These so-called "smart glues" are used extensively in armor and aerospace construction as well as electronic assemblies.

Smart glues are one of the most useful tools available to the technician faced with the prospect of jury-rigging a damaged mechanism. Their variable properties allow different make-shift repairs to be made with a single container of glue. Here are four of the most common combinations possible with the chemicals contained in a standard glue pack:

Rapid-forming mix ◆

This mix halves the required repair time, but the technician must use extreme caution in choosing where to place the glue to make sure the repair will hold. If he makes a mistake and mis-evaluates the tensions and mechanical requirements of the break, the glue bond will let go under stress and the previously repaired damage will return.



◆ Slow-forming mix

This is the mode used for normal repair. The mix can be colored using special dyes to make the repair disappear (or stand out, if required) and can incorporate reinforcing fibers for a stronger bond. Depending on the thickness of the glue coating, this mix sets in about one to six hours.

◆ Foam mode

Under the action of a special catalyst, the glue becomes a foamed polymer material, with the size of the air bubbles depending on the catalyst used. This foam can be used for tasks such as plugging holes, supporting loose equipment and wiring, etc. The foam is not sturdy enough to act in a true structural capacity, nor can it be used to patch up damaged armor plating.

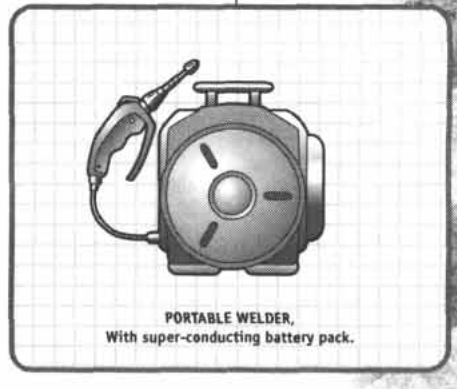
◆ Conductor mode

With the proper catalyst/impurity mixed in, this smart glue combination hardens into a solid paste that can conduct electricity. Depending on the "doping" procedure used, the paste can serve as makeshift wiring or even low-grade capacitors or resistors. The conductor mode is far from efficient, but it does the job.

◆ Welding

Welding is often used where parts made of similar metals or alloys have to be joined. Due to the typically high melting point of modern metallic materials, however, new methods of welding, involving tools with a higher energy output, are required. Portable and semi-portable kits for flash and plasma welding, called simply "welders," can now be found in most well-equipped workshops. These can often reach temperatures of up to 10,000° Celsius for short periods of time, sometimes more (depending on the tool and the facilities). The bulk of the equipment and the short range of the torch makes for a poor weapon, however.

Most welders can act both as high-powered cutters and as standard welding torches. Some bulky low-technology models still rely on the oxidation reaction of two gases, but more modern devices use a plasma arc instead and are electrically powered from one or more rechargeable superconducting loops. Power packs using standard hydrogen fuel cell generators are also available. The entire power pack assembly is housed in a rugged high-impact casing designed to protect it against rough treatment from hurried technicians.



PORTABLE WELDER,
With super-conducting battery pack.

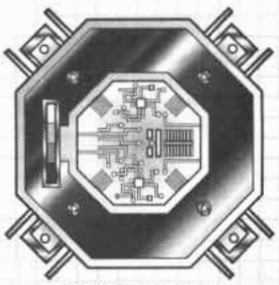
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2.2 - Electronics

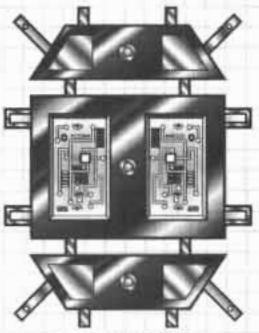
Electronics. For millennia the heart and soul of the machines of Mankind, these complex items are vital to the people of the 62nd century. Circuitry is used in all types of equipment, from the lowly kitchen appliance to the most complex military dropship, and practically all are monitored by a computer of some sort.

The electronic circuitry of the 62nd century can be roughly divided into three main categories: ceramic chips, neural networks and the more advanced optical NNets. All have their advantages and disadvantages, but some are more suited to certain tasks than others.

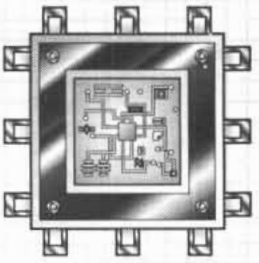
2.2.1 - Ceramic Chips



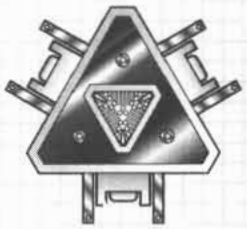
SENSOR CONTROL CHIP



CIRCUIT MONITORING CHIP



MECHANICAL CONTROL CHIP



FIRE CONTROL CHIP

Silicon chips are the oldest form of computer technology still in use. Actually, "silicon" is a misnomer: this material has not been used for centuries, having been replaced by more advanced ceramic compounds and superconductors that dissipate heat better. Less heat means that more circuits can be placed on a given surface, decreasing the overall size of the chip and improving speed and processing power. However, the old name remains common in popular language; they are also often referred to as "cerachips."

Externally, the computer chips still look like black or colored bits of plastic or ceramic with metal connector pins sticking out. Color coding is widely used in the military, although there is no set standard (which causes many, many problems for technicians working on unfamiliar circuitry). A rough set of universal standards did emerge during the War, though, and many of the newer vehicles carry such color-coded electronics. Shape is also a common indicator of the function of the chip, though not an absolute. The table below lists the most common colors and shapes as well as their associated functions.

Although they are incredibly slow when compared to modern optical NNet systems, silicon chips have the advantage of simplicity, extreme ruggedness and ease of manufacture. Automated micro-factories can turn them out by the handful if fed the correct raw material and given the time to lay out the precise circuitry within.

Cerachips are chiefly used for low-power and low-speed applications such as door controller mechanisms, low-tech appliances and the like. The military uses them in simple but important circuitry such as pump relay controllers, sensor sub-interpreters and many types of system monitoring devices.

CHIP COLOR CODING

Color	Shape	Usual Function
Green	Rectangular, Round	Communication
Blue	Octogonal	Sensors
Red	Triangular	Fire Control
Yellow	Rectangular, Square	Mechanic/Monitoring
Black	Rectangular	Movement

Self-diagnosis

Some advanced chips boast self-diagnosis readouts and can offer limited troubleshooting advice — unfortunately, most often the advice is "this chip is burnt out. Replace as soon as possible."

The presence of a SD readout makes the task of identifying or evaluating the chip much easier and faster. The readout is sometimes faulty, however, and an incorrect evaluation can be provided: a good chip reads as a bad one and vice-versa. A good tech knows when to trust a readout or not.

Customizing Chips

Modern ceramic chips can pack an awful lot of components onto a very small surface. Heat is not a problem since super-conducting links and ceramic compounds are used throughout. As a result, chip manufacturers tend to put more logic gates and other components than called for by the chip's intended function. This does not raise the price of the chip appreciably and enables it to fulfill several possible tasks by simply switching a couple of jumpers inside the casing. Therefore, many techs carry scores of blank, usable chips ready to replace almost anything at a moment's notice.

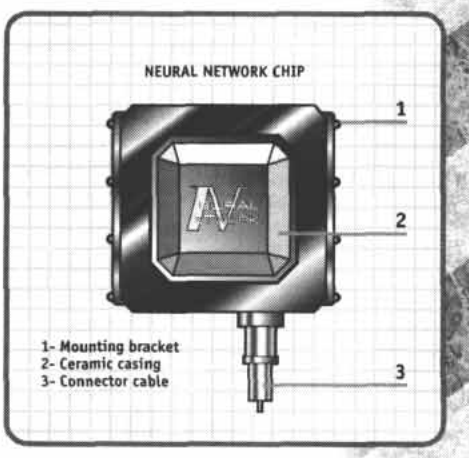
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Neural Networks - 2.2.2

Neural networks were developed back in the beginning of the third millennium and have been the basis for many of the advancements in computer science that followed. Although research started as early as the late twentieth century, no significant improvements were made until the widespread use of cerachips enabled the construction of small, interconnected circuits.

NNets are flexible electronic circuitry, so named because they mimic natural neural pathways. These sophisticated electronic circuits are able to learn from their mistakes and establish new connections within their matrix by both changing their basic programming and by creating new electronic pathways through artificially forced crystal growths. Such changes are monitored and limited by design parameters that are generally implanted at the factory to prevent unwanted variations from the intended functions. These advanced computer chips form the basis of the 62nd-century computer.

NNets resemble regular cerachips except that they tend to be slightly bigger. They also sport a connector on only one side, generally an optic fiber cable leading to a standard jack. All NNets are black, a side effect of the protective coating applied to their exterior, and often boast the NNet symbol: a stylized mechanical brain. NNets tend to be more fragile than regular cerachips. As a result, neural net chips are often mounted on special isolated plates within the machine's electronics bay.

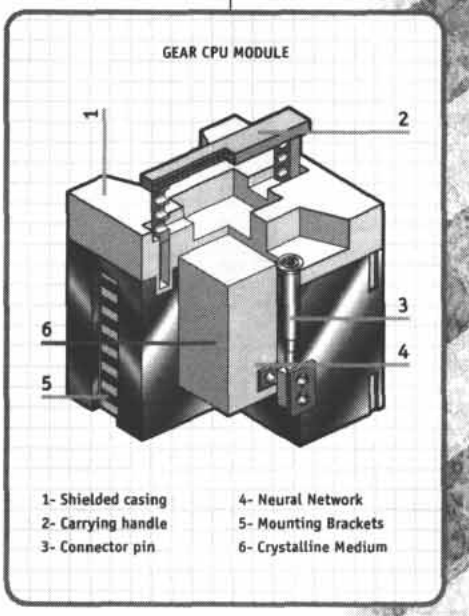


◆ Optical NNets

Optical NNets are used for high speed calculations and other demanding data manipulations. They are similar in principle to basic neural networks, but use the interactions of photons in a transparent composite matrix for data storage and transfer. The size of a circuit can be scaled down to the molecular level, and the operation of such an NNet creates no heat or wear; it must, however, be well shielded against "parasite" photons and energy from outside. All optical NNets are roughly cubic in shape.

The main disadvantages of the optical NNets are their cost and the complexity of their manufacture. The actual act of building them is relatively simple, as the process is mostly automated — but the machines that make NNet chips are fabulously expensive. In addition, the subsequent period of training under the supervision of a human technician requires a considerable investment in time and resources. Optical NNets are becoming easier to manufacture and train as the processes and techniques used to make them are better understood by scientists and technicians. However, ONNets remains costly and rare, and it is unlikely that they will completely replace the rugged silicon chips and ceramic NNets.

Like regular NNets, optical NNets must complete their programming by creating new pathways within themselves. Those found in an ONNet are molecule-thin strands of crystal that can be easily broken by excessive jarring. External "noise" (photons and other particles) can also disrupt the system. For these reasons, all ONNets are well-shielded and encased in shock-proof material. With the development curve of the Optical NNet following that of the Heavy Gear, it is no surprise that this circuitry has grown increasingly complex since the failed Earth invasion. The influx of Caprician and Terran technology, also due to the war, helped solve many problems that had eluded the scientists working on NNets. The latest generation of NNets are capable of surprisingly independent actions, which may lead to true artificial intelligence in the near future — with unforeseeable consequences.



Neural Network Evolution ◆

With the complexity of the self-developing neural network came a surprising phenomenon that experts call Behavioral Mimetism Syndrome, or BMS for short. Neural networks that work with humans for a long time will acquire some of their work-related habits. For example, a computer that is used for processing meteorological information every morning might do so even if its operator is not present, simply because it is used to a "routine." At the very least, it will inquire if it should launch the program.

Not all of these new self-programmed behaviors are useful and/or harmless. Safeguards and limitation routines prevent most complications, but sometimes the results can be most unexpected. A perfect example is the legendary Bowser, a very old Hunter-class Gear that almost has a personality of its own. It has been known to move by itself when threatened and can express simple "opinions," mostly with unsavory gestures learned from the troopers it served alongside. Its whereabouts are unknown at this time.

Just as human children learn how to behave by observing adults, neural nets can learn human mannerisms by observing human behavior. This behavior usually falls into two categories: useful and impolite. Useful mannerisms include limited hand signals (provided the vehicle has hands), fetching its owner, or signaling for help. Impolite mannerisms include obscene hand gestures and other bad manners (like honking the horn in the middle of the night to annoy the neighbors). These quirks are more than compensated for by the Nnet's flexibility and computing power, however. Over a long period of time, neural nets may even learn to act independently, though they remain limited by the restraining routines imprinted on their circuitry.

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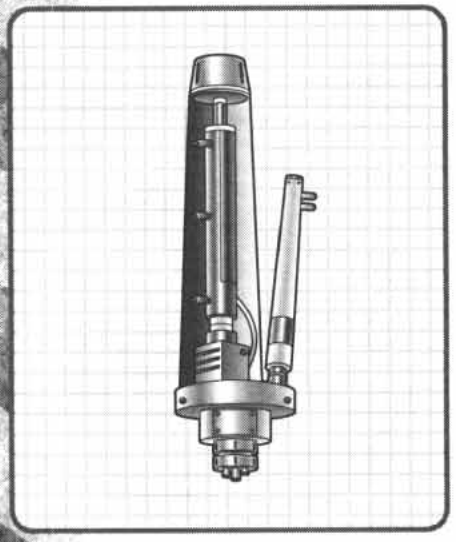
2.3 - Communications

Communications are the 62nd-century officer's nightmare. Messages can be intercepted, scrambled or just fail to reach the receiver. This has created the need for fast and powerful multi-band emitters/receivers capable of punching through the dense electronic fog created by enemy vehicles and drones.

Whenever possible, messages are sent on a microwave tight-beam, line-of-sight pulse to prevent both interception and location. Emitters not only code and compress the pulses to durations of a thousandth of a second, but also automatically vary the frequency used according to a preset algorithm. If there are no hostile units within range, a general, wide pulse message can also be used. The process is fully digital from beginning to end, ensuring crystal-clear reception under normal circumstances. Enemy scramblers can affect this, although correction routines are included in the comm software.

Several antenna types are in use, the exact type installed depending on its intended function and range band . Simple aerials are popular for low-power comm systems, while more sophisticated ones use blade or "flush plate" antennae. Blister and "combination" antennae are, in fact, low-interference pods housing several communication devices, such as directional arrays and comm lasers. Often, more than one antenna will be used by a given comm system.

2.3.1 - Short Range



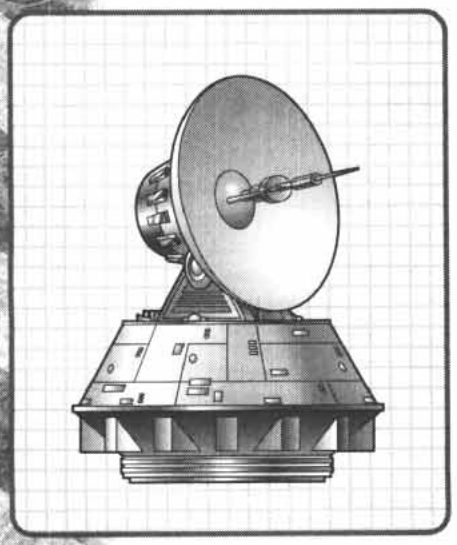
Communication systems are found in most settlements and vehicles nowadays, regardless of whether they are civilian or military in nature. The dangerous half-tamed nature of Terra Nova makes it a necessity to keep in touch with others, to ask for assistance or to help out. Most of these systems are somewhat short-ranged, allowing communications within a radius of a few tens of kilometers at best.

Radio is the most common type of short-wave communication used. The civilian systems are based around simple solid-state elements and are easy to put together and repair. Military systems are more complex, incorporating scramblers and frequency-hopping devices to stay ahead of enemy direction finding, jamming or intercept. They operate on digital pulse codes, sending their data-compressed signal through aerials and virtual phased arrays that can be tuned to a wide range of frequencies and power levels.

Units and settlements may also be connected through cables (either low tech metal wire or the more common optic fiber), allowing clear communication across any type of environment. There are downsides as well, obviously: unless the cable is permanently installed, it may be cut or snag somewhere, and its weight often becomes unmanageable over long distances.

Other systems are possible for short-range communications, such as laser pulses or visual signals. For example, both Gears and infantrymen may contact friendly forces within line of sight by making hand signals that can be "read" by others. Very short burst of laser energy from a rangefinder may also be used, though it requires that the two units be looking exactly at one another to avoid signal leakage.

2.3.2 - Long Range



Long range communications usually occurs between city-states or field headquarters; few combat vehicles in the field need to contact anything beyond the scope of the battle. Those that do bounce their signals off a friendly comsat or orbiting ship, which then relay the data to the destination or yet another relay, avoiding the need for a gigantic comm system.

By its very nature, long range communication requires more power and thus larger emitting and receiving systems: the longer the wave, the longer the range, the larger the antenna. A matrix of emitters in a mast-type structure or a broad category of phased-array systems are used to get around these limitations. Phased array are computer controlled radiation-emitters encased under broad featureless panels. These systems generally require broad flat surfaces, but can also be mounted in strips if continuous surfaces are few. Power and sensibility, and hence range, will be determined by the total number of elements in the array. For longer ranges, though, more powerful systems are needed.

An off-shoot of the Gate Drive sensors, the neutrino interference detector (NID) array is a highly sophisticated communication device that is used for transplanetary and deep space communication. Its neutrino emissions are impossible to block and almost impossible to intercept, but they require sophisticated and bulky detectors that can be mounted only in buildings or on large vehicles such as landships. Communication beams must be sent to a very precise location, or else are undetectable; a vehicle will call its base (which is equipped with a very large detection array, often hundreds of meters on each side) to announce its position, then wait for a two-way link to be established.

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Remote Control - 2.3.3

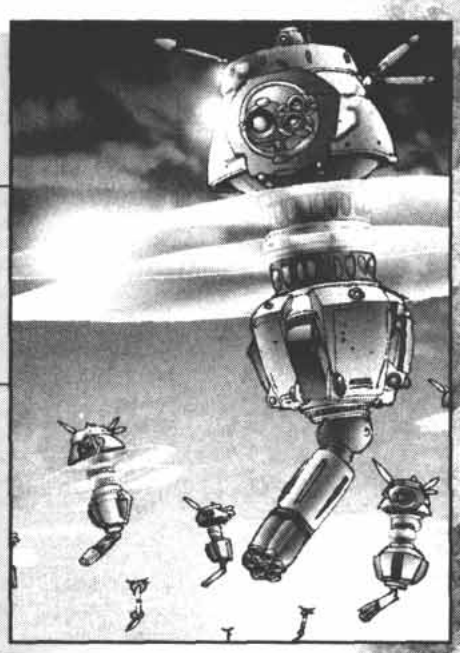
Remote controlled vehicles — also known as "drones" —are very useful in situations where a human life might be needlessly put at risk. Unfortunately, they are neither as responsive nor as flexible as a manned vehicle, which restricts them to simple operations. Almost any vehicle can be equipped for remote control, though it is rarely done except for dedicated drone designs. There are two ways to remotely control a vehicle: radio guidance and wire guidance.

Radio guidance offers the greater range of the two methods, but suffers from two disadvantages. First, there is always a time lag associated with the use of security frequency hopping and signal scrambling procedures, reducing the overall response time of the operator and thus the overall efficiency of the vehicle. These procedures are necessary to prevent hostile forces from taking over the vehicle's controls. Second, the two-way datalink flow can be easily jammed by electronic countermeasure equipment. ECCM can eliminate this, but requires expensive additional equipment.

Wire guidance removes both of these inconveniences, but presents its own particular set of problems. This method uses a fine but resilient optic fiber cable that trails behind the drone. The wire is spooled within a small container carried by the command unit (be it a vehicle, base or infantryman). This command cable can get snagged in obstacles or be cut, resulting in the loss of control of the drone unit. See the rules for remote control on page 17 of this manual.

Recon Drones

Reconnaissance is probably the most common mission entrusted to drones. Small and inexpensive drones have been used for ages as communication relays, forward observers and general bait and cannon fodder material. Modern drones often carry a laser designator as well, allowing them to "paint" targets for incoming guided ordinance. Although most recon drones are flyers, ground and submarine drones are also very common.



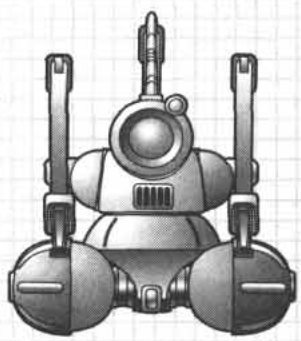
Work Drones

Work drones are part of another common drone category. These remotes are used for tasks too dangerous, hard or simply boring for human beings. For example, drones are used to defuse bombs, handle ammunition, conduct simple maintenance operations and examine hard to reach places and conduits. Work drones are often equipped with specialized equipment relevant to the task at hand.

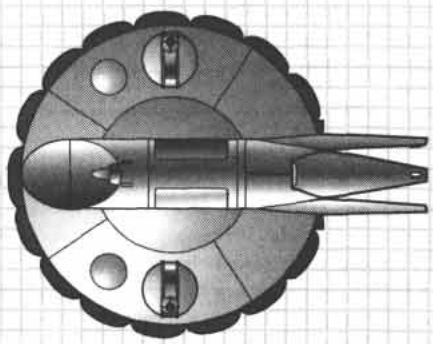
Hunter/Killer Drones

Hunter/Killer drones are dedicated combat vehicles. They are most often used to bear the brunt of the initial attack and help clear the field before the real assault starts. Hunter drones actively seek out enemy units as targets for attack. They often carry a light weapon for use against infantry (their most common target).

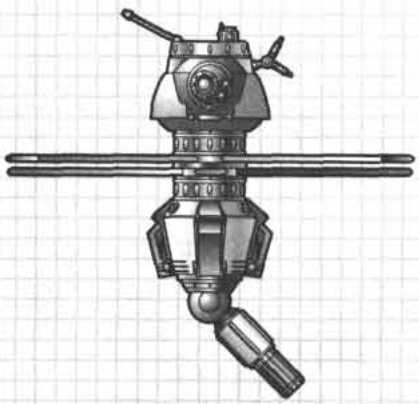
Killer drones are also attack vehicles, but use a different strategy: once they find their target, they detonate the explosives they are carrying. Cruise missiles are one type of killer drone, though they most often operate in autopilot mode.



WORK DRONE



RECON DRONE



HUNTER KILLER

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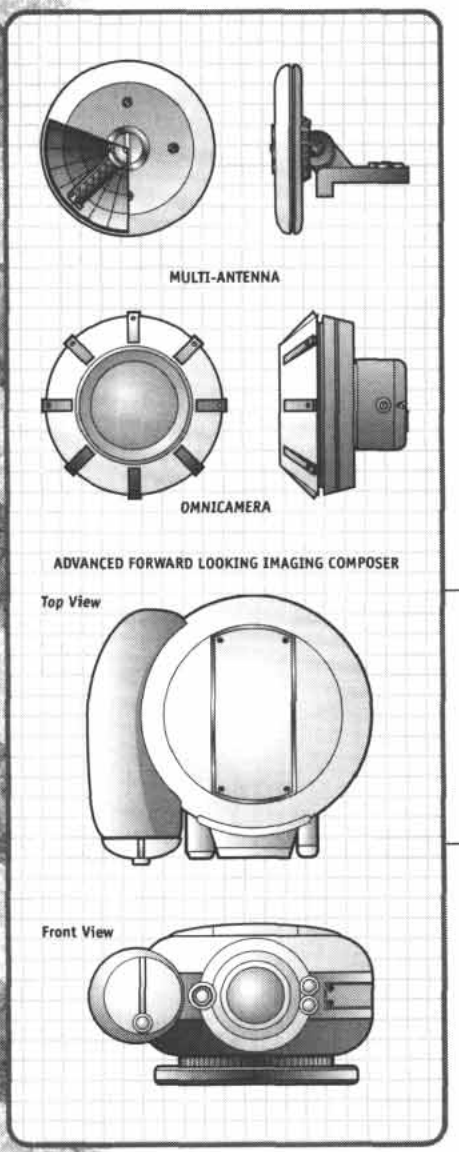
2.4 - Sensors

Sensors are essential to any front-line combat vehicle in the 62nd century. Although most vehicles are served quite well by the classic Mark I Eyeball, the fast-flowing, modern battlefield requires additional and often very sophisticated means to detect an enemy that, over the years, has become quite adept at concealing his location.

Sensors can be divided into two general categories, passive and active. Passive sensors only collect information from their surroundings. They do not reveal the presence of the unit using them, which is why they are preferred for combat vehicles. Active sensors tend to be both more powerful and accurate, but they must send out some form of energy to function. This energy can be detected by enemy units and used to calculate the approximate position of the emitter, which makes it impossible to hide while actively scanning. The emitted energy can also be used as "guiding rails" by enemy missiles, and so active sensors are used sparingly.

The most basic sensor packages are used to help boost the crew's own senses and contain at least some kind of telescope (such as binoculars) and one rangefinder (mechanical, optical or electronic). Thermo-optical cameras are next in popularity and are installed on many military vehicles to assist in night operations. Dedicated combat vehicles carry additional active sensors in order to acquire targets on the battlefield. Foremost amongst these are the radar and ladar systems, which both offer their own set of advantages and disadvantages (see next page). With improvements in technology, even a small vehicle can carry a powerful radar or ladar system.

2.4.1 - Optical Systems



Human beings receive about 90% of their sensory input through their eyes, and vehicle crews are no different. Coupled with high definition displays, digital imaging cameras constitute a major component of many basic sensor packages. Tied in to the vehicle's drive and battle computers, cameras are mounted on gyro-stabilized frames that can follow targets through the most spectacular maneuvers. Being passive in nature (cameras only receive signals, they do not need to emit their own), cameras supply most of the basic environmental data, both for piloting and combat purposes.

Some light amplification and anti-dazzle protection for all optical systems are usually standard, with a few rare exceptions for exceptionally simple cameras. Military issue optical sensors are all shielded against glares, and cameras with low-light capability are common. Limited zoom function is also standard, although the range depends on the quality of the camera, its built-in lenses and the image enhancement software. This can be replaced by a simple telescopic lens assembly to reduce the main processor's workload and increase battlefield survivability, or by a dedicated long range camera.

Dedicated lasers are sometimes added to the optical sensor package for range-finding and depth measurements, although the sensor array is then "active" and thus easier to spot. To avoid this, the above tasks are often fulfilled instead by a pair of small — and passive — stereoscopic cameras. Infrared cameras are generally used only as backup or as a low-cost night-time imaging system because they are easy to fool (with hot smoke or improvised fires, for example). Much preferred is the more modern AFLIC (Advanced Forward Looking Imaging Composer; see text below) system that is mostly used on tanks, striders and aircraft.

Omnicamera ◆

The designation "omnicamera" is used to identify a wide-angle, multi-purpose digital imaging sensor. The omnicamera's main receptor is composed of many smaller optical sensors, each sensitive to a specific portion of the spectrum. Additional lenses placed in front of this assembly allow telescopic and/or microscopic vision. The resulting data is then correlated by a dedicated sub-processor and displayed on flat screens or in holographic displays. Because of their shape and correction software routines, omnicameras have a wider field of vision than other digital cameras.

AFLIC ◆

The Advanced Forward Looking Imaging Composer (AFLIC) system is a small turret-contained sensor package that uses a combination of normal light, low-light and thermal imaging to provide data to a dedicated battle computer. The computer then extrapolates a constantly-updated view of the environment scanned by the sensors. The resulting output is a composite, VR-like environment where every feature of the combat zone is mapped and tagged with the proper colors. Additional information can be displayed on request, modifying the view according to radiated thermal energy or any other heat or reflectivity-based characteristics.

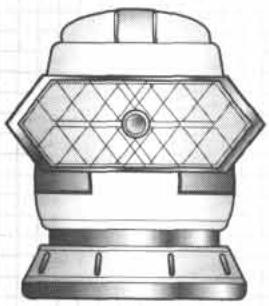
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Radiation-based Systems - 2.4.2

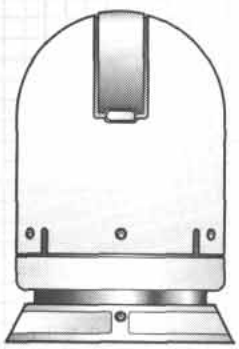
The ubiquitous radar still remains as popular as ever, although it is now often used in semi-passive, pulse-emitting mode to reduce the chance of alerting enemy forces. The bulk of a modern radar system is filled with sorting and discriminating circuitry used to cut through the electronic fog generated over the modern battlefield by all those active sensor, communication and ECM devices. All radar except the most basic models includes Track-While-Scan (TWS) capability and variable sweep width, along with "intelligent" pulse-scanning procedures for increasing area coverage.

Other long range detectors work on a similar principle, but use different wave-lengths. The ladar and madar are two such systems, one using low-intensity laser beams to scan while the other relies on microwaves. Ladars and madars are primarily used on spaceships and are standard equipment on all Gateships, though ladars are also used by many ground and air vehicles.

Radiation detectors such as Geiger counters are sometimes mounted as part of a mission-specific sensor package, especially on spaceships and prospecting vehicles. An even more specialized radiation detector is the Neutrino Interaction Detector (NID), an advanced high-energy sensor designed to detect and measure neutrino emissions. It is used by Gateships as part of their Gate-calibration gear and by battleships to detect the fusion engines of enemy vessels.



LADAR EMITTER



RADAR DOME

Radar ◆

Modern radars (short for RAdio Detecting And Ranging) generally have emitting and receiving arrays integrated into the skin of the vehicle, giving them greater coverage and allowing them to track in synthetic aperture mode (in effect, creating a "virtual antenna" many times the size of the vehicle). Smaller directional radomes (such as the one pictured here) are also used for precision work, though they lose in power.

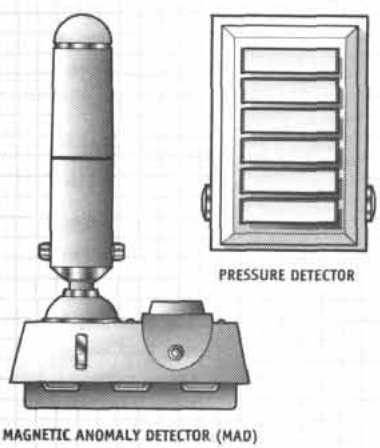
Ladar ◆

Ladars (also known as lidars) use laser beams instead of radio waves. Specialized emitters can shape the beam into sensor arrays of varying width, power and frequency, while optic guides allow a greater area coverage. Although ladars are affected by atmospheric conditions such as dust and smoke, they are more precise than radars, if somewhat shorter-ranged.

Specialized Systems - 2.4.3

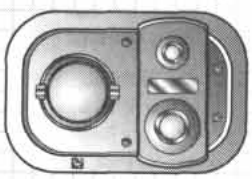
Other sensor systems are used for some very specific purposes, such as the environmental feedback required by the drive computer of walker vehicles. Accelerometers are one such system. When used in conjunction with the simpler electro-mechanical position sensors in the various joints, they provide a wealth of information to the CPU. Motion and vibration sensors are also used to monitor the terrain being crossed for any excessive displacement or disruption.

Densitometer and magnetometers (Magnetic Anomaly Detector, or MAD) are sometimes part of the on-board sensor equipment. Both systems are especially useful for detecting concentrations of metal ore in the ground, and so are frequently found on prospecting vehicles. More rarely used is the sonar, however. The lack of surface water on Terra Nova has reduced interest in this "sound radar", as its performance can be easily impaired by random noise in an atmospheric environment.



PRESSURE DETECTOR

MAGNETIC ANOMALY DETECTOR (MAD)



Pressure Sensors ◆

Pressure sensors are used mostly on manipulator devices and in the legs of walker vehicles. They provide feedback to the drive computer to ensure that operating limits are not exceeded. Pressure sensors are also used on tanks and other heavy vehicles, helping them navigate treacherous ground.

Geological Sensors ◆

The Magnetic Anomaly Detector, or MAD, detects the minute disturbances in the magnetic field of the planet caused by concentration of metals or monopoles. Since most war vehicles are composed partly of ceramics and polymers, MADs are not very effective combat sensors. Seismic motion detectors use vibrations transmitted through the ground to create an image of any underground resources.

Bryce Hubbard (order #959915)

2.5 - Tech-related Rules

The following section contains all the rules related to the technology described in this chapter. Additional cross-referencing is available both in the Index (page 186) and throughout the text itself. The rules are useful to technician characters working on high tech equipment, but can be applied to any situation where a character is dealing with a piece of hardware, regardless of its function or origin. Note that although the rules on NNet learning are intended primarily for Gears, they can be used for any other types of military vehicle or computer equipped with such circuitry, if the Gamemaster so desires.

2.5.1 - Smart Glues

Smart glues were discussed on page 9. They are one of the most useful tools available to the technician faced with the prospect of jury-rigging a damaged mechanism. These glues' variable properties allow different makeshift repairs to be made with a single container of glue by using the Tinker Skill. One smart glue pack (found in most mechanical repair kits) costs 80 marks/dinars, weighs 1 kg and contains 2 uses. The glue components are also available in batches of 2.5 kg (5 uses) or 25 kg (50 uses) for 150 and 1200 marks/dinars, respectively. The larger formats can be used to refill any field mechanical repair kit.

The rapid-forming glue combination halves the time required for mechanical repairs, but the tech must roll against his Tinker Skill every combat turn against a Threshold of 4 to see if the repair holds. If the test is failed or fumbled, the glue bond breaks and the previously repaired damage returns in full. If the vehicle is not submitted to a combat situation after the repair is made, roll every hour instead. The slow-forming mix is the chemical combination used for normal repair work — there is no particular game effect. It is assumed that all standard small repair procedures use this glue combination. The mix can be colored using special dyes.

Under the action of a catalyst, the glue can becomes a rapidly expanding polymer foam. It is resilient but can be cut with an ordinary saw or heavy knife. This foam can be used for numerous jury-rigging tasks. One glue pack is treated as one die's worth of Mechanical Salvage points (see page 150). No more than 5% of the total required Salvage points may be replaced by foamed glue. It is not mechanically strong enough for major structural repair. The glue can also become a malleable, plastic-looking paste that conducts electricity. The paste can serve as make-shift wiring when rolled thin enough, but it is mostly intended to bridge tiny gaps in circuitry. One use is treated as 1 Electronic Salvage point (see page 150). No more than 5% of the total required Electronic Salvage points may be replaced by the glue.

2.5.2 - Electronic Chips

About 1 in 6 chips is equipped for self-diagnosis; if needed, roll one die to determine if the chip has one. The presence of a self-diagnostic readout gives a +1 to any Skill roll for the purpose of identifying the chip or evaluating its condition. However, a Fumble means the readout was faulty and an incorrect evaluation was provided: a good chip reads as a bad one and vice-versa.

Due to their design, chips can easily be customized and reprogrammed to serve in a variety of functions. It takes approximatly five minutes minus the Skill level of the tech per attempt. Roll against the higher or either Electronics or Tinker Skills against a Threshold of 4 to see if the chip can be converted. If the test is failed, the modification is not done, but another test may be rerolled. If the test is Fumbled, the chip cannot be converted. Simple computer chips are freely available on the market for prices varying between 1 to 2d6 marks/dinars. More advanced chips are also available for specialized application, with a correspondingly higher price and rarity. If need be, one can assume that a chip or chip set corresponding to one Electronic Salvage point (see page 150) is worth 1d6x100 marks/dinars.

2.5.3 - Neural Network Evolution

Neural Nets (NNets) can learn and improve themselves. Over time, about 1 in 6 neural nets will start to gain Learning points (roll one die per new NNet in the campaign). Such NNets gain a Learning point after every battle and after every cycle of active duty. All NNets start with 0 Learning Points; when a NNet reaches 10 points, it can exchanges them for a roll on the Neural Net Learning Table.

The "Electronics" and "Body Control" results represent the NNet learning to better use its "body." Quarter points are accumulated until they total one point, but they can be used as tie-breakers. Due to hardware limitations, the NNet bonus in any vehicular Attribute cannot exceed +1. Neural nets start with -10 Creativity and Knowledge Attributes. When "Intelligence Increase" is rolled, roll one die twice. If the first roll is 4 or greater, raise the NNet's Creativity by one point. If the second roll is 4 or greater, raise the NNet's Knowledge by one point. Rolls of less than 4 are ignored. If crew casualties cripple a combat vehicle, the NNet may take over of its own accord by rolling less than its Independence Score on one die. If successful, the NNet operates as a human Rookie (Attributes 0, all Skills level 1) pilot. All neural nets automatically begin with an Independence Score of 0.

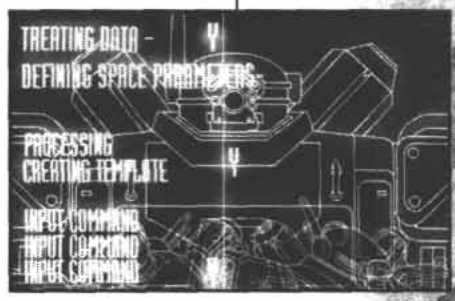
The neural networks used in Gears are highly complex. Relocated CPUs lose all vehicular Attribute bonuses, but keep improvement in mannerisms, Independence or mental Attributes. An Electronic Skill roll with a Threshold of 6 will allow the Gear to recover the vehicular Attribute bonus in 1d6 seasons, minus 1 week times the Margin of Success (thus a MoS of 3 will cut three weeks). If the Technician fails the Skill roll, the Gear will not recover his vehicular Attributes for 1d6 cycles. If the Technician Skill roll is fumbled, the Gear permanently loses its bonus and must be wiped (e.g. lose all acquired abilities) if it is to relearn any improved body control routines.

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Neural Net Learning Table

Die Roll	Benefit	Die Roll	Benefit
1	One Useful Mannerism*	4	+1 Independence
2	One Impolite Mannerism	5	Intelligence Increase
3	Electronics (reroll):	6	Body Control (reroll):
	1-4: +0.25 Communication		1-4: +0.25 Maneuverability
	5-6: +0.25 Sensor		5-6: +0.25 Fire Control

*Useful mannerisms include limited hand signals (provided the vehicle has hands), fetching its owner, or signaling for help. Impolite mannerisms include obscene hand gestures and other bad manners (like honking the horn in the middle of the night to annoy the neighbors).



Sensors and Communications - 2.5.4

The range and rating given for the sensor and communication systems are the passive combat statistics. By switching to active mode, the listed sensor and communication ranges can be doubled at any time, but the vehicle gains the "Large Sensor Profile, Rating 2" Flaw for that turn — if the Flaw is already present, its rating increases by 2.

By boosting the power even more, the range can be tripled, but at a cost of 2 more rating points. An Electronic Warfare roll, modified by the vehicle's Sensor rating, is also rolled against a Threshold of 5. If the roll is failed, the increased Large Sensor Profile takes effect, but the increased range does not. If the roll is fumbled, the vehicle is considered "locked-on" by any Guided weapon for the entire turn because of its sudden high energy signature.

Thus, a Grizzly Gear trying to detect another vehicle at a range of 6 km would need triple its normal sensor range (2 km x 3) and would be extremely easy to detect (Large Sensor Profile 1 + 2 + 2 = 5) because of its electronic emissions.

Unless using a relay station or friendly vehicle as a spotter, the maximum sensor range is equal to the distance to the horizon. From a ground-based, 4.5-meter tall Gear, this is a bit less than 7 km. This distance will increase if the unit is placed on a high vantage point, such as a mountain or other high ground, and decrease if the vehicle is on low ground (valley, canyon).

Remote Control Operations - 2.5.5

Almost any vehicle can be equipped with remote control equipment, though the inherent limitations of this type of interface means that in general, only small unmanned vehicles are likely to be equipped with it. Remote-controlled vehicles are referred to as "drones."

The remote control equipment is actually a software modification of the Autopilot Perk. Instead of responding to its internal programming, the Autopilot receives its instructions through the communication system and sends back environmental data gathered by its sensor array. Because of this, a drone must be equipped with all three of the above systems. Drones are not affected by "Crew" hits — any such damage is ignored, though Armor points are lost as usual.

If the drone must perform actions (i.e., fire a weapon, make an Active Sensor sweep), it must buy the Automation perk to represent the actual mechanical systems (note that this is an exception to the rule stating that at least one crewman must be aboard for Automation to be used). A drone cannot perform more actions than those afforded by its Automation level; for example, Automation 4 would allow up to three actions per turn. Drones are also limited by the controller's own action total. In the above example, a single controller could perform three actions at -2 each, but not four at -3. Two controllers could handle the three actions with only a -1 penalty. A single person cannot control more than one vehicle at a time, though a vehicle can have multiple controllers.

Because of the associated data-encoding procedures and control lags, remotely piloted vehicles suffer a basic -1 modifier on all of their rolls. If the vehicle is controlled through a Satellite Uplink, the extra lag increases the penalty to -2. The vehicle must be within communication range or contact will be lost. ECM affects the control link normally, and must be tested against every turn when present. The Stealth Perk can be bought for a drone, but it becomes useless when the drone is under direct guidance, since the remote control two-way transmission always points to its general location.

Drones may be wire guided instead of radio guided. This removes the need for a communication system as well as the time lag, since wire transmission cannot be intercepted and are thus not encoded. Wire guiding also makes the drone immune to ECM, but it implies that the vehicle is trailing a very fine wire for control. A Piloting roll must be made every turn against the highest Movement Point cost for the hexes traveled to avoid snagging the cable. Flying drones must test also and use the overflown ground's MP cost. Failure means the cable is stuck and the drone must halt for the next round to free it. A fumble means the cable is severed. For simplicity's sake, it is assumed that the length of the control cable is equal to the communication range of the drone.

If contact is lost, the software automatically switches to a predetermined program. The vehicle is then controlled by the Autopilot until contact is regained or the vehicle runs out of fuel, whichever comes first. The program should consists of a single line of text and should be written down when the drone is released.

Bryce Hubbard (order #959915)

LIFE LINES



They just kept coming. The roar of a medivac hopper flying over the MASH encampment, bringing yet another load of wounded soldiers, shattered his train of thought. The hopper would be carrying at least three wounded, he guessed. They couldn't handle what they had now and they were being sent more. Von Netch tried his best to ignore that thought and concentrate on the triage sessions already underway.

Sixteen soldiers were sitting or lying in the tent, all of them bleeding and hurt. Two had already passed out from the pain and shock and were being rushed to the adjoining operating theater. Nurses and doctors were sorting through the wounded, quickly assessing wounds with a critical eye and giving each a priority for treatment.

He stop briefly to hand some sterilized gauze to a soldier with a bad cut on his scalp and moved on. He hoped that cut would get seen to at some point, but he wasn't very confident. The next one was lying on his back, pale but defiant. When he got to him, Von Netch rolled him over gently. The bedding was sticky with blood.

"Oww!" The young soldier jerked, his face briefly distorted by a flash of pain. The pallor of his cheeks contrasted sharply with the bright red and pink of the torn skin and exposed muscles of his right shoulder. "Careful, Doc, dammit! I'd like to keep that arm, if you don't mind!"

"Stop moving and it'll stop hurting," mumbled Von Netch, less than thrilled to be dealt a case of bravado on top of everything else. The hand scanner's pattern recognition feature confirmed the nature of the damage. The doctor rapidly punched a new operating sequence on the small datapad mounted on top of the complex medical glove covering his right hand. A tiny hypospray nozzle extended from the tip of its index finger like a surreal talon. Von Netch briefly wondered why medical equipment always seemed to look like weaponry of some kind.

In the next bed an infantryman started screaming. He was looking down at the place where his lower right leg used to be, now only an empty space at the end of a bloody stump. A nurse was already on her way, ready to get him sedated and into surgery as soon as an operating table became available. Land-mine wound, no doubt; Von Netch saw too many of those.

"Doc, you sure you know what you're doing?" The question snapped Von Netch back to the job at hand, the job of getting this kid stable enough to wait his turn without dying. He was now just as pale as the doctor's shirt, sweat coating his skin as he started coming out of shock.

Von Netch gave him a disbelieving glance. "Let me get this straight. Half your shoulder is missing, and you're worried about a tiny injection?! Sheesh." The medic made a quick gesture, firmly grabbing the man's good arm. The glove automatically injected a clear serum through the heavy cloth.

"Now, I gave you 2 cc's of a painkiller/antibiotic solution," he continued. "It will stop most of the pain and prevent any infection from setting in until I get to you."

Von Netch looked around again. The three newcomers had no beds and were lying on sanitary blankets in the hall. They needed to be tended to immediately. The tent was getting more and more crowded by the minute, and more hoppers could be heard landing outside, their jets howling like banshees.

"That may take a while."

Bryce Hubbard (order #959915)

Medicine in the 62nd century - 3.1

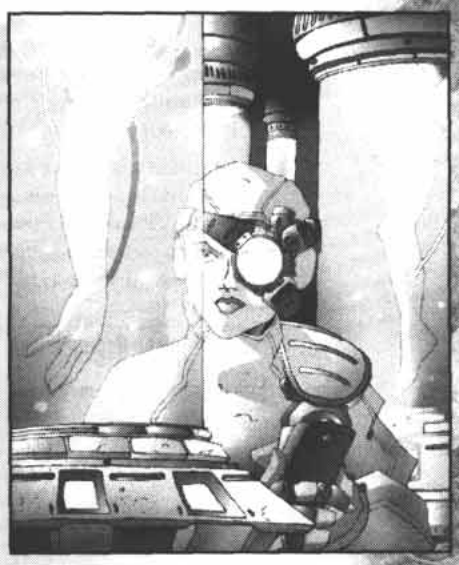
Modern medical science and its applications, as far as the characters are concerned, deal mainly with making them heal faster so they can go on the next mission without becoming cripples by the end of the campaign. Terranovan medical science is advanced enough in both hemispheres that doctors can almost totally heal third degree burns in a matter of weeks, sometimes even as few as three or four. It is also possible to recover from nearly fatal wounds in less than a month, although that requires many drugs and constant medical monitoring.

Medicine has recovered, and surpassed, what it had lost during the last Ice Age. Early during the 49th century, biology had finally become a very mathematical and precise science, something that had been only a dream during the Dark Ages of Medicine (from the 17th to the 24th century). A biological entity is now as easily programmable as a computer. Contagious diseases are a problem that can take anywhere between minutes or hours to heal, no more. Epidemics are almost unheard of. Whenever something of this sort occurs, it is eradicated within a few days at most. Problems arise only when the disease kills too quickly for a research team to react, as was the case with the St-Vincent Plague or the epidemic in the Montcalm Oasis (see Into the Badlands, p.15).

Despite all its advances, however, medicine is a highly regulated field of science due to its potential for abuse. Indeed, in both hemispheres, doctors are subject to severe rulings that prevent them from using some of the biotechnology available to them. This curious social stigma against the more advanced bio-technologies is rooted in the horrors of the War of the Alliance and before that, the Prime Knight and other supersoldier programs of the distant past.

A Brief History of Medicine - 3.1.1

What is considered to be the beginning of true medicine did not appear before the nineteenth century. Previous attempts at medical healing relied on observations and deductions that were sometimes right, but more often than not caused harm to the patient. It was not before the scientific method was applied by physicians and researchers that medicine came into its own. For example, the development of germ theory and a better understanding of how the body works improved patient survival rates greatly, as did the development of anesthesia. Even then, a lack of reliable methods for diagnosing internal problems made some medical treatments difficult. X-rays, sonic imaging techniques and other invasion-free devices eliminated the pain and risk involved.



The development of high tech surgery and genetic engineering in the twentieth and twenty-first centuries, however, made the most radical differences. Medical staff did not just react to illness or trauma anymore, they could detect it in advance and actively work to prevent it. Tailored micro-organisms produced advanced drugs and other compounds, while current induction crystalizers forced broken bones to mend in days rather than weeks. Prosthetics, incorporating ultra-light composites and advanced nerve linkages hidden under extremely realistic polymer pseudo-skin, returned full autonomy to accident victims (pre-natal deformations being almost always corrected in the womb by genetic techniques).

By the late colonial era, even a small medipack could accomplish what would have amounted to miracles a mere millennia earlier. Few people worry about their health anymore; often, it is just a matter of finding the right physician in time.

The Neufeldt Axiom - 3.1.2

The basic credo of the medical profession has always been based on the principles established by the Greek Hippocrate. The oath stated, in part, "first do no harm", a motto that was interpreted as the need to preserve life above all else. This led to a series of debates in the late 20th and early 21st centuries which culminated in the ironic execution of a group of doctors who had performed a large number of assisted suicides.



The Hippocratic oath served well for many centuries, until the Ice Age drastically changed the face of the planet and the destiny of Mankind itself. Compounded by the development of regeneration technologies, problems with overpopulation, and bad experience with burned-out supermen, this crisis period clearly showed the need for more thought.

The successor to the Hippocratic Oath was first proposed at the Cairo Medical Conference of 5325 by Doctor Luiza Neufeldt. The Cairo conference was to be a landmark in history for the many techniques that were first presented there, not just because of its philosophical contributions. What doctor Neufeldt proposed was a significant shift in the way medicine was to be applied: the purpose of medical treatment should place the quality of life ahead of longevity; to make the patients happier, rather than keep them alive at all costs.

Bryce Hubbard (order #959915)

3.2 - Genetics

Genetics is the catch-all name for all treatments involving the manipulation and splicing of genetic material both in vivo and in vitro, generally for the purpose of medical treatments (see Bio-Engineering, page 25, for a discussion on design work for custom living organisms). The human gene map has long since been decoded, and its various functions and uses are well-understood by the highly trained geneticists that get to play with it. Nature being what it is, however, the occasional mishap still happens, though they are nowhere as bad as those in the early days of genetics, where causes and effects where not always connected and the cure was sometimes worse than the desease.

Genetic flaws and diseases are few and far between on Terra Nova, mainly because the original colonists were either carefully screened to start with or received extensive corrective treatments before taking the trip. Though the cases have become rarer, they have not disappeared completely. Small mutations continue to occur and accumulate over time. The cosmic radiation received during the original transit must have influenced the DNA of the first colonists, and the alien biochemistry of the planet combines with all the above to create subtle, often undetectable changes.

While they almost always provide a solution to any given medical problem, it is usually prohibited to perform a genetic operation on a patient without a special legal authorization. Such authorizations are always long in coming and, almost invariably, outrageously expensive to obtain. Human society still remembers the abuses and horrors of the past, and has placed many safeguards to make sure they will not happen again.

3.2.1 - Genetic Manipulations

In general, genetic corrections are easy to perform (relatively speaking, of course). Actual modifications to the gene map, the type that drastically change the body layout or chemistry of the patient, are much harder, involving the splicing of entirely new coded sequences within the genetic material of every cell in the body. Important genetic augmentations are detectable for up to 10 years after they have been performed. Because of the yearly genetic checkups (GenChecks) required by law, there are very few unrecorded, genetically enhanced individuals walking about.

The easiest genetic manipulations are those performed before birth, before the body has begun to grow and cells start to differenciate and specialize. Augmentations become increasingly difficult with age as the gene map stabilizes over time. It is a very messy business to genetically alter a six year-old, and it becomes nearly impossible to successfully do it without severe secondary effects (cancers, for example) once past puberty. This does not prevent some pleople from trying anyway, or just falling prey to ruthless fixers that promise incredible changes, only to disappear with the money.

◆ Tissue Regeneration



Genetic manipulation can be used to regrow missing body parts. This takes some time even in a properly equipped hospital and may not be available to all patients. In general, the younger the patient, the better the chances of success. If regeneration is not possible, the patient will be forced to rely on prosthetics (see next page).

A tissue sample is first taken and then modified to take it back to a more primitive, undifferentiated cell type. The cells are then encouraged to grow into whatever type of tissue is required for the operation. The new organ grows quite fast, having the entire resources of a growth matrix devoted to it. When it reaches the desired physical age, it is taken out of the vat and carefully transplanted to the patient's body. Since the cells were originally from the person, there are no rejection problems, and rehabilitation is usually quite fast.

Game Effects ◆

Genetic manipulations can be used to improve or "repair" the Attributes of a character, or regrow a missing limb. An increase of one point in one physical Attribute costs between 100,000 and 600,000 marks/dinars. The Threshold for success is 4 plus the character's age in cycles divided by ten (rounded down). On a failure, the regrowth does not grow properly and the patient will be forced to go through the entire procedure again, or have a prosthetic attached.

Augmentation of the mental Attributes, or augmentation to bring a physical Attribute above +3, can only be done before birth. They are also much more expensive: 800,000 to 2,000,000 marks/dinars, plus legal fees (between 150 and 200% of the cost). Increasing any Attribute above +4 is completely illegal. Because of the unpredictability of genetic mutations, pre-birth genetic manipulations have only a 75% rate of success. This drops radically to 20% during the first five years of life, and down to 4% until puberty. Past that point, it takes a miracle (1 per 10,000 is successful).

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Prosthetics - 3.3

Cybernetic limbs (also called "cybs") do exist, but those who wear them are too often viewed with a mix of pity and mild disgust. A few social groups see them as a mark of martial prowess — some rover bands, for example — but overall no one would have them installed for the fun of it. Although they are easily implanted and can very discreetly replace any biological equivalent, they represent a social stigma that is very annoying for most cyborgs. Prosthetics look artificial upon inspection, but can pass unnoticed under normal scrutiny, especially if the cyborg is wearing clothes. Implants not designed to pass as human limbs (chrome-plated, exposed mechanisms, etc.) generally cost less than fully concealed ones.

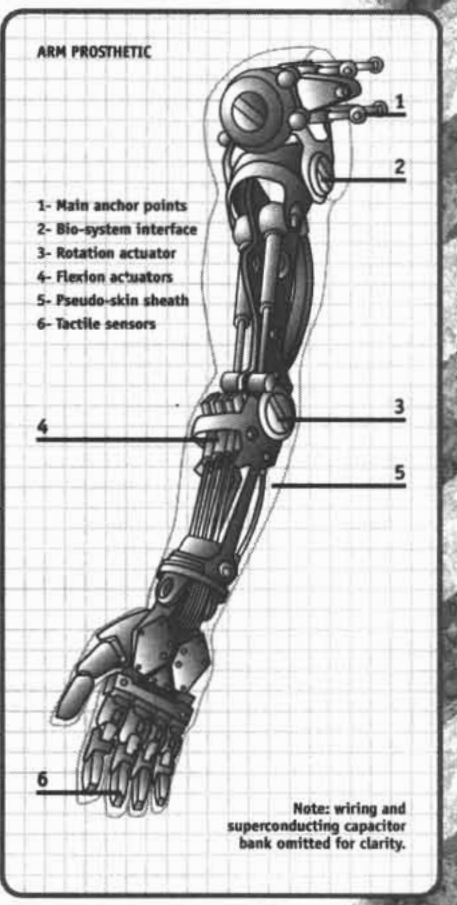
Arm and leg replacements are often roomy enough to conceal some small items such as a watch, mini-radio or even weaponry. However, power augmentations and built-in weaponry are strictly forbidden by law in most city-states and settlements. Devices of a lethal or potentially harmful nature may not be attached to a person in any permanent way, though this can be hard to enforce when dealing with concealed cybs. The law usually sets a limit of 25% past human maximal capacity for damage output as the authorized high end.

Types of Prosthetic Replacements - 3.3.1

Arms and legs are probably the most common prosthetic replacement. Advances in computer and material technology have allowed the creation of artificial limbs that replicate nearly all functions of natural ones. Some limbs can even be designed to augment the physical performance of the wearer, though the body remains limited by its natural muscles and skeletal structure.

Eyes can be cybernetically replaced and even augmented in many ways, each more expensive than the next. Fully artificial eyes (which require complete replacement) include a system that projects data directly onto the wearer's field of vision. They also commonly include automatic shutoff to protect against blinding flashes of light. Ears are more easily modifiable than eyes, and correspondingly cost less. Radio Reception ears are very popular among the general public.

Other cyber replacements are more specialized. The cyberspine was first developed for people suffering from crippling back injuries. It consists of a cybernetically-enhanced spinal cord, reinforced vertebrae and augmented synthetic back muscles. Because of their bulk, cyberspines cannot be hidden. Other implants include flesh pockets and duraskin armor. Flesh pockets are just that — supple, sealable containment units hidden within a person's flesh. Duraskin is the ultimate in personal civilian armor: a subcutaneous layer of fine duraplast ballistic fiber that absorbs both kinetic and electromagnetic energy. Duraskin does not grow or shrink with the body, nor does it repair itself.



◆ Materials

The main concern of the designer is to provide a limb that is similar in weight to a natural one and yet still be strong enough to withstand day-to-day use. The basic structure, or "bones," is made of light alloys that imitate the natural shapes and the articulations are self-lubricating. Non-allergenic, semi-organic polymers provide the interface with the rest of the body, where the prosthesis is attached via special rivets and organic resins.

◆ Interface

The interface between the natural nerve system and the limb is made up of paired neuron/coil groups. An extremely small metal coil, protected by a polymer shell, is protein-bonded to neurons in each motor nerve. Whenever the neurons "fire," they induce a current in the coil which is detected by the computer. The system works both ways, sending information back to the nervous system.

Power Sources and Maintenance - 3.3.2

Maintenance is of the utmost importance for implanted prosthetics, since they do not benefit from the body's natural healing capacity. They must be checked regularly for power levels and micro-fractures, and the bio-interface must be carefully monitored to make sure that no biological trauma occurs.

Cybs are powered by one or more small super-conducting batteries that are located within an easy-to-reach compartment. These batteries can be recharged by practically any energy source — it is easy to jury-rig an adapter, given time and a few pieces of assorted hardware. In addition to the purely mechanical maintenance, each cyb must be checked at least once a cycle to make sure no infection or rejection occurs.

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3.3.3 Descriptions and Rules

Each individual must receive tailored prosthetics; the cost of this customization, added to the cost of any option added, may modify the listed prices considerably. Prosthetics look artificial upon inspection, but can pass unnoticed under normal scrutiny, especially under clothes. Implants not designed to pass as human limbs cost 20% less than the listed price. Implants that can pass the most thorough visual investigation (Notice check versus Threshold of 9) cost 50% more than ordinary ones.

Each arm is considered to have free internal space equal to a small Flesh Pocket, while the roomier leg has internal space equal to a large Flesh Pocket. Items (such as guns or radios) can be built directly into the prosthetic for twice their normal price (quadruple if the item is concealed). Alternatively, the space can be designed to be used as a standard flesh pocket.

◆ Limb Replacement

"Crude" arms are very basic replacements and impose a -3 penalty on all arm-related functions and Skill checks. "Basic" arms are a little better and allow limited manipulation abilities; they impose a penalty of -2 instead. Neither type can pass as a normal human limb (although Basic arms can go unnoticed underneath clothes), and must use specially adapted tools. A Crude or Basic arm is considered destroyed if it receives two Flesh wounds. A Deep wound counts as two Flesh wounds for all prosthetic arms.

"Standard" replacements, used as intelligent prosthetics, give the wearer no bonus of any kind, but replicate nearly all movements of a normal arm and hand. They are only limited in very fine motor control (-1 penalty to artistic Skills only). The limb is considered deactivated if it receives two Flesh wounds, and destroyed after three. "Advanced" arms give a +1 bonus to AD and UD when specifically using it. A pair of Advanced arms gives a +1 to FIT; any increase in Strength due to FIT increase cancels the aforementioned damage bonus. Advanced arms have 15 points of Armor; any wound done specifically to such an arm is considered a Flesh wound at worst. The arm is considered deactivated after two consecutive, targeted Flesh wounds, and destroyed after three.

"Crude" legs are simple pegs and impose a -3 penalty on all movement-related functions and Skill checks. Jumping and jogging (or any faster movement) are impossible. "Basic" legs are somewhat more useful: they impose a penalty of -2 on all movement-related tests, but do permit painful jogging. Neither type can pass as a normal human limb, but Basic legs can go unnoticed underneath clothes. A Crude or Basic leg is considered destroyed if it receives three Flesh wounds; a Deep wound counts as two Flesh wounds for all leg types.

As with arms, "Standard" legs simply replace a character's normal legs, giving no bonus or penalty. A character can have just one Standard artificial leg without any balance problem. Standard legs are only limited in their fine motor control (-1 penalty to Dance Skill). The limb is considered deactivated if it receives three Flesh wounds, and destroyed after four. "Advanced" legs are only useful when used in pairs and give a +1 bonus to FIT; this bonus is added to that received from Advanced artificial arms only if a Cyberspine is present. An additional 5 meters/round is added to the wearer's Sprinting Speed, cumulative with speed bonuses due to FIT increase. Advanced legs have 20 points of Armor and take targeted damage like Advanced arms, but are deactivated after three Flesh wounds and destroyed after four.

◆ Sensory Organ Replacements

Fully artificial Eyes (i.e. complete replacement) include a system that projects data directly into the wearer's field of vision. They also include automatic shutoff to protect against blinding flashes of light. "Deluxe" artificial eyes include Holovid reception. "Telephoto" eyes have extra resolving power at the cost of a narrower field of vision. The character can see as a x50 telescope and gets a +1 bonus for an aimed ranged attack (the modifier may then exceed the usual maximum aiming modifier). "Infrared" eyes can see into the infrared spectrum and detect sources of heat in complete darkness. The motion and shape detection eye ("Eagle Eye") recognize particular shapes and detect moving objects by passive scanning, giving a +1 bonus to PER for visual information. At least one full month of practice is required before being able to use these abilities, and it may take up to a cycle to become truly proficient with them.

There are no additional bonuses for having a pair of matched eyes, but two types of eyes may be mixed. A single human-sized eye cannot feature more than one type of cybernetic augmentation. By mounting part of the hardware on an exterior plate, however, it is possible to add a second option. APP automatically suffers a -1 modifier, while the cost is equal to the total cost of the installed options, times 1.5.

Ears are more easily modifiable than eyes. The most common implant is the Volume Control augmentation, which define the amount of noise reaching the inner ear; such implants include an automatic cutoff system that blocks sudden, very loud noises. "High Sensitivity" ears give a +1 bonus to PER, but only for hearing tests. "Radio Reception" ears are very popular, since they don't have to replace the actual ears. They allow the user to receive hi-fidelity radio broadcasts, either local or remote. They have a range of around 15 km, depending on the emitter's power. "Sonar" ears allow the cyborg to "see" in the dark with a receiver that processes the sound waves generated by a throat implant. Sonar ears reduce the total darkness penalty to only -2 penalty, but the wearer must first practice with the device for at least one month. "Subsonic" and "Ultrasonic" ears give the ability to hear well into the respective frequency range.

Except for Volume Control and Sonar ears, which must be used in pairs, there is no bonus for having a matched pair. Ear types can be mixed without a problem, but an ear cannot feature more than two options. By mounting part of the hardware on an exterior plate, a third option may be added. APP automatically suffers a -1 modifier, with the cost equal to the total cost of all the options, times 1.5.

Bryce Hubbard (order #959915)

Other Cyborg Implants

A Cyberspine gives the wearer a +1 bonus to both FIT and BLD, though the FIT bonus is not added to those provided by any limb replacements (if present). The cyberspine does, however, allow FIT bonuses from arms and legs to be cumulative. It gives the wearer 18 points of Armor against rear attacks. Cyberspines cause an automatic -1 to APP whenever visible.

Flesh Pockets are supple, sealable containment units hidden within a person's flesh. Mini pockets hold a volume of up to 8 cubic centimeters (cc) and are detected with a Notice roll against a Threshold of 6 (8 if empty). Small flesh pockets can hold up to 250 cc, enough for a small handgun, and are detected with a Notice roll against a Threshold of 4 (6 if empty). Large pockets can hold up to 750 cc, enough for a large handgun, and are detected with a Notice roll against a Threshold of 2 (4 if empty). Large flesh pockets can only be implanted in the torso. Small and Mini pockets can be implanted anywhere except the head.

Duraskin is a subcutaneous layer of fine Duraplast ballistic fiber that absorbs both kinetic and electromagnetic energy. This adds points of Armor to the body. Unless the wearer is wounded, it is virtually impossible to detect Duraskin. It is as complicated to take off as it is to insert, requiring two weeks in a specialized surgical center for either operation (these two weeks of intensive care usually cost about 250% of the armor's listed cost). Duraskin does not grow or shrink with the body, nor does it repair itself. If a character with Duraskin is wounded or gains or loses weight, he will lose one point of Armor per Flesh wound (or per point of Build changed) and two points of Armor per Deep wound in addition to the wound's effect. These lost Armor points will impair the healing process (double the healing time) and must be repaired by a qualified medic (Skill level 2+). Repairing one point of Armor costs 10% of the Duraskin's original cost and takes one complete day.

Power Source and Maintenance

Crude cybs do not require any power source and will last indefinitely, although you do have to tighten the springs and screws once in a while. All other cybs are powered by one or more small super-conducting batteries. These can be recharged by practically any energy source — it is easy to jury-rig an adapter (Tinker or Electronic Skill, Threshold 3). Each battery lasts half a cycle, two cycles for Basic implants (they have lower energy requirement). Past that time, a discrete indicator warns that the battery must be replaced. The battery will last for one more week, after which it causes a -1 penalty; each additional week will add -1. Once at -5, the item becomes useless. Arms require one battery to function, legs and cyberspines two batteries each. All other implants draw their power from a smaller battery located in the lower torso. Flesh Pockets and Duraskin do not require a power source.

Each item must be checked twice per cycle to make sure no infection or rejection has occurred. This apply to all prosthetics except Crude and Basic limbs. The character must pass a Health roll versus a Threshold of 3 (5 if not in a medical environment, +1 per check missed). If failed, a minor complication develops in a random prosthesis: it performs at -1 for all tasks until a medic looks at it. If the test is fumbled, a Flesh wound is immediately applied.

Prosthetic Reference Table

Item	Mass	Cost	CP Cost	Recovery	Item	Mass	Cost	CP Cost	Recovery
Arm, Crude	7%*	2,000	-4	1 days	Eye, Optical Readout	0.3	130,000	3	3 days
Arm, Basic	9%*	16,000	-2	3 days	Eye, Holovid Opt. Read.	0.3	200,000	5	3 days
Arm, Standard	12%*	130,200	0	7 days	Eye, Telephoto	0.3	460,000	8	4 days
Arm, Advanced	15%*	290,000	5	10 days	Eye, Infrared	0.3	350,000	7	4 days
Leg, Crude	10%*	3,000	-5	1 days	Eye, Eagle	0.3	570,000	6	4 days
Leg, Basic	12%*	18,500	-3	4 days	Ear, Volume Control	0.2	110,000	3	3 days
Leg, Standard	15%*	150,400	0	9 days	Ear, Radio Reception	0.2	80,400	4	2 days
Leg, Advanced	20%*	310,600	7	14 days	Ear, High Sensitivity	0.2	270,000	5	3 days
Cyberspine	10%*	1,000,000	16	30 days	Ears, Sonar	0.6+0.2	760,000	12	5 days
Flesh Pocket, mini	0.01	12,000	1	1 day	Ear, Subsonic	0.3	290,000	6	3 days
Flesh Pocket, small	0.02	15,000	3	1 day	Ear, Ultrasonic	0.3	350,000	7	3 days
Flesh Pocket, large	0.04	20,500	5	1 day	Cyb Battery (small)	0.3	1000	n/a	n/a
Duraskin (Armor 10)	5%*	100,500	6	4 days	Cyb Battery (large)	0.5	2500	n/a	n/a
Duraskin (Armor 20)	8%*	250,000	10						7 days

Mass is the item's mass in kilograms; items marked * use the percentage of BLD in kilograms.

Cost is the item's cost in marks/dinars.

CP gives the cost in Character Points for implants added during character generation. Negative values give back CPs.

Recovery lists the recovery time for the surgical operations required (in Terranovan days). A period of time equal to three times the recovery time is also needed for complete healing and readaptation. Recovery times for multiple implants are not cumulative.

Bryce Hubbard (order #959915)

3.4 - Webbling

Webbling is a field of medical science that was only granted "independent" science status in the late TN 1800s, after veterinarian Jolene Moth (the "cybervette," as the hourly tabloids called her) demonstrated the potential benefits of harnessing animals with such devices and having them work for man. Webbling, in short, involves interfacing an animal's brain with an internal computer neural network in order to better train it, or so it can control a device to perform certain duties.

Although the device is harmless to the animal (and perhaps even pleasurable), there has been quite a bit of controversy with this application of cybernetics and electronics. Webbling can be performed on most animals, provided they are sufficiently intelligent to properly interface with the NNet. "Webbling" consists of two processes: download and upload. The download is a set of instructions, with accompanying stimulation of the pleasure centers (operant conditioning), to perform certain actions — somewhat akin to programming, while the upload is a set of instructions sent by the animal to perform the desired actions through a remote-controlled device attached to the NNet.

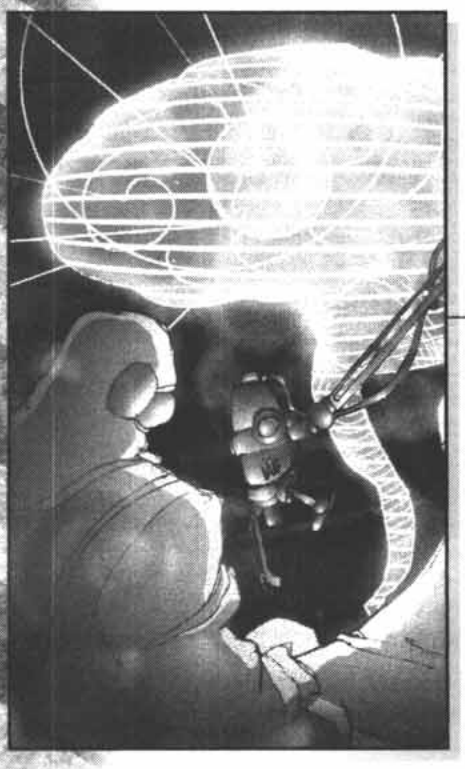
Naturally, very few animals are intelligent enough to be worth the investment. Currently, many of the larger mammals (or "mammaloids") and reptiles are capable of supporting the webbling procedure (dogs , monkeys, horses, dolphins, barnabies, for instance), but no birds, insects or fish have been successfully webbled.

Webbling is rather expensive, and often done out of fancy rather than need. Most of the time, machines are more reliable and durable than webbled animals, but are obviously far less "charming." A typical webbling will cost around 1,200,000 marks or dinars and will allow the animal to perform simple actions after a few weeks of training. While its intelligence is not increased, it can perform "more" because of the remote devices to which it is now connected. Webbling is completely internal and it is impossible to recognize a webbled animal as such.

It has not escaped anyone's attention that this could easily be used on humans. However, if anyone has done it, it is not known whether it met with any degree of success. Indeed, a human is considered too willful for the download to work effectively without extensive neural damage. Nonetheless, there are those who worry that this technology exists at all.

In both hemispheres, it is considered legal to harness and program animals with webbling brainworks in order to train them to perform domestic, commercial or industrial duties. It is thus possible to have a SenseDog™ equipped with Peripheral Sensory Webware™ to watch one's home more effectively, or a cloned ButlerMonkey™ who will take your coat and hat off when you visit a (very) wealthy friend's house. It is illegal to webble animals for combat or any other purpose that could cause harm to a human. Using webblings on humans is, of course, totally illegal.

3.4.1 - Game Effects



Webbling is only possible with large and rather intelligent animals. The Instinct (or Knowledge) score of the creature must be at least equal to -1 and its Build equal to at least -6. The operation is complex and requires extensive preparation. It takes one week to grow the basic neural network in the laboratory. Another full week and costs between 300,000 and 450,000 marks/dinars must be allowed for each level of webbling installed. The exact cost will depend on the clinic where the operation is performed. One level of webbling gives a bonus of +1 to Instinct (or Knowledge) and -1 to Willpower when resisting commands. It also gives the animal an additional Skill at level 1. It is possible to apply this bonus to an existing Skill instead, if so desired. Additional Skill or Skill level (without further Instinct upgrade) are available for half the webbling operation's price. The maximum Skill level available through webbling is 2 for any Skill.

The Cybervette

Webbling has been explored for many centuries, with the preliminary research going back to the third millenium. Progress came at a very slow rate, however, mainly due to the public's reluctance to fund a technology that could be used to program living creatures as if they were computers. The military expressed early interest in the technology, but abandoned it as unpractical when the potential for neurological damage to human neuron cells was discovered. In the late TN 1880s, veterinarian Jolene Moth came across a reference to the interfacing of the neural nets and living brain cells when browsing through an archive. She already had experience with neural interfacing, having briefly studied prosthetic sciences cycles before. She began to experiment with small animals in her lab, but met with little success at first. Moth had to face some hard opposition from groups concerned about her work (even escaping one attempt on her life in TN 1892), but pressed on. By TN 1894, she had defined the current operating parameters and established guidelines for webbling installation. She is the first to admit that using this technique on a human would not only prove difficult (or even harmful), but raise considerable ethical problems. At age 76, Dr. Moth can still be found working in her lab, refining her techniques.

Bryce Hubbard (order #959915)

Bioengineering - 3.5

Along with computers, biotechnology has been the great legacy of the first industrial age that took Mankind from the fields and villages and into space. The discovery and subsequent manipulation of the basic building blocks of life itself led to the creation of amazing products and medical techniques. It has also opened the door to the creation of chimera and other monstrosities, leading to many daunting ethical dilemmas.

There is sometimes confusion about the differences between genetic work and bioengineering, for both mean essentially the same thing and use the same basic techniques. The term genetic work is generally used to identify processes that repair damage on a living organism (see page 20) whereas bioengineering is used to describe the work done to create custom organisms, such as the modified bacterias used to grow polymers or the infamous super-soldiers used by the armies of Earth.

Genetic work has never been subject to the same kind of stigma as bioengineering, as most regard it as simply another medical tool. Bioengineering, on the other hand, is a process that has been vilified and denounced since the idea was first presented. In the 20th century, eugenics experts were employed by dictators to prove the "purity" of one race or another. In the 21st century, conflicts arose over the idea of "ready-to-order" children, often "programmed" to fulfill their parents' dreams. The super-soldier disasters of the late Ice Age did nothing to improve the image that bioengineering had among the general populace, and its practitioners and subjects are still looked upon with suspicion.

Prime Knights - 3.5.1



Only sketchy reports still exist on the subject of the Prime Knights, for the secrets of their development was lost with their home country of Kyr Arya millennia ago. They are now viewed by most people as a legend, mythical super-beings that were taller, stronger, faster, and would have enslaved humanity had they not been destroyed. Some cultures have even been known to use the Prime Knights as boogiemen to scare children into bed or control populations. Most historians, however, agree that they were most probably superb specimens of humankind, but that they did not have any super-human abilities.

As usual, the truth lies somewhere in between. The Primes were humans, but they excelled in so many domains they amazed observers. They were uniformly bright, level-headed, in excellent physical condition and with near-total immunity to diseases. They all had phenomenal eye-hand coordination and lightning-fast reaction time, making them superior pilots and marksmen.

While the Prime Knights were unable to reproduce among themselves, they could and did reproduce with normal humans. The offspring resulting from those unions were true half-breeds, possessing diluted versions of their Prime Knight parent's abilities. Over generations of breeding with humans, the Prime Knight genes and abilities have faded almost completely. There are rumors that early-generation Prime Knight descendants made a point of conceiving children with each other, hoping to reconcentrate their abilities and bear true Prime Knights, but no proof they ever succeeded.

GRELs - 3.5.2



In many ways, the Genetically Recombined Experimental Legionnaires (GRELs) are the descendants of the Prime Knight program, though any medical specialist will note that they are a pale imitation of their forebears. Despite their advantages, GRELs benefited from technological advantages and from unshakable morale more than anything else. Their combat skills may have been sharp, but their tactics tend to lack imagination.

A GREL is essentially a very specialized human being that is optimized for combat. All the major body structures are basically human, but either exaggerated (if useful for their assigned role) or underdeveloped (anything else). Thus, all GRELs are large and powerfully built, with little body fat, but they have little creativity and learning abilities. Mordred-class shocktroopers, for example, were bred for strength and loyalty. They were not terribly intelligent, but they had completely unshakable morale due to hypno-training designed to keep them going under heavy fire. They had almost no personal initiative, and had to receive orders to accomplish any remotely complex task.

GRELs of one type are all grown from the same basic template, with only minor changes between batches to prevent a single disease strain from eliminating entire regiments. It was thought that these could be used to create a disabling "key" for destroying rogues, but the chances of the key mutating were too high and the idea was abandoned. Once force-grown in-vitro, using techniques similar to the ones perfected for organ regeneration, GRELs are programmed through a symbiotic neural network that is grown onto their cerebellum during the gestation period.

Bryce Hubbard (order #959915)

DEADLY GAMES



Captain DeLoren stared intently at the holographic reproduction of the battlefield. Oversized representations of the units seemed to float over their positions, color and intensity representing their status. Detailed shading and effects indicated terrain types. Red units, marked with question marks, moved through the hills above the main battle line. They were rebel units, but their class was unclear.

"Isolate and enhance sector 9A," he said to the display's processor. A secondary image appeared in front of DeLoren, zooming in on the unidentified rebel units. They were moving slowly through the brush, keeping to the ridge to maintain a watch on the valley. Pretty large, too — they had to be striders. Some of the Long Fang Nagas stolen from Republican Heavy Industries last season, most likely.

He knew the rebel forces were closing in on his fleeing advanced battle group, and there was nothing he could do to prevent it from where he was. Touching a transparent icon, he activated a comm channel to his lead tank. "DeLoren here. Report."

The tank commander's face appeared in a small window that seemed to hang in the air. The image within was grainy and bouncy, the result of the massive ECM network deployed by the rebels in this part of the valley. DeLoren wished he could call upon ECCM, but those units were unavailable at the moment.

"It ain't good, sir. They've deployed artillery or striders up there in the hills, and they're pounding us with rocket-boosted shells. I sent a Gear cadre to hunt them down, but that may take a couple hours. They also had a few hoppers, but we shot them down." The commander was putting on a brave face, despite the fact that he had to know that his unit was in deep trouble.

"What about the main force?" DeLoren was more concerned about his forces being overrun.

"Still about 30 klicks out, sir. Their tanks have trouble in the hills. Then again, so do ours."

DeLoren closed the window, ending the communication, and brought up a larger scale map. The main rebel force was clearly visible moving through the jungle; the situation was grim. Under no circumstances were the rebels to be allowed to take control of the valley.

DeLoren tapped the resources icon, bringing up the availability of tactical support. Satellite artillery was well over the horizon and he doubted he could get authorization for such a small skirmish anyway. Air support was minimal at best, but anything could help. Sliding through the tactical request menus, he sent a priority message for a single bombing run over the main rebel force. He only had a lone flight of Quetzal fighter-bombers, but they could do some serious damage nonetheless — if the request made it through the red tape in time.

His reserve would have to be committed sooner than he thought. He opened another channel. "Hank, tell the boys we're going in. Power up the Gears and load them onto the transports. We're boosting out in three minutes."

That meant a two hour flight to the battle. DeLoren hoped the battle group could hold out that long.

Bryce Hubbard (order #959915)

4.1 Military Technology in the 62nd Century

The first centuries of the third millennium brought forth incredible advances in all of the major scientific fields. Computers were faster, materials sturdier, weapons deadlier. Medicine was capable of curing almost every known disease (see Medicine), and space travel was a fact of everyday life. The numerous armed conflicts of the third and fourth millennium, however, with their ever-shrinking supply lines, soon showed the folly of relying on technology to win battles. This caused a curious evolution, with more developments being made horizontally, in already known fields, instead of branching out into new areas. The major factors involved in this new philosophy were availability, cost and maintenance.

The availability of the high tech equipment in question was often a problem. More than once, military forces had to use whatever was available to them instead of the advanced tools and equipment designed and produced in far away locations, simply because they could not get the high tech stuff. With the advent of interplanetary conflict, logistics became a procurement officer's nightmare.

Another important consideration was the increasing ease of building cheap weapons able to defeat multi-million dollar vehicles in one shot, such as the infamous infantryman's hand-held "tank-killer" missile launchers. As a result, military vehicles were designed within much tighter guidelines and schedules and included as much field-tested equipment as possible to reduce their cost.

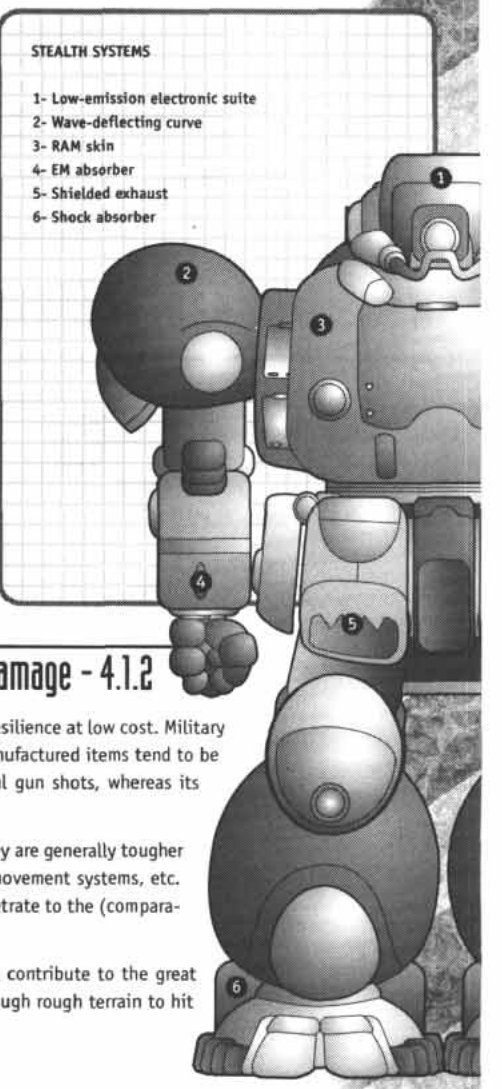
Designs gradually evolved into sophisticated and completely self-contained modular forms that could withstand a lot of punishment, required minimal maintenance and could undergo extensive hours of use without breaking down. By the fifth millennium, all tools of war could practically be built on the battlefield as long as suitable parts, either new or cannibalized, could be found.

The Influence of Stealth Technology- 4.1.1

The use of stealth technology in organized warfare dates as far back as the early twentieth century. Since the advent of electronic sensors and long range weapons, soldiers have sought ways to hide from their enemy while harming them, following the old adage "you can't hurt what you can't see." The original methods used were as primitive as the sensors, and consisted mostly of camouflage and specialized paint schemes to prevent visual detection.

With the advent of high-resolution radar and other advanced artificial detection systems in the late 20th and early 21st centuries, the old methods became virtually useless almost overnight. The first true stealth systems date from this period and, like the weapon and sensor systems they were designed to hide from, were subject to rapid evolution. The first few types (and the simplest of all) of stealth technology were mostly confined to the design of the shape of the vehicle and put numerous limits on its operating parameters. Later systems added electronic arrays to send false return signals and mask their own telltale emissions.

By the time humanity started settling the stars, electronic anti-detection systems were built as standard into the frames of most military vehicles. This trend continued up to the 62nd century: ground-based vehicles were built with a low-profile hull, shielded exhausts and a low-emission electronic suite, while deep sea, air and space vehicles carried even more complex systems such as sculpted anti-radar forms, energy absorbers and the like. Current Terranovan military vehicles are somewhat simpler and use mostly shielded systems to avoid leaving telltale traces of their presence. Walker vehicles, being by design quite tall, generally rely more on electronic masking systems than their shape to avoid electronic detection — a large silhouette is considered an acceptable trade-off for increased mobility.



Accuracy and Damage - 4.1.2

Advances in material and engineering techniques over the centuries have created structures of incredible resilience at low cost. Military vehicles benefited the most from this, naturally, but it is a given that nearly all 62nd-century, human-manufactured items tend to be extremely resistant to damage. Even the farmer's lowly all-terrain vehicle may be able to survive several gun shots, whereas its distant ancestors would have been severely damaged by the same attack.

This has caused a new problem for military weapon designers: not only are the new vehicles more agile, they are generally tougher too. The best way to harm an armored vehicle is thus to target its weak points: access panels, hatches, movement systems, etc. The more accurate the weapon, the better chance it has of finding a weak point in the outer hull and penetrate to the (comparatively) fragile systems underneath, causing large amounts of damage.

Low-recoil weapons, fast-processing targeting systems, gyrostabilized mounts and guided projectiles all contribute to the great accuracy of 62nd-century weaponry. Their high degree of sophistication allows even a Gear bouncing through rough terrain to hit a dodging opponent at a respectable distance.

Bryce Hubbard (order #959915)

4.2 - Offensive Technology

Offensive technology is a broad term that covers the various tools designed to find and remove enemy threats, either by taking away their ability to be a danger to the unit or by destroying them outright. The tools for doing so are generally the many types of weapons currently available to any well-equipped armed force, but they should also include sensors and communications equipment as well. The latter are required to first find and confirm the location of the enemy before the weapons can be brought to bear, making them just as crucial in the whole process as the guns and missiles.

Offensive systems greatly define the design of the vehicle they are mounted upon. They often represent a significant portion of its cost and their physical requirements are reflected in the overall design. It is not unheard of, for example, for a tank or a plane to be literally designed around a particular weapon system. While offensive systems can be hidden, they are generally quite apparent on the hull, turret or arms — mostly from engineering considerations, but also (though few would admit it) to make the vehicle more threatening. Heavy Gears are perhaps the ultimate expression of this psychologically inspired design. Indeed, resembling huge armored troops and carrying huge rifles, Gears exude intimidation. It is hardly a coincidence that the first military Gears were a product of the media-minded United Mercantile Federation.

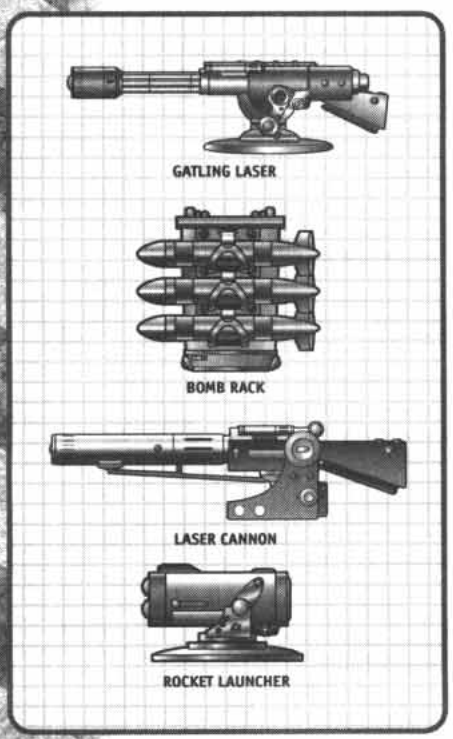
This section briefly examine the technologies used in weapon systems of various types and sizes: how they work, what type of vehicle carries them and so on. Sensors and communication procedures and technologies were already covered in the Basic Engineering Chapter (page 10) and will thus not be repeated here.

4.2.1 - Personal Weapons

Of all the weapons available, the trusty chemical slug-thrower is still the weapon of choice. It is simple, efficient and able to withstand day-to-day punishment without a problem. New materials and ammunition types make it far superior to a bulky laser weapon with its energy backpack and fragile lens array (although it still has its advantages — sniping, for example, is made much easier with a laser rifle). Many Terranovans own a hand-held firearm of some sort (in the Badlands, by necessity, virtually every homestead has one or more). Designs vary, but the automatic or semi-automatic hard polymer handgun is the most common (for weapon statistics, refer to the Personal Equipment and Weaponry chapter of the **Heavy Gear Second Edition** rulebook, page 67).

Infantrymen use automatic rifles or submachine guns. Unless they operate as garrison troops, Terranovan soldiers rarely use caseless ammunition since it is hard to manufacture/recycle in the field (for caseless ammunition rules, see page 79 of the rulebook). Portable heavy weapons are also available, either as small guided missiles or high-powered recoilless rifles.

4.2.2 - Vehicular Weapons



Vehicle-mounted weaponry is also predominantly projectile based. Not only are these weapons efficient and simple to build and maintain, they can sustain an enormous amount of punishment before breaking down, thanks to the advanced materials used in their construction. Cannons are generally equipped with some kind of standard pressure-regulated barrel. The larger guns tend to use the more sophisticated electro-boost system, whereas a constant energy discharge ionizes the propellant throughout the barrel, creating a plasma shock wave on which the shell "rides." Rifling is a thing of the past, as the needle-like shells and penetrators are better stabilized with fin-like projections than with a simple spinning motion.

Missiles and rockets are still popular weapons, mainly because of their small size and high damage potential. Many military vehicles carry at least one rocket pod to provide emergency punch in tight situations. These rockets generally have only limited guidance systems, with some models having none at all. Missiles, on the other hand, have semi-active or fire-and-forget guidance. Both types of weapons must face the electronic counter-measures and point-defense systems of their target, which tend to limit their battlefield effectiveness.

"High tech" weapons such as lasers, electromagnetic railguns and particle accelerators are not considered advanced anymore, but the denomination has stuck — at least until an even more lethal form of weaponry is designed. These "advanced" weapons are rarely carried by ground units because the presence of atmosphere and their large energy requirements prevent their efficient use. Only Earth vehicles used in the War of the Alliance ever carried a significant amount of energy weaponry.

Space-born units are a different matter altogether: here, the situation is reversed, with advanced weaponry being far more effective in the vacuum and enormous distances of space combat. Spacecraft armament is also much more powerful, on average, than their ground equivalent. Lasers need to supply enough energy to punch through armor at range of several thousand kilometers, while missiles equipped with micro-yield tactical warheads need not even reach their target to kill it.

Bryce Hubbard (order #959915)

4.2.3 Ammunition Types

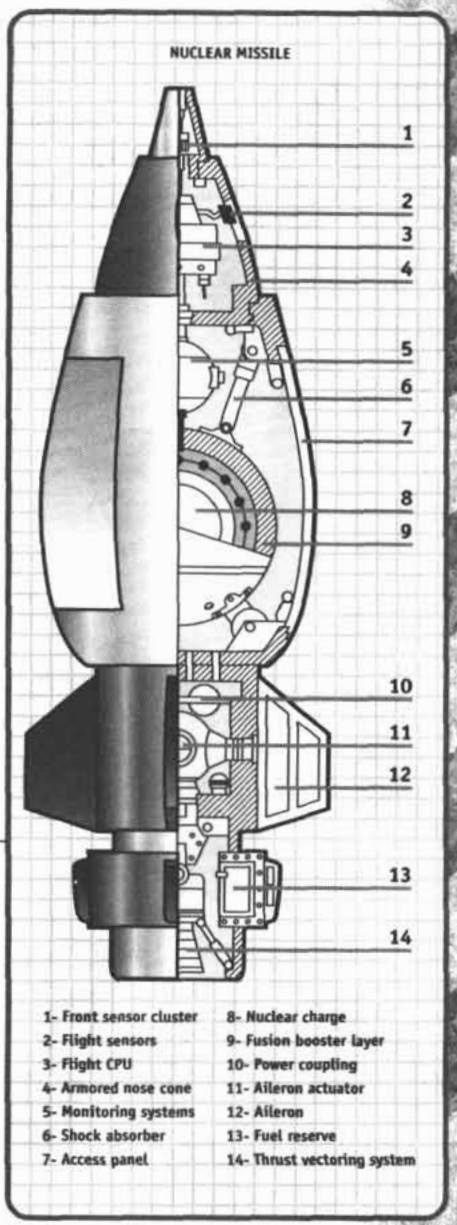
Modern weapons can fire a wide variety of sophisticated ammunition ranging from guided shells to self-propelled rockets. They are also capable of firing simpler ammunition, such as solid shells or high explosive ones, to facilitate resupply in the field.

The standard shell has residual rocket boosters and sports a molecularly aligned steel alloy tip designed for maximum penetration at all ranges. Fins deploy from the rear of the shell to stabilize it and improve accuracy. Some shell types have several tips and are designed to break up in flight, showering the target with sub-munitions. Specialized payloads can also be found, such as micro-mine carriers, saboted shells, incendiary compounds, smoke, chaff and almost any combination in between (game statistics for these ammunition loads can be found in this sourcebook, page 140).

A special type of shell is used by the short-range weapon known as the "snub cannon." The term "snub" here applies not to the weapon itself, but to the shell, which has a rounded and somewhat flattened nose. The multi-stage projectile uses a combination of sabot and self-forging warhead technologies to impart enormous terminal kinetic energy to its target at the cost of range and accuracy. The explosive warhead can also be detonated as normal, making the weapon at least marginally efficient against infantry units.

Projectile weapons still use a chemical reaction to force their load out of the barrel. Gel-type binary propellants, however, have all but replaced solid propellants in shell design, since these new designs are more stable and efficient. The gels are specifically engineered to completely burn upon ignition, with any residue being converted through a heat-activated chemical process into a lubricant for the barrel. With the proper chemical catalysts, the gel from unfired shells can even be converted into raw fuel, although it is a poor substitute for the real thing and is best used only in an emergency (see *Technician's Corner*, Chapter 7, page 153).

Advanced "booster" shells are equipped with a simple flight computer, sensor unit and rear vanes to control flight. Technically, these could almost be defined as cannon-boosted missiles. They are very costly, however, and not used very often. Boosted shells are often equipped with MEPHADA (MEmory Plastic Heat-Activated Deployable Ailerons) technology, where the shells literally "grow" fins upon emerging from the weapon's barrel.



◆ Nuclear Armament

Nuclear technology has been perfected in the last millennia. Both fission and fusion reactions are now well understood and used in a variety of fields, most of them space related. Even primitive anti-matter devices were deployed by Earth forces during the war. This means that nuclear armament can be found in the world of Heavy Gear; it is, however, practically never used.

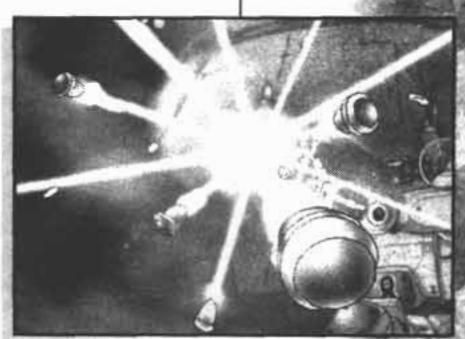
Nuclear weapons are so powerful that although some units could theoretically survive low-yield explosions, most vehicles are going to end up vaporized by the blast (see Mass Destruction Ammo, page XXX). This doesn't translate into a very fun game, although nuclear explosions could be used as part of a clearly defined scenario.

Mass destruction weapons are of no use when trying to conquer resources and territories, as they destroy the very objectives of the military action. Since most of the operations in the world of Heavy Gear revolve around the struggle over resources and territories, nukes are rarely, if ever, used.

◪ Guided or Unguided?

The rocket pods in the Heavy Gear rulebook represent the lowest form of missile weapons in use on Terra Nova. Some have crude guidance systems that allow them to compensate for the target's movements; in simulation terms, these are represented by "F" (Front Arc) rocket pods, reflecting their capacity to hit a target almost anywhere within 180 degrees. "FF" (Fixed Forward Arc) rockets have no guidance system at all — they rely solely on their initial trajectory to make contact with the target, which is why their fire arc is much more limited.

Some weapons have the "Guided" characteristic and can track a target after launching. Although their short burn time at launch limits their arc of interception, these weapons can use their guidance system to track a target and somewhat compensate for its movements. These are generally costlier and much, much deadlier because of their increased payload and accuracy. Anti-Tank Missiles are one example of such weapons. Some weapons can also fire guided shells.

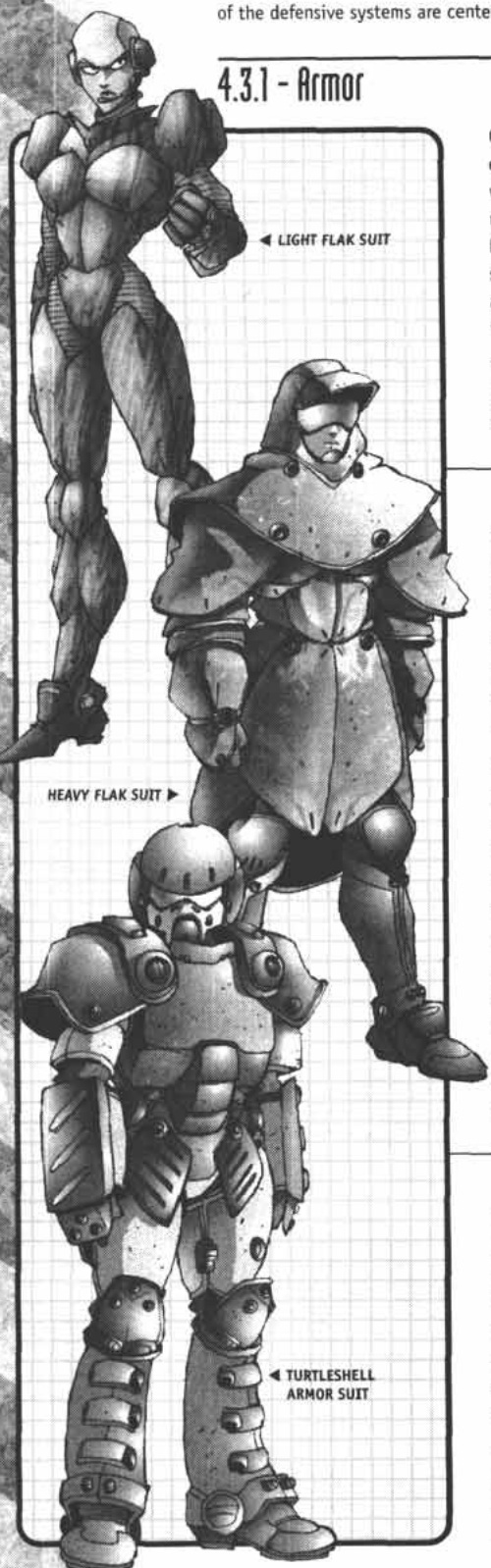


Bryce Hubbard (order #959915)

4.3 - Defensive Technology

Defensive technology is a broad term that covers the various items designed to shield and protect a combat unit from detection and harm. Electronics has already been discussed in the *Basic Engineering* chapter (page 10) and so will only be examined in passing. Most of the defensive systems are centered are means to either prevent the enemy from hitting, or absorbing the damage.

4.3.1 - Armor



Over the centuries, a variety of materials have been used to protect a soldier and his equipment from enemy fire. With the power of today's weapons, nothing less than advanced composite layered armor will do. At least, that's the theory. Composite armor, while very advanced, is also costly and hard to repair. Sometimes, a whole armor plate will have to be completely replaced because of a single hairline fracture. That is why many non-combatant vehicles, such as supply trucks, are armored with simple rolled, armor-grade molecular steel, which, while not as strong, is far easier to manufacture and repair. While it may not stop an anti-tank missile or a particle beam discharge, it will stop an infantryman's bullets.

There are many types of armor in existence, their characteristics depending on their intended use (see the *Materials* section for more information, pages 7-8). For ease of reference, armor is divided into two broad categories: personal and vehicular.

Personal Armor ◆

The most common forms of body armor available to infantry are light flak, heavy flak, and "turtleshell." Light flak consists of thin bulletproof clothing resembling normal combat fatigues. It is made of composite synthetic fibers interwoven with alloy threads. When hit by a projectile, the fibers and the threads dissipate the energy of the impact over the whole armor section. A second layer catches any fragments that may come through. Light flak armor stops most shrapnel and light caliber shots, but is almost useless against armor-piercing ammunition and high powered projectiles. It is relatively ineffective against laser and energy weapons, though the synthetic fibers can vaporize to absorb at least some of the attack.

Heavy flak is a bulky suit of flexible body armor worn over normal fatigues. It is similar to light flak armor but incorporates higher grades of material as well as some lightweight alloy or ceramic plates over vital areas. This increases the overall weight and bulk, but affords a greater degree of protection. Some heavy flak armor is customized to fit the wearer for increased mobility and reduced encumbrance.

The nec plus ultra of personal armor is the "turtleshell," a nickname for full suits of polymer or composite plates. Turtleshell consists of several layers of integrated material designed to absorb the maximum possible amount of energy from any incoming projectile. The outer layer is generally a hard ceramic that will shatter a projectile on impact or will vaporize to reduce the efficiency of energy beams striking it. The middle layer is a high-grade polymer composite that further absorbs energy and dissipates it across the entire armor section. The last layer, composed of padded ballistic fibers, catches any spalling or remaining fragments. The armor plates are worn on top of a full body undergarment that permits air circulation and absorbs excess humidity.

Vehicle Armor ◆

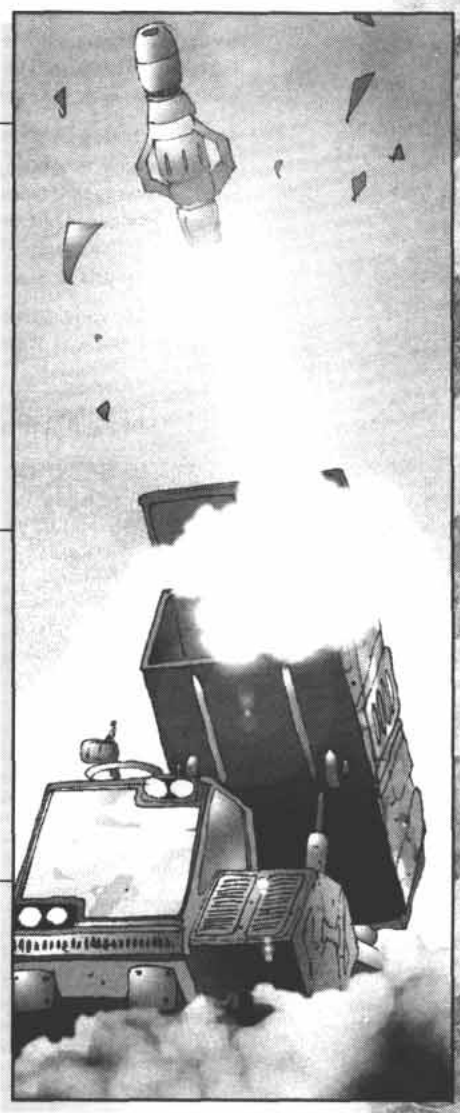
Vehicular-grade armor is even more diversified. Most vehicles are completely unarmored: any weapon hit will, most likely, directly affect their structure and cause damage to their systems. The next step in protection is armor-grade steel, a high quality steel alloy rolled and tempered for maximum resistance. This is the basic material used in weapon penetration tests. Front-line combat units are most likely to be equipped with the best armor composite material. The density and weight of these composites vary immensely, as do their capabilities. Some are treated for resilience, others have additional ceramic layers for heat resistance. Modern vehicular armor is only a few centimeters thick and is very light, while still providing considerable protection.

A variant of vehicular armor is used on the hulls of many spacecraft in the 62nd century. It is not that different from standard armor, although it is submitted to more treatments and contains specialized foamed layers to stop radiation cascading and micro-particle surface abrasion. It also contains more ceramic and polymer compounds, on average, than any other type of armor.

Bryce Hubbard (order #959915)

Static Defenses - 4.3.2

Static defenses cover the various weapons that, because of their nature, cannot be employed (or can only serve in a limited fashion) for offensive purposes. This includes minefields, gun emplacements and anti-aircraft laser platforms.



◆ Minefields

Mines have dramatically reduced in size over the centuries — the smaller a mine is, the harder it will be to find, and the more you can cram into one delivery system. Modern mines are made of lightweight, non-reactive plastic to avoid detection. A special timer is often built into the mine's mechanism as a safeguard measure. After the programmed lifespan has expired, the timer releases a molecular plastic dissolver that dismantles the mine, leaving the area safe for the victor. The dissolver is coded at the molecular level to prevent enemy forces from using it to clear minefields. Thus, minefields cease to be a danger to the (hopefully friendly) civilian population once the conflict is over. A counter-enzyme can also be used to make the mines permanent in case of defeat.

The various game characteristics of minefields are covered in the **Heavy Gear** rulebook on page 158. Optionally, more detailed and advanced minefield rules are found in the **Tactical Field Support** sourcebook.

◆ Gun Emplacements

With the resurgence of raiding and low destruction conflicts, gun emplacements have made a limited comeback in warfare. Due to advances in spotting and long-range fire, they are now manufactured as modular units, easy to break down and carry out, and often come equipped with a point-defense system to shoot down incoming missiles. Manned and unmanned versions are manufactured, although the latter tends to be a lot more expensive.

Makeshift and cobbled-together emplacements were also extensively used in the War of the Alliance and in numerous Badlands skirmishes over the years. These are often nothing more than a salvaged vehicular weapon with a makeshift fire control system, placed behind a revetment. They are more vulnerable than ready-made emplacements, but they are inexpensive and easier to set up.

◆ Anti-Aircraft Laser Platforms

Some defensive gun emplacements use megawatt lasers instead of ammunition-based weapons. Laser armament requires a great deal of power, often making it impractical as a front-line vehicle's main weapon. Lasers are more viable in a purely defensive role since they can be connected to a large, stationary power grid. As a result, laser turrets are used to defend permanent installations such as fortresses or city-states. Their (almost) line-of-sight range, combined with their extreme accuracy, make them perfect anti-aircraft and anti-missile platforms.

Electronic Defenses - 4.3.3

Not all means of defense are physical in nature. A good deal of the survivability of modern combat vehicles is due to the electronic systems they carry that enable them to either hide their presence or reduce their signature.

In general, only dedicated electronic warfare or scout vehicles carry a significant amount of electronic countermeasures. Most combat vehicles make do with simple low-emission systems, passive or semi-active sensors and low-power wave absorbers. Although this reduces the range and power of the sensor and communication systems, their sophistication still permits long-range communication.

◆ Electronics in Combat

The range and rating given for the sensor and communication systems of **Heavy Gear**'s vehicles are the combat statistics. Therefore, the sensors mounted on a Hunter-class Gear would be able to acquire a target at up to 2 km under normal combat conditions; that is, with the sensors on low-power, semi-active mode. Likewise, reliable and clear communication, unless specifically blocked by ECM, could be tight-beamed up to 10 km away.

There are times, however, when more range is desirable, even at the expense of detection. By switching to active mode, the listed sensor and communication ranges can be increased, but the vehicle becomes much more likely to be detected by enemy forces nearby.

Bryce Hubbard (order #959915)

4.4 - Command, Control and Communication

Army units tend to become smaller and smaller as the centuries go by and the technology used to equip them improves. In addition to the age-old infantry, which is now equipped with advanced body armor and weaponry, the 62nd-century military commander can call on heavy tracked tanks, swift hovercraft and nimble walkers. Sturdy, cheap and versatile, these vehicles can fill a wide variety of offensive and defensive roles. The complete coordination of all these forces is crucial to the success of any operation.

With the technological improvements, the face of war on Terra Nova is very different from that of earlier eras. Reliable communication systems, complex encryption procedures, satellite and drone reconnaissance all contribute to the fragmentation of the chain of command. Terranovan units tend to operate in small groups, coordinating their actions through constant communication with one another. Computers and expert systems help officers sift through the enormous amount of information gathered by the vehicles' sensors, sorting useful information from the noise and updating tactical memory banks on a regular basis. Little might be actually used during combat, but should the data be needed, it will be there.

Because of this, constant and clear communications are vital to the efficiency of a military unit. The actual procedures and mechanisms of communication were examined in Chapter 2, page 10, and so need not be repeated here.

4.4.1 - Communications In The Field



The structure of the communication network of a typical modern army is often referred to as a "hive" configuration, because the loss of one element in the chain will not completely disrupt the entire chain of command. In the "hive," each unit (infantry squad or vehicle) is merely a redundant link in the command chain. If the unit is lost to enemy fire, the entire "hive" network almost immediately perceives the loss and reroute the comm lines automatically, using alternate units to ensure a continuous data feed to all commanding officers. Feeds are generally limited to one or two ranks above and below a given unit to avoid swamping the command structure with unnecessary or irrelevent information.

To ensure a maximum awareness to all members of the team, each vehicle may make its basic sensor input available to any unit that requires it. While the information retransmitted is sketchy at best, battle computers are often able to pull out a surprisingly clear picture of the battle from these diverse points of view.

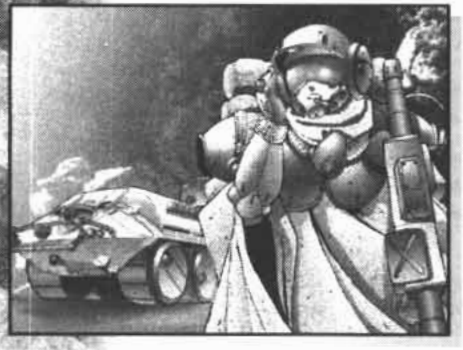
◆ Infantry



Each soldier has his own set of miniaturized sensors, including a micro-camera placed in his helmet. The micro-camera is sensitive to both the visual and infrared portions of the spectrum. Many equipment packages, such as the McKindle RS-87N worn by Norlight army troops, also include low-light equipment for night-fighting, retransmitting their output within the soldier's HUD.

The two-way communication system can operate on broadband frequencies, though it is limited somewhat by the lack of a proper antenna array. The communication system also doubles as a full IFF (Identification Friend or Foe) transponder. If satellite coverage allows it, a GPS (Global Position System) let the commander pinpoint the position of his men to the millimeter. The combat computer incorporated in the helmet pre-integrate all gathered data, serving as a primary filter to avoid overloading the trooper (and ultimately, his commander) with irrelevant information. The computer also monitors the welfare of the soldier through tiny passive sensors imbedded within the uniform.

● Combat Vehicles



All vehicles in the squad are patched into the hive, so do not have to maintain squad coherency once in combat (though they usually do to support one another). The tactical information is gathered by the vehicle's combat computer, broken down to its essentials, and "squirted" out to the hive via highly-compressed data packets. This allows all crew to know the position of all other vehicles in the force at all times, drastically reducing the incidence of friendly fire.

These "data squirts" transmissions are affected by enemy electronic countermeasures, and these are often deployed to prevent the commanding officer from guiding his troops with the most efficient tactics. Though each vehicle's onboard computers can extrapolate the relative position of both friends and foes from whatever fragment of information that does manage to make it through, their predictions are usually not accurate enough to allow targeting unless a significant effort is made to transmit the data.

Bryce Hubbard (order #959915)

Aerial Warfare - 4.5

Ground warfare was one of Mankind's earliest occupations, and it has kept on being one of its most time consuming. It got a good swift kick in the pants with the advent of flight in the early twentieth-century, however, and has never looked back. Although the development of air and space-capable vehicles greatly modified the balance of power in battle for a few centuries, the advent of powerful anti-aircraft weaponry such as the area defense laser turret (see page 31) and truly efficient man-portable surface-to-air missiles brought an effective end to the concept of air superiority. While this statement is not 100% true — an aircraft is still capable of engaging and destroying several times its weight in ground vehicles — they are not the decisive factor they once were. This holds even more true on Terra Nova, whose harsh weather is not kind to airborne vehicles.

On Terra Nova, short flights between polar locations are fine, but voyages across the Badlands pit aircraft against strong heat-generated convection winds, not to mention the occasional tempest (which will surely bring down any plane, no matter how well-designed it is). Ground and sub-orbital travel is safer and much more efficient. Grunts on the ground usually only see support and transport aircraft, while choppers and hoppers (vectored thrust aerodynes) are used for close support and anti-vehicular duties. Aircraft are poorly suited to raiding and resource acquisition, so ground forces see most of the action.

Many of the best ground support hoppers are produced by Paxton Arms, the huge weapons conglomerate based out of Peace River. Badlanders themselves, the designers at Paxton realize the hardships of desert flight and make fast, reliable and deadly aircraft. Their most popular design is assuredly the Dragonfly hopper. This two-man aerodyne is a nimble attack craft and has become one of Paxton's greatest success stories. Indeed, it is now the standard attack hopper of the Northern Guard. Paxton also manufactures variants of the Dragonfly, most notably the Black Wind stealth hopper. This deadly craft as a well-merited reputation as an aerial assassin.

Military aircraft are designed with stealth characteristics from the outset. Given the power and accuracy of modern sensors and weapons, aircraft and aerodynes are very vulnerable — once acquired, their chances of survival drop considerably. An aircraft's stealth characteristics and the pilot's skills at avoiding the attention of the enemy now go a long way towards ensuring its survival. Similarly, guided missiles, once expected to make "dogfight" combat disappear, are opposed with stealth, decoys and active counter-missile systems. All these factors combined make it very hard to accurately target a combat aircraft from a distance.

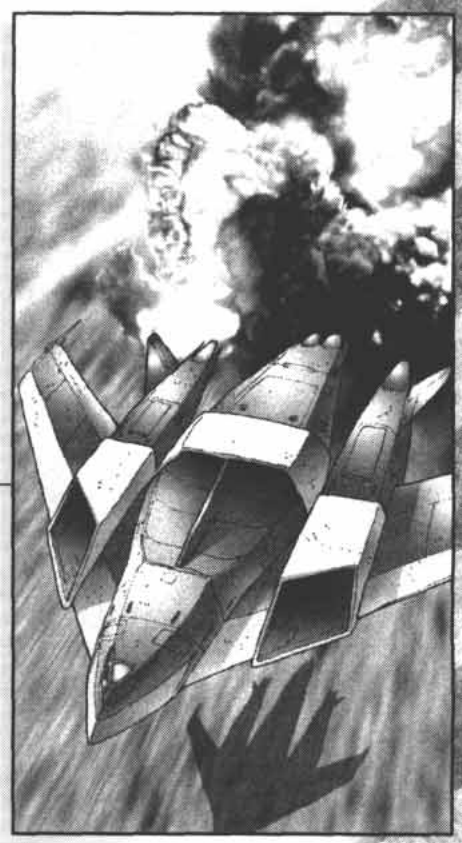
The art of close -in fighting, with most fighter combat occurring within an envelope of ten kilometers or even less, has thus made a comeback — much to the delight of glory-hounds and their adoring fans.

Vehicle Types ◆

Most of aerial missions nowadays are either to support (or stop, depending on which side you are on) the advance of ground forces or transport forces and supplies to the front. These functions imply different performance characteristics and are usually fulfilled by different types of aircraft, although some craft do perform hybrid functions.

Aircraft are divided into three general categories for convenience: conventional, VTOL and rotary wing. Conventional aircraft are fixed wing designs that fly in atmosphere only (though some rare models can reach low-orbit by themselves). Their main strength is endurance and fuel-efficiency, but they are vulnerable to anti-aircraft assets. They are preferred for long range transport, ground support and interception missions.

VTOL (Vertical Take-Off and Landing) aircraft are jet or turbine powered vehicles that can hover in mid-air and use almost any clear surface as a convenient landing pad. They are used mainly for short range ground support and interception, since they require lots of fuel to operate. Rotary wing aircraft use either propellers or rotors for lift, using power from jet or turbine engines. They are less costly than jet-powered VTOLs, but slower. Rotary wing vehicles are ideally suited to close ground support and transport roles, in which they excel.



◆ The Great Bomb Run

During the War of the Alliance, bombers on both sides were used to pound targets into submissions, often taking heavy damage themselves as they ran the gauntlet of interceptors and anti-aircraft fire. The Terranovan craft were hidden in hangars during the day and taken out at night, where they made fast strike against local CEF camps.

The Great Bomb Run was the nickname given to Operation: Pearl String, an ambitious, last ditch attempt by a Northern bomber squadron — the 28th Air Wing — to cause as much destruction as possible before their home base was discovered and destroyed. Colonel McGruger, the base's commander and a fine pilot himself, sent his Buzzard bombers on a string of attacks that would take them from their Badlands base right up to the Northern border. Only two aircraft made it home, but they were credited with the destruction of no less than twenty-eight supply bases in one night.

Bryce Hubbard (order #959915)

4.6 - Naval Warfare

Naval warfare, such as it is imagined by the public at large, is practically non-existent on Terra Nova and will in all likeliness never be. All of the planet's main bodies of water are small and land-locked, which means that boats are next to useless for attacking enemy forces directly. Large fleets of ocean-going vessels will never exchange cannon or missile fire on the surface of Terra Nova (though landships do, time and again).

Both the Confederated Northern City-States and the Allied Southern Territories maintain a small fleet of scout boats and large RSW (Rigid Side Walls) naval hovercraft, but these exist primarily for civil patrol duties and general security tasks. Only the navy of the Southern Republic fields any conventional naval vessels on Lake Esperance, though observers are doubtful about their actual combat usefulness — many whisper that they are nothing more than over-gunned pleasure craft for the high ranking officers of the Republican Army.

The Republican fleet goes back to the early days of that league's existence. The SR was born from a program of conquest carried out by the city of Marabou and aimed (initially) at the cities of Siwa Oasis, Ashanti, and Port Oasis. Three of these four cities sprawl on the shore of Lake Esperance and Siwa Oasis is but a short trip up the large Siwa River. This made sea power an important part of the Marabouin program of conquest. Indeed, only Marabou had a significant and well-armed navy and this made all the difference. The small coast guards of the other city-states could not secure their shores, leaving the targeted communities vulnerable to off-shore artillery. Marabou used this tactic mercilessly against Ashanti, which it bombed into the ground in short order. Naval power has remained part of the Republican definition of military pride ever since. Today, both the landship and sea vessel shipyards of the AST are located in Marabou.

Numerous shallow-water craft are used for river and swamp patrols, however. These low-hulled vehicles are rarely more than 10 meters long and cruise along the rivers and deltas of both hemispheres. Using these as high speed "roads" inland, such craft can lend fire support or deliver supplies to a beleaguered unit very rapidly, provided they are near a large enough river. Many of these patrol boat designs carry one or two water-worthy Gears on a platform at the front or rear of the hull for engineering and defensive purposes. Special variations of river boats operate in the underground environment of the MacAllen Cave Network, moving miners and others through the cavernous rivers of this underworld. This is a treacherous world for sailors and light and nimble craft are usually preferable to heavier vessels prone to get tied up in sudden shallows and hidden underwater rocks.

◆ Vehicle Types



Naval craft can be divided into several rough categories. The first is the conventional boat, a vehicle propelled by water screws or jets and using a water-tight hull to float. Their mission types include river patrol, intersettlement transport, and sometimes even fire support, if a battle occurs close enough to the water. Inexpensive to build, they are common only in areas with many rivers and small lakes. Flat, shallow hulled craft are used in the jungle of the South to transport goods and troops between isolated villages.

Hovercraft, vehicles that use powerful blowers to create a cushion of air underneath their hull to ride upon using the ground-effect principle, are another type of water-capable craft. They are quite versatile — they can go over water as well as any relatively flat surface — but they have their own restrictions (see page 55). Rigid Side Walls (RSW) craft are an off-shoot of the hovercraft principle. The flexible skirts are replaced on either side by solid walls, which double as a catamaran hull when the blowers are not active. In effect, they are a combination of hovercraft and conventional naval vessels. The Wing In Ground Effect (WIGE) craft, another vehicle operating on the ground-effect principle, is basically an aircraft that rides on the air cushion created between the wings and the ground. Few Terranovan water surfaces are large enough for these fast vehicles, however. All of these can be used out of the water as well.

The Story of the Swamp Darling ◆

The Southern Republic used river boats in great number when it waged its wars in the southern territories. Small rivers abound in the jungle and can serve as natural "roads" into hostile territory. The Republican army was quick to take advantage of this, building inexpensive river barges to conduct patrols.

The Swamp Darling is probably the most famous of these boats. The boat became a legend in its own time, serving with distinction during the southern unification conflicts in the late TN 1600s. The crew was notorious for being adept at recovering every bit of spare junk that came across their path, and they even fielded a fully operational Hunter Gear for a short period in TN 1679. The Darling was lost in a catastrophic assault ten cycles later, but her legend lives on in the heart of all naval servicemen.

Bryce Hubbard (order #959915)

Space Warfare - 4.7

Space is a dangerous place, hostile to all life as we know it and unforgiving of the slightest mistake. Each and every life-sustaining act, taken for granted on the ground, requires the assistance of some kind of machinery. Every piece of equipment that is forgotten, or that fails to work properly, may well cause the death of the entire crew. Space, however, remains the ultimate high ground. He who controls space, sees all and can attack all, provided he obeys the rules of nature. For this reason, combat spacecraft have been in use since the early days of space exploration, first in a pure reconnaissance capacity and later on in an offensive one. The conversion was not such a giant leap: because of the quantity of energy that must be expended to move, communicate and survive in the vacuum, a good spacecraft design is almost always a good combat vehicle.

Space warfare is a completely different experience from combat on the ground. It is fully three dimensional and subject to the implacable laws of orbital mechanics. Specific weapon types have evolved to answer the peculiar requirements of the environment, such as the lack of an atmospheric medium and the extreme distances. Space weapons were rapidly developed out of more pacific tools, because they share many functions with their forebears: laser cannons that can punch a hole through a small moon can be used for secure communication over very long distance; kinetic weapons use the same basic technology as a simple reaction engine, or the massdriver used to gather rocks and minerals for construction projects; a modified missile can be used as a kind of message torpedo, and vice-versa.

Most combat vessels have a similar layout, the model for which was developed over the centuries of space exploration and conquest and gradually refined through trials and errors. Gun and laser turrets are located on the outer sides of the hull for a maximum arc of fire (the hsip simply rotate along its axis to bring the weapon to bear). Thus, crew compartments are shielded by the bulk of the hull when the laser is firing; this also places the ship between crew and enemy. Drones and mines are stored in aft bays to be easily dropped, while ASATs and other missiles benefit from the ship's velocity and are usually located forward. The rear section of the vessel is reserved for the powerful drives that move the ship along.

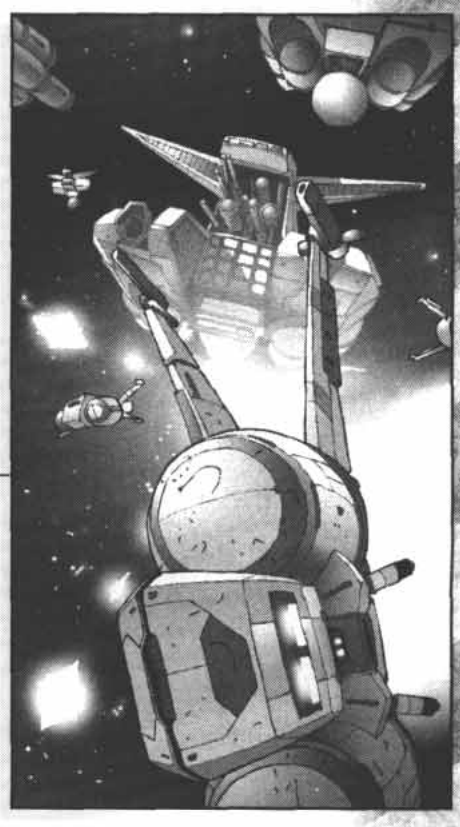
Spaceships use a standard fusion thruster system called a fusion tube. The fusion tube is an off-shoot of several projects, notably the Gate Drive. This system is efficient, well-understood, and can use almost any liquid or gas as reaction mass, making it extremely popular among spacecraft designers. Some vessels, mostly the smaller ones, still rely on chemical propulsion or disposable solid fuel boosters, since they are not big enough to house a fusion core. Fusion tubes are capable of developing awesome accelerations for short periods of time, making the movements of spacecraft engaged in combat a particularly spectacular event.

Vehicle Types ◆

Spacecraft can be divided into two categories, deep space vehicles and interface vehicles. The first category is generally subdivided between the FTL-capable ships (generally called Gateships, for their ability to open the spatial discontinuities that allow FTL travel) and the rest, which must rely on the Gateships for intersystem travel. Apart from physical sizes and the presence of the Gate drive, there are few design differences between the two. Non-FTL ships tend to have more powerful engines and weapons, but that is because they do not have to carry the mass of the Gate drive around.

Few spaceships are light and aerodynamic enough to be atmosphere-capable. They can park themselves in high orbit, but that's about it. A wide variety of vehicles are used to fill the gap between orbit and ground, most of them powered by fusion tubes just like their space brethren. These same interface vehicles can also be used for fast deployments of troops via sub-orbital flight, with no location on the planet is more than an hour's flight away. Simply flight up to orbit, make half an orbit, and come down over the target site. If the site is close enough, even a sub-orbital parabola will suffice.

As long as anti-aircraft assets are properly neutralized, this enable a modern combat force to effectively wage war across an entire planet with minimal logistic problems.



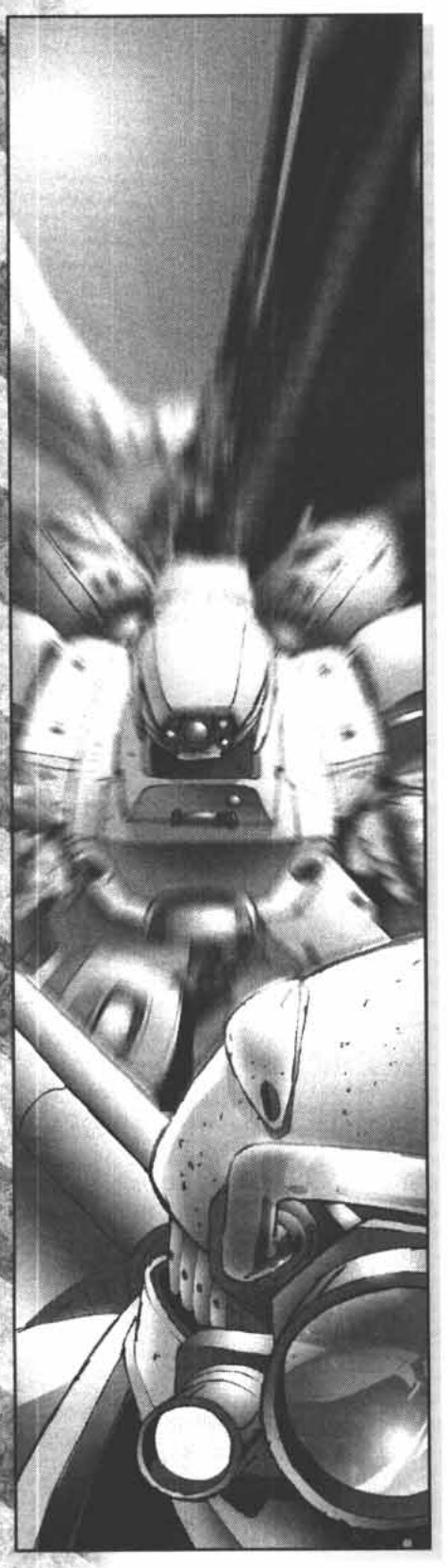
◆ Hide and Seek

Space battles were common during the War of the Alliance, though they occurred mainly with the many Terranovan drones and missiles rather than their ships. Still, the tiny navies of the planet gave a good fight during the three cycles of the War, using the resources of the Helios system to harass the Colonial Expeditionary Fleet and force them to expend ships and reaction mass hunting for foes that, often, were not even there.

The Terranovan efforts were effective enough against far superior numbers that they played a significant roll in the ground victory over the CEF. Indeed, the Earther fleet was forced to withdraw from Terranovan orbit, which. left the ground forces isolated, and unable to open up new fronts. So many CEF ships were crippled, in fact, that over 100,000 CEF personnel (mostly GRELs) were abandoned on Terra Nova.

Bryce Hubbard (order #959915)

NO GUTS, NO GLORY



Madena was not having fun. The Hunter she was piloting just wasn't going to catch up to the Jaguar fifty meters ahead. They had been chasing each other the whole goddamn time and he was going to get away with it. Bloody bastard.

The Jaguar was gleaming and pretty, more like some polished toy than a real racing machine. That polished toy was going to win, however. Pulling out her autocannon, Madena fired wildly while she ran, hoping against hope to distract the pilot enough to let her catch up. No such luck; he weaved back and forth as the last of her shells knocked into a nearby rock-face.

A tight turn was coming up and she hoped he would have to cut speed enough to let her get in close. Gunning her engine, she tried to steal a few meters from his lead. He'd have to slow down sooner or later, either that or smash into the wall. Even he wasn't that stupid, she thought.

"Won't be that easy, grandma!" His voice was as annoying as his attitude and anger flashed through Madena like a jolt. But he wasn't kidding. Going into the turn much too quickly, he skidded his machine along the ferroconcrete wall, scraping layers of coating off his Jaguar, but coming out at high speed. Yes, "Pretty Boy" Stahl was definitely a bastard.

Madena slowed her Gear, knowing full well that she'd better not imitate his move. Zipping through the turn, she expected Stahl to have opened up an even larger lead. She was going to have to settle for second place. If there was one thing she hated, it was second place. She'd paid her dues and Stahl was waltzing in and taking all the accolades with a souped-up machine and smile that made her want to belt him. And there seemed to be nothing she could do about it.

But then Stahl got cocky; or at least even more cocky than usual. As she came out of the turn into the straight-away, he was less than thirty meters away. She punched the throttle, knowing what to expect. She could just imagine his smirk.

As Madena's Hunter sprung forward, Stahl went into a tight spin. Drawing his fragmentation cannon, he fired off a shot directly at her. Thousands of tiny ceramet flechettes filled the air between them, and his voice crackled over the radio once more. "Happy birthday, grandma!"

Madena didn't respond. She didn't need to. Other pilots might panic when their sensor screen filled with shot, but not her. She kept a lock on him as the needles bounced off the durasheet hide of her Gear. His little ploy wasn't going to win him this race. Quite the opposite.

Pulling her controls like the pro she was, she brought her Gear into a charging skid right at the Jaguar. Stahl's machine was almost standing straight when she hit, but he was still off balance. The noise of the impact was defeaning, even within her helmet.

The Jaguar seemed to absorb the impact for a fraction of a second, then toppled like a drunk, its sensor pod smashing against the ferroconcrete railing of the track. Madena barely lost any speed and bounced across the finish line before Stahl could fully recover from his close encounter with the wall.

When he limped over in fourth place, Madena opened up the comm channel. "One lesson, Stahl. On the Death Track, don't mess with the best."

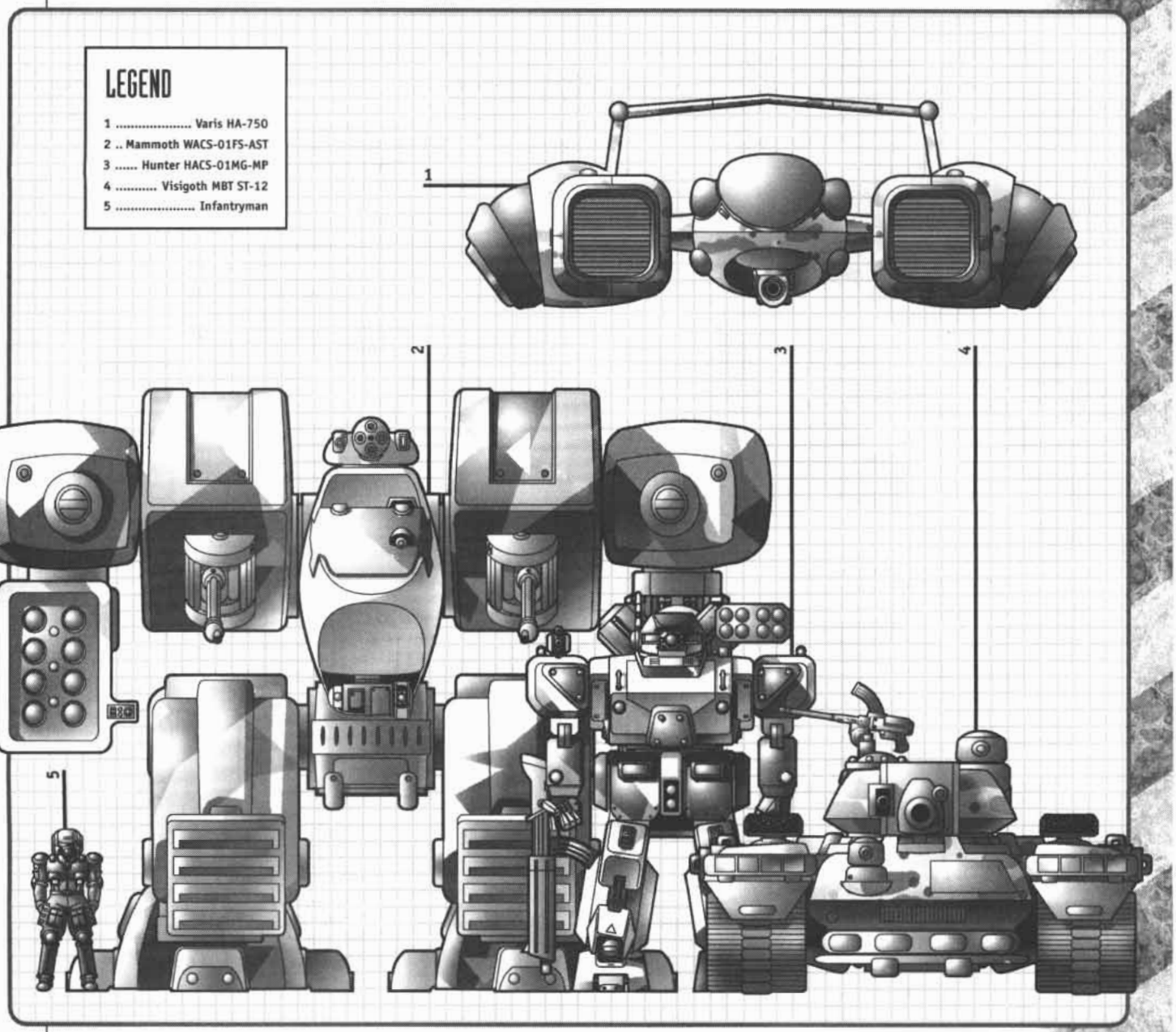
Bryce Hubbard (order #959915)

The Modern Combat Vehicle - 5.1

Vehicles have been in use since the dawn of history, and ever since their invention have been used in all sorts of conflicts. Military vehicles used to be quite similar to their civilian counterparts (after all, a chariot has few moving parts), then slowly evolved to fit new roles that made them very different. By the post-Ice Age and interstellar colonial periods, however, civilian and military vehicles were once more very close in design: even civilians needed protection and mobility on still-savage worlds.

Vehicles provide mobility, protection and offensive power, usually at varying levels. Few vehicles, if any, can provide all three at high levels. Most of the restrictions are centered around the weaponry; though a heavily armored cargo truck will bring some looks, it will merely be seen as an example of extreme prudence by city folk and as good common sense by jungle dwellers.

Few people can claim never to have seen a combat vehicle. All city-states maintain security and militia forces that regularly patrol the streets and the territories surrounding the city-state. There are also tons of hulks remaining from the War of the Alliance. Desert sands shift periodically to reveal the half-corroded remains of a tank or Gear, and crash sites of spaceships can contain anything from hand-sized fragments to a full hull, depending on the speed of the impact.



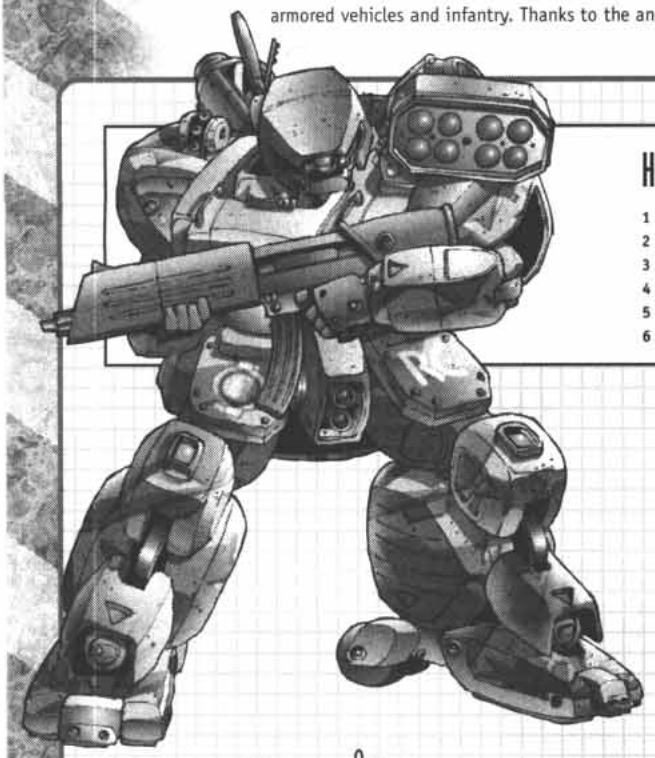
Bryce Hubbard (order #959915)

5.2 - Heavy Gear

Heavy Gears (often shortened to just "Gear") are one of the most notable developments in the history of military technology. Although combat walkers had been used as far back as the early third millennium, they were always cumbersome and much too conspicuous to survive the hi-tech battlefield, relegating them to support and engineering duties. This changed with the development of the Gear walker combat vehicle.

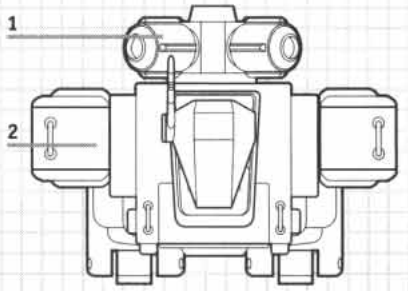
The Gear is actually a compromise between the infantryman's flexibility and the armored vehicle's resilience and firepower. It is, in effect, a one-man IFV (Infantry Fighting Vehicle) that protects the pilot and allows him to carry far more payload and armor than an ordinary soldier. The Gear's smaller size (they rarely stand above 5 meters high) and its mobility (derived from its humanoid shape) allow it to survive where a bigger, more cumbersome walker vehicle might not. Its biggest advantage is, however, its low cost: mass-produced Gears are cheap enough to form a major part of the modern army.

Gears are not the ultimate combat vehicles, but they come darn close. In any marginally rough terrain, they will have the edge over both armored vehicles and infantry. Thanks to the angle of fire afforded by their arms, they can even lay down their own anti-aircraft fire.

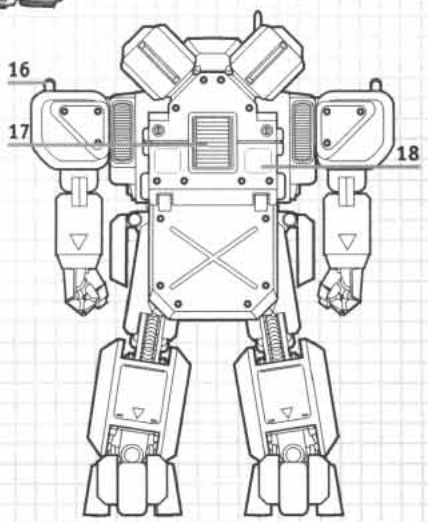


HUNTER HACS-01MG-MP

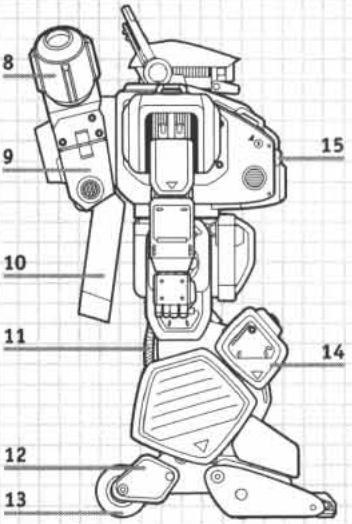
1 ..... Backpack assembly
2 ..... Shoulder block
3 .. Communication antennae
4 ..... Main sensor cluster
5 ..... Front skirt armor
6 ..... Manipulator
7 ..... Hardpoint
8 ... Generator/pump housing
9 ..... V-engine housing
10 ..... Armored fuel tank
11 ..... Power transfer line
12 .. Primary shock absorbers
13 ..... SMS roadwheel
14 ..... Knee block
15 ..... Headlights
16 ..... Handle
17 ..... Main engine radiator
18 ..... Battery housing



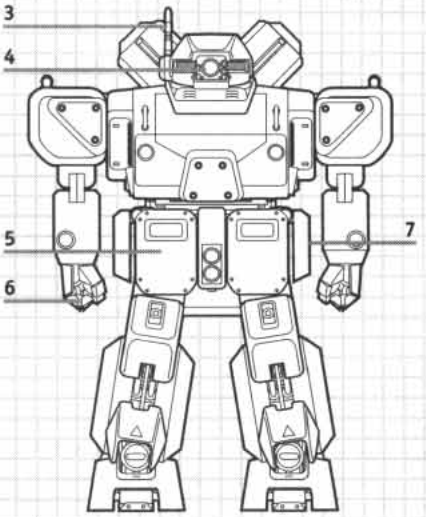
TOP VIEW



REAR VIEW



SIDE VIEW



FRONT VIEW

Bryce Hubbard (order #959915)

Heavy Gear Development - 5.2.1

The early walker vehicle experiments date back to the early 21st century, when computers and powerplant technology made the first walker designs practical. Multi-legged beasts were the norm at first, along with "exoskeletons," man-worn armor powered by small motors and capacitor packs. Although early tests and prototypes proved that such vehicles were possible, the concept had several shortcomings. A man clad in such armor was faster and could carry more weaponry than a regular infantryman, but was totally vulnerable to any of the vehicle-mounted weaponry in service. Even lowly soldiers could take the suit out with heavy weapons, knocking the pilot unconscious well before his armor was breached. In addition, the powered armor could not handle the recoil generated by many large weapons, restricting it to missiles and low recoil guns — many of which were powerless against increasingly tough vehicular armor, ECM and point defense systems.

On the other hand, the vehicular-sized walker could carry more armor and weaponry, but it was more vulnerable and much more expensive than a comparably sized wheeled vehicle. Walkers proved extremely mobile and saw limited action throughout the third millennia. They became tougher and more reliable With advances in technology, in the centuries that followed the Emigration Wars. During the Ice Age, walkers were a common sight, ferrying material and people across the frozen and often treacherous wastelands. A notable use of walker vehicles in warfare was during the historical period known as the Crusades, where walker tanks were used along with other, more conventional tools of battle. Most memorable were the Paladin bipedal walkers used by the synthetic, genetically engineered soldiers known as the Prime Knights.

The Colonial Era ◆

By the end of the Ice Age, walkers returned to more peaceful occupations like construction and transport. Then came the Gate Drive and the colonization period. The first interplanetary colonists were suddenly faced with a difficult problem: their new home planets were similar to Earth, but with a number of critical differences. For one, they were wilder and featured uncertain conditions. The best solution was to use the walker type vehicle that was already commonly used in construction and other specialized tasks.

Because the colonial corporations were unwilling to spend large sums of money to transport important quantities of cargo over to Terra Nova, mission specialists had to turn toward modular and highly adaptable components that could serve in a variety of ways and yet be easy to maintain using local resources and material. The first of this new line of equipment was the Hardhat, a rugged cockpit/main body system to which a variety of tool limbs could be attached. The Hardhat was self contained: it carried its own walk-drive computer and sensor pod. Additional sensor and computer modules came with the modular limbs.

The first twenty years of colonization saw the arrival of nearly 1200 Hardhats on Terra Nova. They were adaptable to a huge number of functions, and even discarded units were used as spare parts to build conventional vehicles. The Hardhats served as the basis for the evolution of the walker vehicle on many of the colonial planets.

Terra Nova on its Own ◆

By TN 1467 (5800 A.D.), walkers were used extensively on the rugged terrain and deserts of Terra Nova. When the colonial corporations were forced to withdraw because of the economic crisis on Earth, many settlers armed their machines with makeshift weaponry in the hope of breaking through the spaceports' defensive lines. This was the first use of the humanoid walker as a viable weapon. The technology was still crude, but the potential was obvious.

As the cycles passed and the city-states were founded one by one, new armies arose to protect them. These armies included walker vehicles in various roles, including infantry support, but they were still modified civilian equipment. In TN 1674 (5948 A.D.), United Mercantile Federation engineers started work on a true military walking infantry vehicle, or BOT (Bipedal One-man Tank).

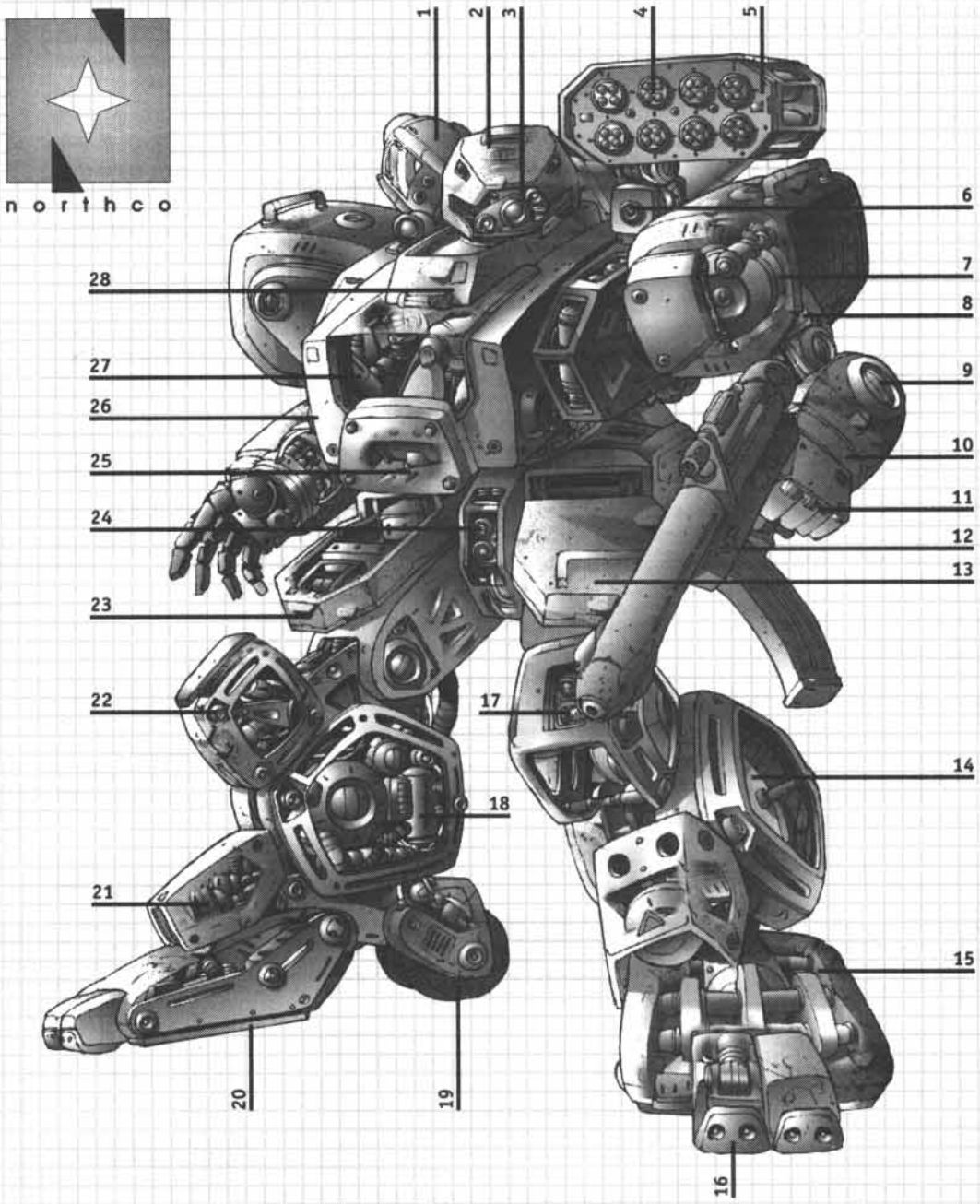
The First True Gear ◆

By TN 1678 (5950 A.D.), the result of this program was the GP-01 Hunter, an ugly, rugged, boxy machine that could be easily mass produced and fielded in large numbers. Thousands of Hunters left the assembly line in the next seventy cycles, many of them sold to the UMF's allies in the Northern Confederation. These first Hunters were little more than redesigned construction machines, yet they fared well in their new assignments.

Worried about this new technological development, the Southern Republic tried to acquire a few Hunters by several means — some legal, others definitely not — but to no avail. It was not until TN 1679 (5951 A.D.) that Republican commandos were able to steal one from an advanced Protectorate force in the Badlands, which had itself stolen the design from the Federation. A mere six months later, the Republic was using its own version of the Hunter (renamed Jäger) to force its neighboring Southern states into a coalition led by the Republic. Other than cosmetic and slight mechanical changes, the Jäger was essentially the same machine as its Northern cousin.

So successful was the Hunter that it took several decades for wholly new Gear designs to appear. During that time, the faithful Hunter was modified and reworked for a huge number of operational roles and served on virtually all fronts during the many skirmishes between the various city-states. The rest, as they say, is history.

Bryce Hubbard (order #959915)



JAGUAR INTERNAL STRUCTURE AND SYSTEMS

1 ..... Generator/Pump Housing
2 ..... Head Mainframe
3 ..... Sensor Plate
4 ..... Rocket Cluster
5 RP-111 Pepperbox II Launcher
6 ..... Modular Hardpoint
7 ..... Arm Elevation Rotor
8 . Lower Arm Rotation Assembly
9 ..... Elbow Mechanism Housing
10 ..... Forearm Shock Absorbers
11 ..... Digit Rotor
12 .. MR 25 Machinecannon Rifle
13 Upper Leg Rotation Assembly
14 Booster Pumps and Heat Sink
15 ..... Foot Structural Member
16Supp. and Balance Mechanisms
17 . Short Range Forward Scanner
18 ..... Pressure Fluid Tanks
19 ..... SMS Wheel Assembly
20 ... Shock-Absorbing Footplate
21 . Short Range Ground Scanner
22 . Knee Block Structural Frame
23 ..... Forward Hip Armor Frame
24 ..... Lower Forward Scanners
25 ..... Cockpit Foot Plate
26 ..... Torso Mainframe
27 .... Torso Suspension Actuator
28 ..... Upper Hatch Assembly

Bryce Hubbard (order #959915)

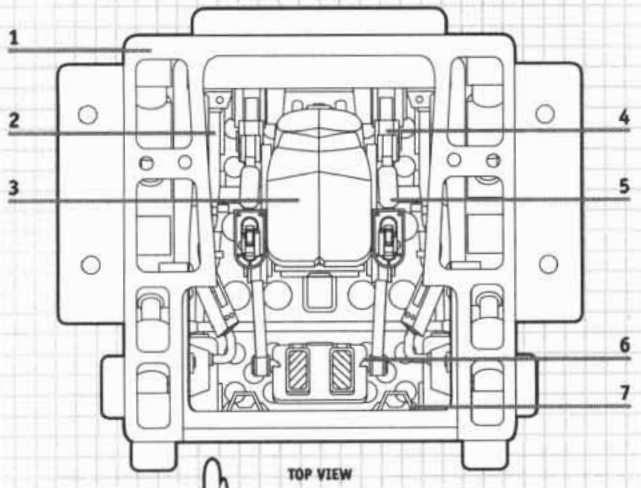
Cockpit - 5.2.2

All Gears can carry one man in a cockpit located in the torso (for obvious internal space reasons). Depending on the design and the machine's intended mission profile, the cockpit can be open topped, sealed, or even pressurized. Most Gears fall in between, with a sealed cockpit and an air circulation system with a minimal internal oxygen supply for emergencies.

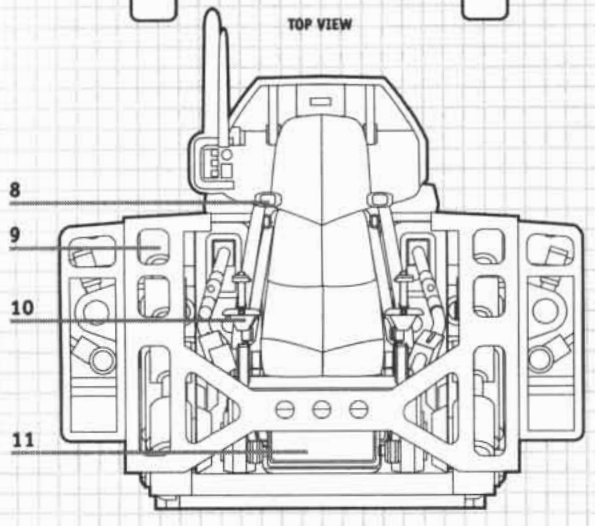
Because of the space required by the machine's internal mechanisms, all Gear cockpits are renowned for their cramped confines. Even heavy fire support Gears like the Northern Grizzly are a tight fit; small scout units like the Southern Iguana or the Northern Cheetah are positively claustrophobic. The older Ferret is even worse and only pilots with a below average stature can hope to pilot one. Even the Jaguar strike Gear suffers from space limitations.

A sturdy seat — reminiscent of those found in fighter planes — occupies the center of the cockpit cavity. The space under and behind the seat is used for electronic equipment, which leaves no room for an ejection system. Sometimes, this equipment is moved to the side consoles to mount an ejection seat, but this is a costly and unpopular option among designers — but not among pilots. A few seat models have roll-bars to secure the pilot in place. This system is more cumbersome than the usual X-shaped belt, but it does offer more protection in case of a collision or fall. Many Gears have special attachments that lock onto the pilot's suit: in that case, the suit has a built-in support web.

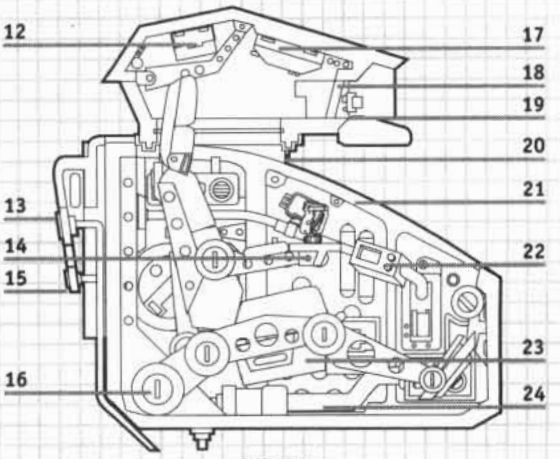
Power feeds and cooling tubes snake along the cockpit walls, completely covering them. This is done on purpose to facilitate emergency repairs on some internal systems. On some smaller models, even the arm rotation sockets at the shoulders are accessible from the cockpit.



TOP VIEW



FRONT VIEW



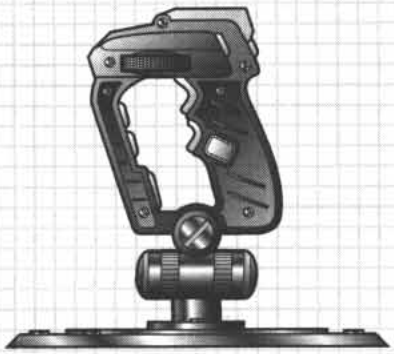
SIDE VIEW

HUNTER HACS-01MG-MP [COCKPIT]

1 ..... Upper torso support ring	13 ..... Pressure line input
2 Main fiber optic computer line	14 ..... Dataglove mount
3 ..... Crash-absorbent padding	15 ..... Power line input
4 ..... Seat support struts	16 ..... Seat shock absorber
5 ..... Padded arm rest	17 ..... Visual sub-processor
6 ..... Foot pedal	18 ..... Armored viewpane
7 .... Front hatch actuator mount	19 ..... Main sensor cluster
8 ..... Safety belt mount	20 ..... Head rotation collar
9 ..... Torso support actuators	21 ..... Main access hatch
10 ..... Control stick	22 ..... Diagnostic panel
11 ..... Footrest	23 ..... CPU housing
12 Communication relay circuitry	24 ..... Coolant conduit

Note: wiring and access hatch actuators omitted for clarity.

Bryce Hubbard (order #959915)



HEAVY GEAR JOYSTICK

Control apparatus

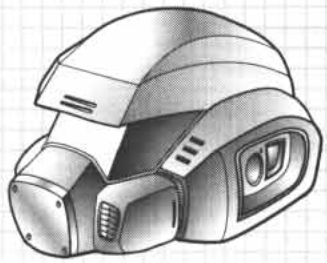
The configuration of the instruments depends on the designers. All are equipped with two joysticks and two foot pedals, but buttons and readouts vary immensely, even between variants of the same model.

The joysticks are fairly complex, sporting several thumb switches as well as finger-activated triggers (see illustration). Combinations of switch, trigger and stick movements are converted into pre-programmed body motion routines called Macromoves (or simply "Macros") by the CPU, much like a 20th century combat video game. Depending on the complexity of the Heavy Gear model and its agility, the joystick can be laden with gadgets and additional controls, making more Macros available to the pilot.

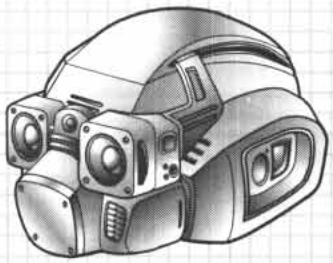
Fine manipulator control is achieved through a small "waldo" harness placed on either side of the seat. Some models use datagloves instead, although their performance is similar to the mechanical waldo harness. The waldo/datagloves system is only used when fine dexterity is required, since standard combat routines have long since been designed for grabbing and lifting using the manipulators.

Customized Grips

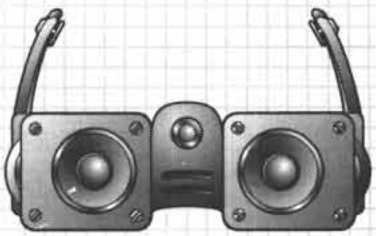
It is crucial that the joysticks of a Gear feel comfortable. Many soldiers have a specialized grip molded to the exact specifications of their hands. Although this is not standard practice, officers have no problem with it because customized joysticks generally increase the pilot's performance levels.



STANDARD HEAVY GEAR PILOT HELMET



HEAVY GEAR PILOT HELMET W/HOLOPROJECTOR



RETINAL HOLOPROJECTORS

Information Display

Early Heavy Gear designs had holographic screens and HUDs to display battle information. This was grossly inefficient as it left blind spots and divided the pilot's attention between several panels. The system was also bulky, further reducing the limited space available in the cockpit (early Hunter pilots were often chosen for their small body size).

With special laser-crystal screens inside a slightly enlarged helmet, the VR system feeds the pilot information processed by the CPU and its visual sub-processor. For all intents and purposes, the trooper can see as if the cockpit were open to the outside. The visual sub-processor automatically redirects the camera array to compensate for changes in position of the eyes, providing a shifting, nearly 270-degree field of view (a camera lens typically only covers about 170 degrees). The remaining 90-degree arc is monitored by the computer, but can be brought to the pilot's attention by a simple vocal or manual command. Sometimes, the helmet is slaved to this function, rotating the entire field of vision when pressure is applied to the helmet's outer neck sensors.

Relevant tactical and battle readouts are superimposed over the landscape by order of priority. Small movement indicators and ID tags enable the pilot to keep track of many targets and can even identify mission objectives. Ranges are indicated beside items, although this option can be modified or deactivated to reduce the visual clutter. A popular alternative is a "range color," where a small distance icon changes color or shade according to the range. The readout can be customized to the pilot's preferences by modifying the display software's parameters. This is done via a small datapad, usually placed on the cockpit wall (a few models have a completely independent datapad that is simply plugged or radio-linked into the control panel). Even more sophisticated helmets using retinal holoprojectors are also in use. The information is projected directly into the eye of the wearer. They are lighter and more comfortable to wear for prolonged periods of time, but they are also more expensive than standard helmets.

Holoscreen

Holoscreens are used for most data displaying applications. While they are not true three-dimensional screens (you must be in front of the display to see what is on it), holoscreens offer limited depth perception as well as perspective. A multi-layered, laser-reactive crystal plate serves as the support for a high speed laser imaging array which literally "paints" the images on the crystal layers.

Holoprojector

Holoprojectors are a more sophisticated version of the holoscreen. Instead of using a permanent, fixed crystal support for displaying the image, the holoprojector uses its environment: any gaseous or liquid medium will do. The resulting image is of lower quality when projected on gases, but thick liquids offer excellent support for a properly calibrated imaging array.

Bryce Hubbard (order #959915)

Central Processing Unit

The "brain" of the Heavy Gear is the Central Processing Unit, or CPU for short. It is a small, semi-transparent, 15 cm cube filled with an intricate lattice of molecular-sized neural networks. This network is so complex that it cannot be repaired if damaged, and must be replaced by a new unit. CPUs are built in completely automated factories. Few errors occur since all operations, from laying the basic neural paths to final testing, are automated, resulting in a comparatively low price for such advanced electronics.

The finished network is encased in a special shock-proof polymer or composite case fitted with a fiber-optic connector and an optic chip jack for customized software chips. This case is normally installed under the pilot seat in the chest of the Heavy Gear. It can be easily removed by reaching under the seat and releasing the connections, and is always the first piece of equipment salvaged when a HG is destroyed or damaged beyond repair.

The CPU's neural network is able to learn and establish new connections within itself. This allows non-linear logic processing as new parallel paths are created to handle computing tasks. This ability for "fuzzy," or open-ended, logic makes the CPU much better at handling the complex body motions of the humanoid Heavy Gear than other "standard" neural networks and computers. A CPU first learns to walk in a special training body before being installed in a HG for final "training" by a certified technician. The resulting low-level Artificial Intelligence handles the actual actions of the mechanical body, responding to the control inputs of the pilot (see Control Apparatus, previous page).

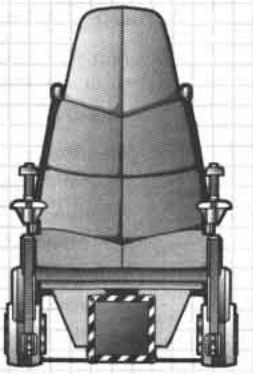
A standard Heavy Gear CPU is not self-aware, although it often gives the impression that it is. It can only respond to simple one- or two-word verbal commands or combat inputs from the cockpit, or follow a simple work routine. Old surplus Heavy Gears can sometimes be seen performing menial or construction tasks in military forces. They cannot move or initiate actions by themselves, although some very complex CPUs have been known to override the security subroutines to take actions of their own in very specific situations (for example, to avoid blows or to protect an unconscious pilot).

CPUs that serve for a long time with the same pilot, in the same Gear, sometimes develop an "affinity" with their controller, much in the same way a dog gets used to its master. Pilots of such machines often comment on the faster control response and all around improved performance. Heavy Gears with this kind of CPU are often referred to as "Warhorse," "Old Dog" or sometimes "Buddy" — depending on the locales and the forces employing them — but the most common term is, by far, Warhorse. Needless to say, a pilot will do the utmost to salvage such a CPU should his vehicle be wrecked (see removal procedure diagrams at right).

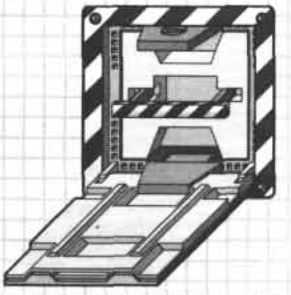
"Relocated" CPUs don't fare as well as new ones, though. Used to a certain type of machine, often a specific one, a CPU will have to accustom itself to its new body. This can take anywhere from a few hours to a few days, depending on the skill of the technician in charge. Other factors to take into consideration are the configuration of the new Heavy Gear and its model type, and how close it is to the original body.

Problems also arise when a new pilot is assigned to an older machine. There is almost always a period of slightly lower performance as the machine lets the pilot act, to better evaluate his/her skills and combat attitude. The Heavy Gear will then appear sluggish and reserved, even timid. If such problems persist over several assignments, many technicians prefer to simply wipe the CPU using a controlled energy pulse to break down the neural paths and reset the system. This is called a "mercy killing."

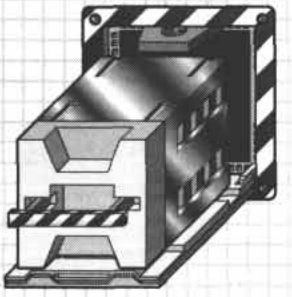
CPU EMERGENCY REMOVAL PROCEDURE



1) Reach under seat



3) Open shock-proof hatch. Release security locks (2) and unlock main CPU handle



4) Pull CPU out of compartment

A Quick Escape

To a veteran Gear pilot, there is little more precious than the CPU of his assigned Gear. It often contains years of training and combat experience which can save the life of the man behind the controls many times. One famous story recalls how a pilot, whose base was under attack, ran out of the barrack and escaped to the nearby town with only his CPU in tow — while completely naked.

Mercy Killings

Mercy killings, although sometimes made necessary by the limitations of neural net technology, are regarded as a grim task by most technicians. There is a tendency amongst people who work for a long time with Gears to start viewing them as living beings rather than inanimate machines. Resetting the NNet is somewhat akin to killing the "personality" within. One technician has compared the experience to putting a wounded riding springer out of its misery.

Pilots find it equally upsetting, especially if one's Gear is the one being wiped. Many armed forces have developed informal rituals around mercy killings. These vary from army to army (and even from base to base), but they almost always take the form of a monumental toasting at the nearest bar. Such rituals are rarely explained to new recruits — the veterans reckon the youngsters would not understand.

Bryce Hubbard (order #959915)

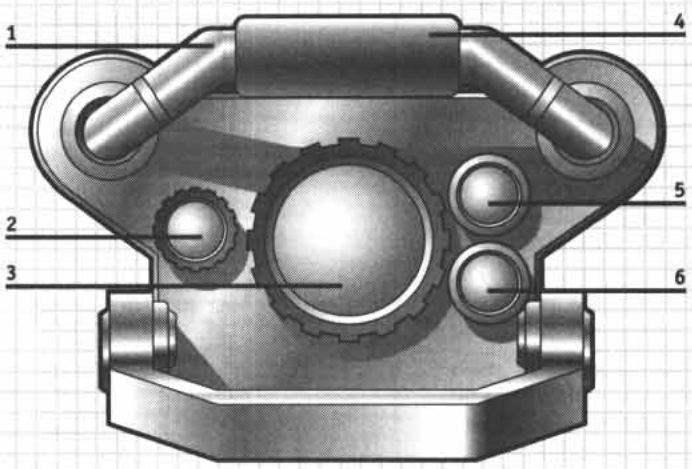
5.2.3 - Sensor Systems

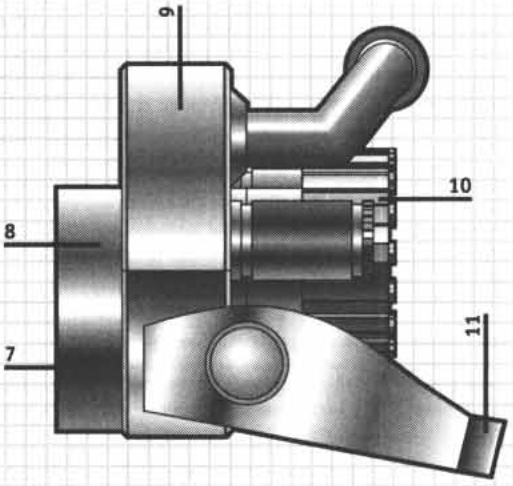
Gears carry a variety of sensor systems that allow both their main CPU and their pilot to relate to the outside environment, both in and out of battle. Without sensors, the pilot would not be able to find his targets, and the Gear would not even be able to move, much less fight. Since Gears are supposed to be inexpensive and easy to maintain, most designs carry only a minimal (but efficient) sensor package that can accomplish both tasks at once.

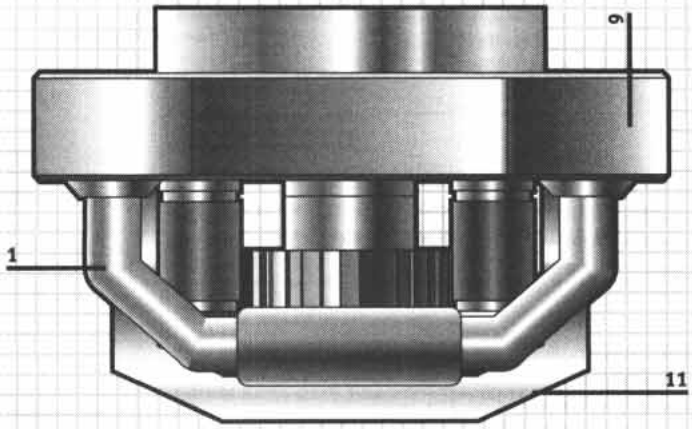
Most of the sensors and their interpretation circuitry are built upon the "black box" and "plug-in" principles, further lowering costs and facilitating both maintenance and upgrades. The sensors and their associated systems are located throughout the structure of the vehicle, coupled with the computer network of the vehicle by high-speed fiber optic links.

The primary sensor system is a small cluster of digital omnicameras, often placed together in what could pass as the Gear's head (what is sometimes called the "canopy" or the "helmet" by technicians and pilots). To facilitate repairs and maintenance, the basic visual sensors are generally mounted on a single articulated plate and armored as a whole. Most models use only one main camera, relying on laser rangefinders and "dumb" stereoscopic cameras for range and depth measurements.

The information so gathered is first processed by the CPU's visual sub-processor, colloquially called "ViSup," "Eyebrain," "Vision Chip" or a multitude of other slang terms depending on the technician in charge. The sub-processor assembles a digital portrait of the world around the machine based on the input of all the cameras. The CPU then combines this information with that from the other sensory systems (see further) to control the Gear's body and perform the actions required by the pilot.







HUNTER MAIN SENSOR CLUSTER

Most of the primary sensors of a Gear are grouped together in the main sensor cluster, a modular assembly attached to the head or upper body of the machine. The cluster is mounted on an articulated powered mount which allows a limited range of movement, although orienting the sensors often requires moving the head. On many Gear models, the sensor cluster is attached to a rail which enables it to be moved through an arc of almost 180°. The exact shape or capabilities of each sensor differ from model to model, the listing below is fairly average.

1- ..... Crash bar
2- ..... Infrared sensor
3- ..... Omnicamera
4- ..... Padding
5- ..... Laser rangefinder
6- ..... Laser scanner
7- .. Fiber optic data line plugs
8- ..... Connector housing
9- . Articulated mounting plate
10- ..... Armored lens housing
11- ..... Sensor crash guard

Note: wiring and actuator mounting points omitted for clarity.

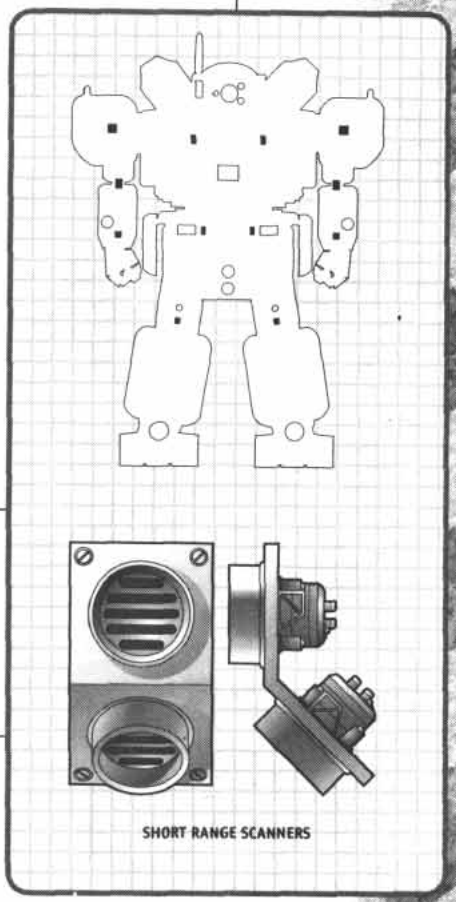
Bryce Hubbard (order #959915)

Main Sensors

A Gear's sensor package is generally centered around one high resolution omnicamera. Zoom function is standard, although the range depends on the quality of the camera, its lenses and the image enhancement software. Sometimes, a dedicated telescopic lens is added to the camera mount. Light amplification and anti-dazzle protection are usually standard, and a small infrared camera is often mounted in tandem with the main sensor. Ultraviolet and microwave scanners are sometimes used by mission-specific vehicles, but only rarely because of their cost and relative specialization.

A network of motion and vibration sensors are placed throughout the body in small clusters, mainly in the feet, waist and lower arms. Pressure sensors and short-range scanners are used in the feet to gauge the ground's relative softness. Manipulators also have pressure sensors in their fingers, although the repeated abuses they go through during normal use quickly put them out of alignment and often, out of commission.

A laser gyroscope, in conjunction with accelerometers and position sensors in the joints, determines the Gear's attitude and balance. Some older models use a simpler mechanical gyroscope that is unfortunately easier to fool and/or damage. Both types of gyroscopes fit in a 10 cm cubic box generally located behind the pilot's seat. The gyroscope is crucial to the walking movement of the machine, as it provides the CPU with the information it needs to properly maintain equilibrium.



SHORT RANGE SCANNERS

The Sensor Sphere

The term "Sensor Sphere" is often used to describe the area covered by a Gear's sensors. Although most people consider only the main sensor cluster located on the head, a Gear carries several additional clusters of cameras and other sensors distributed all over its body. These allow the CPU to keep track of the entire environment of the machine. In fact, the main stumbling block of the system is often the pilot, who in the heat of battle may disregard his machine's capabilities.

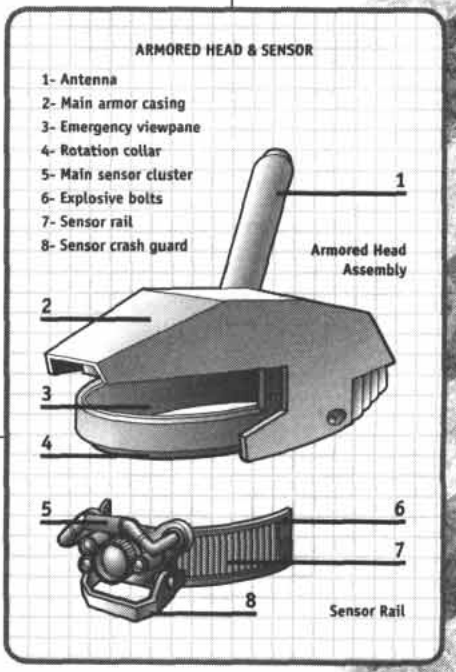
Gyroscope

The tiny gyroscope, hidden behind the pilot's seat in a small electronic bay, is crucial to the good functioning of the Gear. It provides the main balance information to the vehicle's CPU, information without which the Gear would have great trouble just standing up. The gyroscope can be reached from within the cockpit by extending a hand behind the seat, usually on the right side.

Secondary Sensors

All Gears also carry what are referred to as "secondary sensors," or sensors that do not serve a direct combat or movement purposes. The most common of these, found on practically all Gear models in existence, are simple microphones and loudspeakers mounted on the head unit of the machine. These are used when the cockpit is sealed to help the pilot hear what is going on outside and reply without having to open the hatch. Most of the time, a small and inexpensive sub-processor is added to filter out the noises produced by the machine itself. A few rare designs carry more advanced audio equipment, but increased cost and narrow mission profiles often restrict these models to specialist units.

Some types of Gears (almost always recon models) carry magnetometers, short-range high-resolution radar imagers and other advanced sensor equipment such as Geiger radiation counters. These sensors have limited combat usefulness but are invaluable when performing scouting actions or engaging in delicate engineering duties such as mine clearing. Many other types of sensor are also possible, though the above are the most common ones seen on Gears. The total amount of equipment that can be carried by a single unit is limited only by the funds and the miniaturization abilities of the designers. It is not uncommon to have specialist Gears covered with antennae and sensor pods.



The Sensor Eject Function

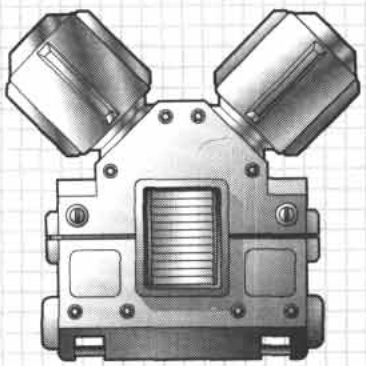
Almost all Heavy Gears (and some other vehicles) are equipped with the Sensor Eject function, a last ditch measure intended to keep the vehicle in battle — or at least return to base — even after receiving major combat damage to its sensor array. The sensor array is designed in such a way as to cover an armored transparent viewpane. If the sensors are damaged or destroyed, explosive bolts eject the whole rig out, leaving the pilot with a small but manageable view of the world outside his machine.

Bryce Hubbard (order #959915)

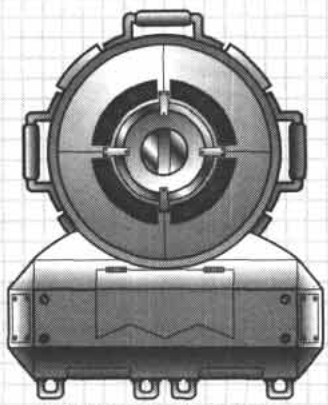
5.2.4 - Mechanical Systems

This section covers the mechanical systems that constitute the actual chassis of the machine and allow it to move about. This includes the powerplant, located in the backpack unit; the transmission, which includes the various means through which the power generated by the engine is transmitted to the various limbs and major systems; and the joints themselves.

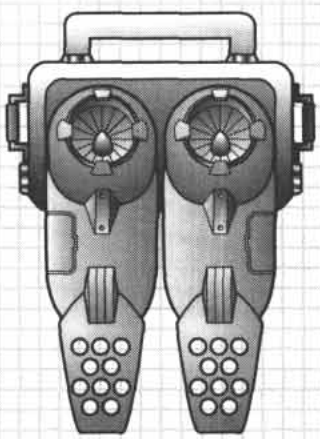
Powerplant



V-ENGINE



SUPER-CONDUCTING BATTERIES



GAS TURBINES

Most Gears use an advanced, very compact internal combustion powerplant called a V-engine. Based on designs developed at the University of the Colorado in the later years of the twentieth century, the V-engine — so named because of its shape — is a twin drive, air cooled powerplant with high efficiency and minimal moving parts.

The core of the V-engine is a support axle made out of high-strength alloy steel. It is truly only a bent bar of metal, and is the strongest part of the engine. Two cylindrical combustion chambers, which look a lot like a revolver's magazine, are slipped over this support axle. These chambers, per their peculiar internal shape, serve as piston housing, distributor cap, lubrication system and cooling fan, all in one. The engine's design thus provides two drive shafts, each delivering equal horsepower. A number of V-shaped pistons (the actual number varies between six and twelve depending on the model) rotate around the support axle, compressing the fuel-air mixture as they go, until the mixture is transferred to the combustion chambers and ignited.

The chambers rotate inside an outer shell made out of a high strength metallic alloy. The engine support pins are molded directly into the shell, as is the air intake. The end result is a fairly compact engine that is rugged, easy to manufacture and easy to repair. The small number of moving parts and the V-engine's ability to use a variety of fuels make it perfectly suited for Heavy Gears.

A few rare Gear models are powered by electrical motors fed by a bank of ambient temperature superconducting coils. The enormous cost of such a system, however, and its inherent limitations, make it unpopular except in specialized "stealth" units or as a back-up system. Its short operating range is also a problem that has yet to be solved. Electrically powered Gears are easily recognized by their distinctive backpack that contains the bulky superconducting capacitors, providing power to a single fluid pump (the generator is obviously not needed in this design).

Experiments were also performed with gas turbines, mostly in the proposed "Hover Gear" programs that have come and gone throughout the years. Some gas turbines have the added advantage of providing residual thrust that is used both for the hoverfans and a limited jumping capacity. Unfortunately, they tend to require extensive maintenance (at least when compared to the more efficient V-engine) and are more expensive to manufacture. Smaller gas turbines with no exhaust jet capacity have been used as back-up powerplants in several stealth designs, where they are used to recharge the battery array when the stealth function is not needed.

Unfortunately, no Terranovan fusion engine was ever made small enough to fit into a Gear — or any other vehicle smaller than a space shuttle for that matter.

Fuel

The advanced design of the V-engine enables it to use a wide range of fuels. As long as the fuel employed is gaseous or liquid and is reasonably combustible, the engine will function (although with a varying degree of efficiency). Of course, the use of improper fuel may result in a reduced deployment range and/or engine life.

The best fuel is refined vehicle-grade gasoline or kerosene. This is not always available, however (especially when trapped behind enemy lines), and Gears have been known to run on fuels as diverse as natural gas, alcohol, machine oil, liquid rocket fuel and even industrial cleaning solvent! For rules on the effects of improper fuel, see page 153.

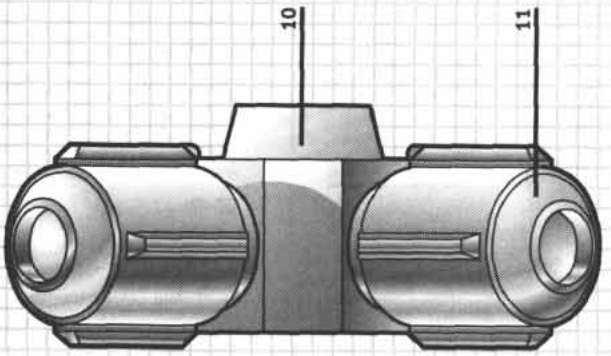
Refueling

Most Gears carry their fuel within an armored, self-sealing tank located in the rear hip armor plate. The flexible fuel lines are located underneath, well hidden from enemy fire. The refueling ports (there are generally two of them) are also mounted under the plate, but near the side edges. Universal adapters allow the ports to fit almost any size of fuel hoses under 15 cm.

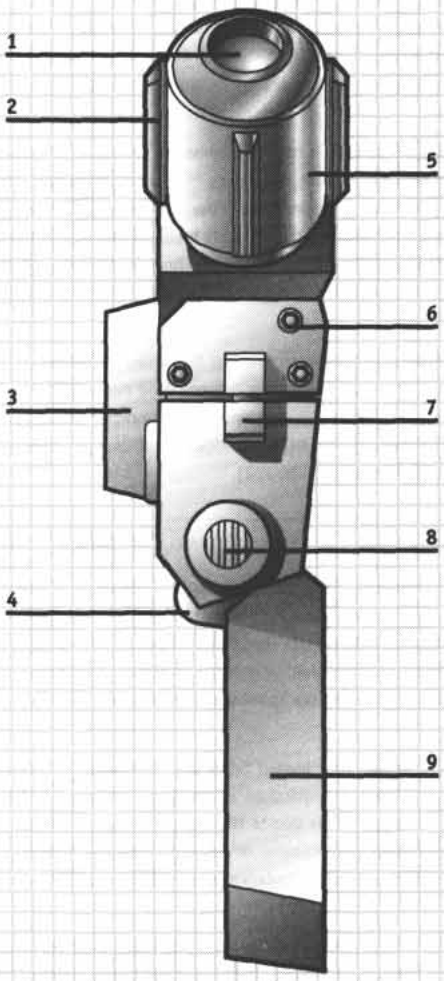
Bryce Hubbard (order #959915)

TYPICAL V-ENGINE BACKPACK HOUSING

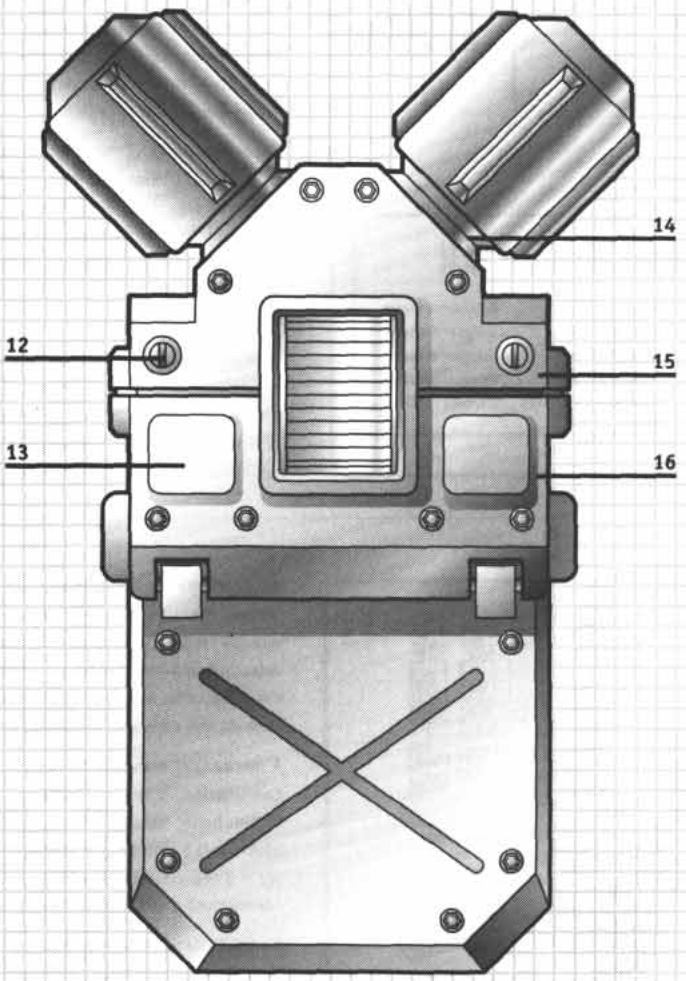
1 ..... Mesh cover
2 ..... Reinforcement rib
3 ..... Main radiator
4 ..... Fuel tank hinges
5 ..... Pump housing
6 ..... Retaining bolt
7 ..... Connecting latches
8 ..... Multi-connector
9 ..... Armored fuel tank
10 ..... Armored casing
11 ..... Upper cover
12 ..... Retaining latch
13 ..... Battery access panel
14 ..... Collar and gasket
15 ..... Upper casing half
16 ..... Lower casing half



TOP VIEW



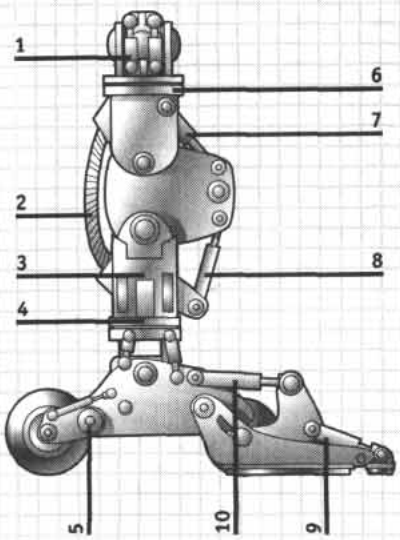
SIDE VIEW



REAR VIEW

Bryce Hubbard (order #959915)

Transmission



GEAR LEG CUT-AWAY VIEW

1 ..... Hip actuators	6 .... rotation actuator
2 ..... Power line	7 ..... Upper actuator
3 ..... shock absorber	8 ..... Lower actuator
4 ..... rotation motor	9 .... Balancer actuator
5 ..... shock absorber	10 ..... foot actuator

Transmission is a catch-all term covering the various pistons and motors that move the machine. All Gears use a combination of hydraulic and electrical power to move their limbs.

In a hydraulic system, fluid is used to transfer force from the engine to the limb. Since fluids are incompressible, and little energy is lost through friction and valve interference, the system is very efficient — when bench-tested. Unfortunately, the motions of a humanoid body waste a lot of energy. Some of it can be recovered (walking is a perfect example of partial energy reclamation), but not all.

Hydraulic systems can generate linear movement through the use of pistons, and rotational movement through a modified circular piston called a rotor. Rotors can have a finite or infinite angular travel, and can reverse their movement simply by inverting the fluid supply (pistons tend to lose efficiency when not used in the direction they were designed for). Gears and striders use both types of actuators.

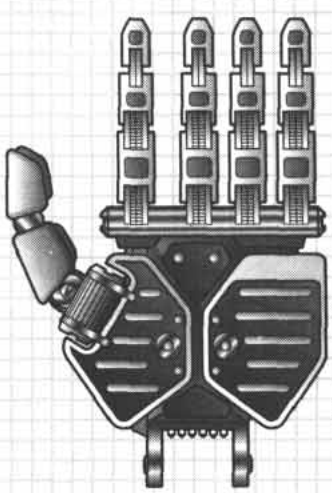
Rotation is sometimes accomplished by off-axis pistons, but this requires slightly more room and a greater number of mechanical linkages. This arrangement is mostly used for "side" or bending motions when internal volume is at a premium.

The hydraulic system is fed by one main pump attached to the engine by a computer-controlled gearbox to maximize efficiency. The second drive shaft of the engine is used for an electrical generator that powers both the SMS (when present) and booster pumps placed in the lower body. Valves, overflow reservoirs and heat exchangers are also part of the circuit attached to the basic frame of the Gear. Some striders use a similar actuator configuration, but the actual design varies according to the model (see *Striders*, page 51).

The fluid used to transmit motive power is a highly advanced polymer compound that is much better than oil at transmitting load. It also has a lower viscosity, which reduces friction in the system and improves efficiency. Technicians nicknamed the fluid "pressure juice." The red-brown fluid is non-flammable, even under high temperature — its molecular structure simply breaks down, producing a caramel-like mess. This fluid is distributed throughout the Gear's body by feed lines made of Duraplast, a composite plastic laced with alloy webbing that can safely contain the high pressures required for rapid, powerful motions.

Such a system, while relatively low-tech, requires constant maintenance to properly function. It is impossible to create a perfectly closed system, nor is it possible to prevent fluid degradation over time. Thus, a major part of the technician's work is to replace lost or aging fluid, change filters, check pumps and do a lot of cleaning up. Such routine maintenance must be religiously observed or else the performance profile will drop off sharply (see *Maintenance*, page 152).

Manipulators



HEAVY GEAR HAND ACTUATOR

All Gears are equipped with some sort of manipulator device, be it a hand, a pincer or a simple grapple system. These are not strictly necessary — it would be possible to attach the weapons directly to the body of the vehicle — but they provide greater versatility than a standard vehicle weapon hardpoint (see further in the text). This is accomplished only at the cost of greater mechanical complexity, however, and technicians usually spend a disproportionate amount of maintenance time on the arms and manipulators.

A mechanical manipulator is similar in general design to a human hand, but somewhat simpler in construction. It is less flexible and is able to exert less strength than a hypothetical equivalent-size human hand, although it can bend in inhuman ways. This is due to the design of the manipulator, which uses a simplified actuator-driven system rather than muscles or tendons. Thus, the manipulator is a self-contained unit that may be removed for repair or replacement simply by undoing a few connections and hydraulic feed lines.

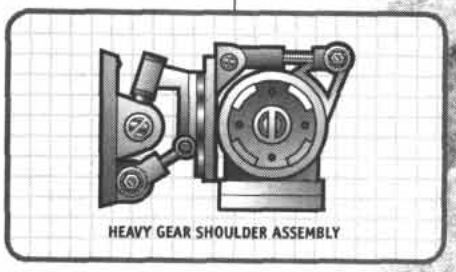
Manipulator arms are costly, mainly because of the great number of joints and actuators they require. Attempts have been made to reduce this cost by using three-fingered hands, where the last three digits of a human-styled hand are fused into a single large one designed for holding, leaving the thumb and index for fine manipulation. Other types of manipulators, such as double-thumbed hands, are also often found on construction and heavy-duty machines for enhanced grasping capability.

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Joints and Articulations

Most joints are simple, sealed ball-bearing axial mounts using self-lubrication technology to extend their useful lifespan. These are designed to resist great mechanical loads, both in torsion and tension. Magnetic-suspension bearings are also available, but they need to be shielded so as not to interfere with the sensor and radio arrays, making them a bit more expensive than regular bearings.

Joints in the lower body and high stress areas are also equipped with shock-absorber mounts, usually gas piston-spring combinations. A few advanced units employ polymer shock-absorbing sheathing for the joints, making for a more supple and agile machine. Unfortunately, this lengthens the maintenance downtime as the polymer's molecular structure breaks down, requiring that the sheaths be replaced after a few dozen hours of operation.



HEAVY GEAR SHOULDER ASSEMBLY

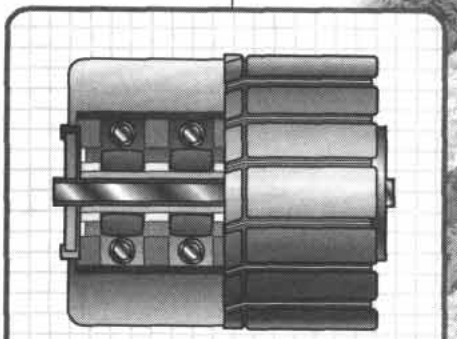
Secondary Movement System

Many Gears have more than one transmission system. This Secondary Movement System, or SMS for short, usually takes the form of wheels or treads placed under the feet of the machine. Although the basic concept may sound ridiculous, one cannot deny the immense increase in speed and efficiency, not to mention versatility, this brings to the Gear weapon system.

Most often, the wheels (or treads) use small but powerful electric motors powered by the generator attached to one of the V-engine's drive shafts. This means that any hit on the back or leg has a chance of cutting off the power supply to the SMS, reducing the system to mere dead weight. To prevent this, some high-end designs channel the SMS power through the structure itself.

Special commands "hardwired" into the CPU change the equilibrium equations to handle high speed "skating" motions. This function can be retrofitted as a software change, but is usually less efficient.

Because of the low ground clearance of the wheels, the SMS is only useful on flat, hard ground like packed sand or concrete. Some SMSs have larger wheels that can be used over broken terrain, but the price of this increased versatility is a bigger, thus more vulnerable, movement system.



MOTIVE WHEEL CUT-AWAY SHOWING CORE MOTOR

Armor - 5.2.5

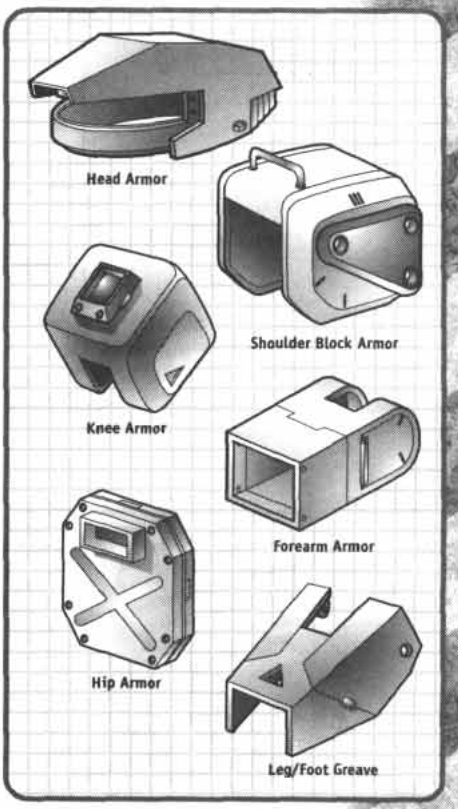
Gears use the same composite armor as all other war vehicles in the 62nd Century. Their tough outer shell is made up of laminated layers of highly resilient metal alloys and ceramics, carefully designed and applied to oppose a maximum of resistance to any type of energy striking them. Unfortunately, the Gears' versatile humanoid shape, so useful for maneuvering, works against them in the domain of physical protection.

Because the limbs of the Gear must have flexibility and a certain amount of space to move, mobile plates and occasional gaps in the armor protection are unavoidable. Some clearance between moving parts is necessary, too, meaning that one cannot just heap on plates or simply add on thickness in the hope of preventing this problem.

All the above factors combine to reduce the potential stopping power of the material used for the armor, leaving weak points that can be exploited by a skilled gunner. Such a complex system of overlapping plates either leaves little room for shot traps or open up plenty of them, all over the surface of the vehicle. Clever solutions have been developed over the centuries to try and improve the coverage, and to some extant modern walker designs are better protected than the ones fielded in the earlier days of the leagues.

As mentioned before, the average Gear carries several centimeters of composite armor. This affords them the same general level of protection as an armored infantry fighting vehicle, which is more or less what the Gear is: a one-man IFV. The thickest armor is found on the main body, the head and the two housings extending from the backpack, protecting the machine's vital area (in this case, the pilot and the powerplant).

Next come the armored casings used to protect the larger sections of the limbs, such as the legs, the forearms and the shoulders. These are often molded in large sections to facilitate repairs and improve their overall resistance. Finally, thinner (and lighter) plates, often mobile, are used to protect the various moving parts such as the articulations. When an armor plate is impractical, ballistic cloth is often employed instead, or the articulation is simply reinforced to withstand incoming fire.



Bryce Hubbard (order #959915)

5.2.6 - Weapons



Gears are rarely designed with built-in weaponry only. The humanoid shape, complete with grasping manipulators, makes the Gear a very versatile tool that can support a wide variety of offensive systems. Nonetheless, it is an accepted practice to standardize a Gear's armament for ease of maintenance, going as far as altering the unit's identification code to reflect the payload being currently carried.

Basic Layout

The typical Gear armament consists of one main weapon, usually hand-held in a rifle or pistol-like form. Rapid-firing, self-loading weapons are preferred, such as autocannons of various calibers or grenade/rocket launchers. The presence of manipulators on the arms of a Gear allow it to change hand-held weapons in the middle of combat and even to pick up enemy rifles (assuming they are not booby trapped, which is often the case).

The main weapon is almost always backed up by another weapon system with a very different but usually completing combat profile. This is generally an indirect fire system such as a rocket pod, guided missile or mortar, but some designs have been known to favor other projectile weaponry as secondary armament.

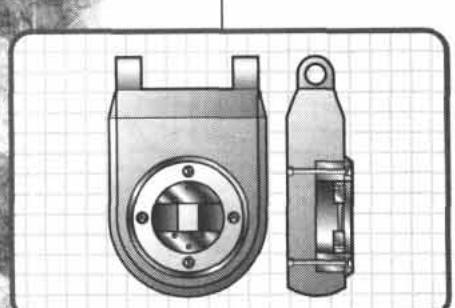
Very few Gears carry energy-based armament, however. Except for some of the larger assault or support models, Gears simply do not have the necessary power output for lasers and particle cannons. They must rely on power packs and heavy batteries, both of which limit their endurance in the field.

External Stores

In addition to the hand-carried main gun, Gears are equipped with hardpoint-mounted support weaponry to give them extra punch, such as a rocket pods located on or near the shoulder(s). Although a trained technician can install new equipment in minutes, such a change is not possible in the middle of a battle.

All Gears possess hardpoints on various parts of their body to accept additional equipment and armament. This often takes the form of either support items (smoke launchers, ECM generators, etc.) or a limited use, hard-hitting weapon for a one-shot-one-kill capability. This equipment can be simply bolted on, with control and power wiring being routed either through the armor or alongside it, but is usually carried in an armored pod to limit the collateral damage should the vehicle be hit.

Hardpoints



Hardpoints are reinforced tabs and pins placed on the hull of vehicles to enable additional weapons and equipment to be attached to the body without taking any interior space. This increases the payload potential of the vehicle as well as its overall versatility.

Most hardpoint designs are standardized to accept a wide variety of optional systems. In addition to the mounting itself, hardpoints have two jacks: one is the electrical feed while the other is the control circuitry feed. The whole assembly is attached via explosive bolts or quick-release connectors, enabling it to be dropped instantaneously if required.

Most vehicles in Heavy Gear carry their armament on reinforced modular hardpoints, if only to simplify repairs. Hardpoint-mounted systems can be dropped at the cost of one action, but cannot be reattached on the field.

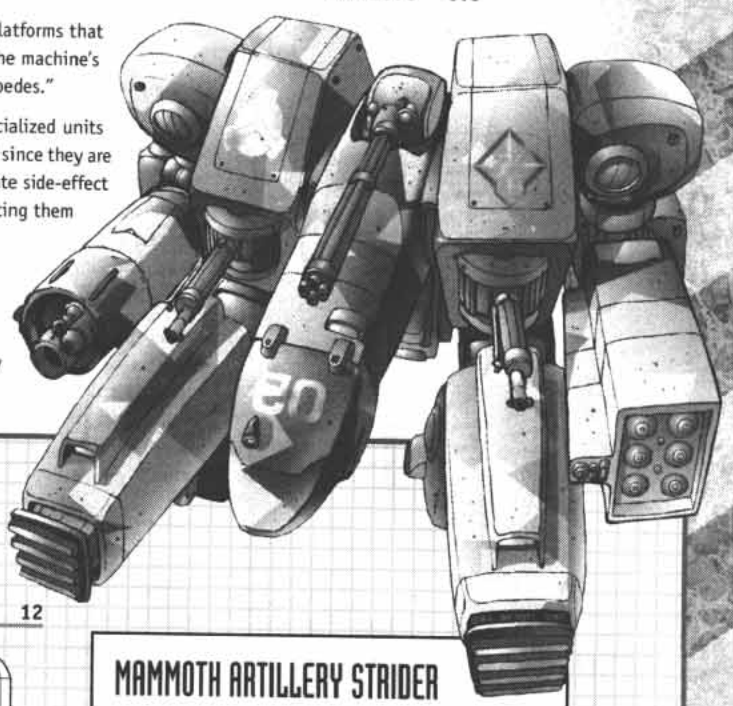
Bryce Hubbard (order #959915)

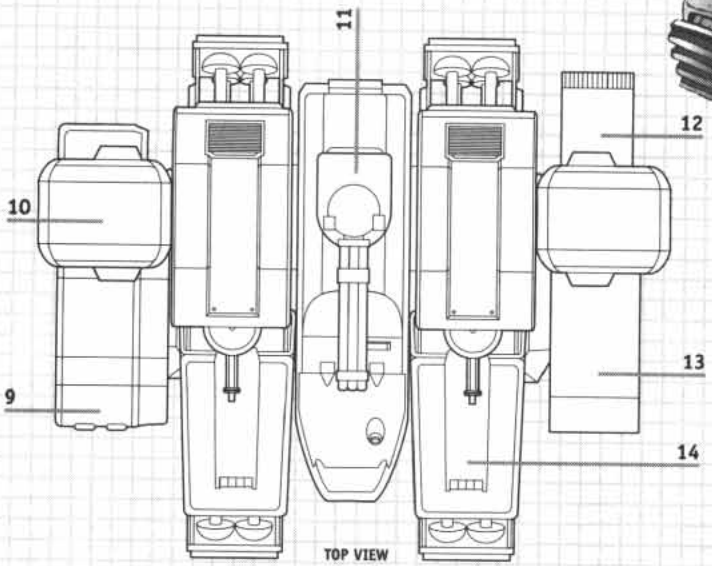
Striders - 5.3

"Strider" is the catch-all term used to designate non-humanoid weapon platforms that use legs for locomotion. The term is derived from the striding motion of the machine's legs. Low-slung, multi-legged walkers are sometimes referred to as "centipedes."

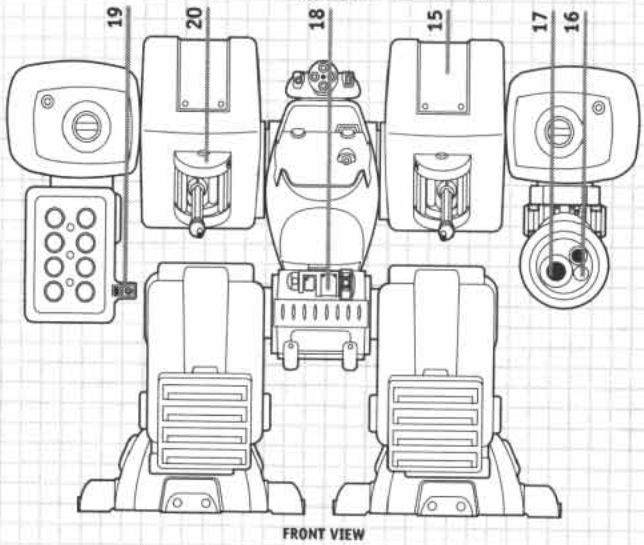
Although they are built using similar technologies, striders are more specialized units than Gears and lack their versatility. They can, however, carry more payload since they are usually bigger and have more powerful engines, but this has the unfortunate side-effect of making them easier to spot (and thus attack) on the battlefield, relegating them mostly to support and artillery purposes.

Most striders have four or more legs and are equipped with large foot plates. This enables them to carry more weight since there is more surface area to distribute it. A few smaller models have only two legs, but the enlarged feet are retained. Traditionally, arms and manipulators are rarely used, with weapon systems mounted on hardpoints and turrets.

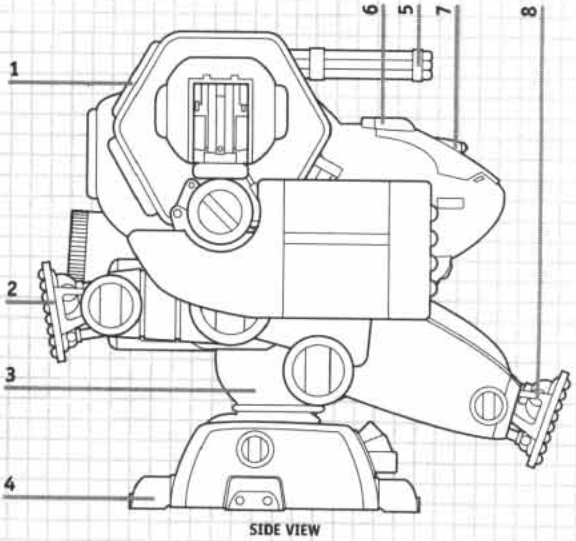




TOP VIEW



FRONT VIEW



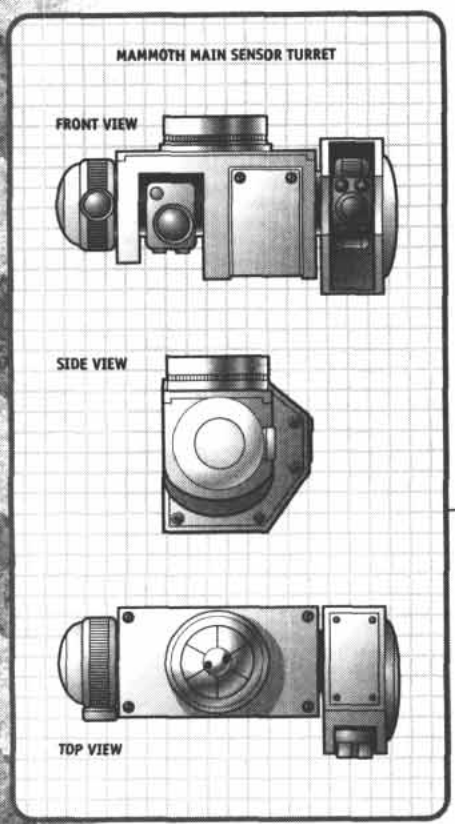
SIDE VIEW

MAMMOTH ARTILLERY STRIDER

1 ..... Starboard torso radiator	11 ..... Autocannon turret
2 ..... Rear support plate	12 ..... Ammunition drum
3 ..... Ballistic cloth cover	13 ..... Snub cannon housing
4 ..... Articulated claw	14 ..... Upper leg casing
5 ..... 30 mm autocannon	15 .... Port torso access hatch
6 ..... Cockpit hatch hinges	16 ..... Targeting sensors
7 ..... Periscope	17 ..... Snub cannon
8 ..... Front support plate	18 ..... AFLIC sensor turret
9- .. Missile launcher housing	19 ..... Targeting sensors
10 ..... Shoulder block	20 ..... AP machinegun

Bryce Hubbard (order #959915)

5.3.1 - Cockpits and Sensors



The smaller striders have a helicopter-style cockpit, with the crewmen placed one behind the other. Larger models are closer to tanks with a single crew compartment (called a combat chamber) with several hatches. Otherwise, the rest of the equipment is very similar to that found in the cockpit of Heavy Gears. Often, HUDs with large holoscreens are used instead of the expensive VR helmet apparatus.

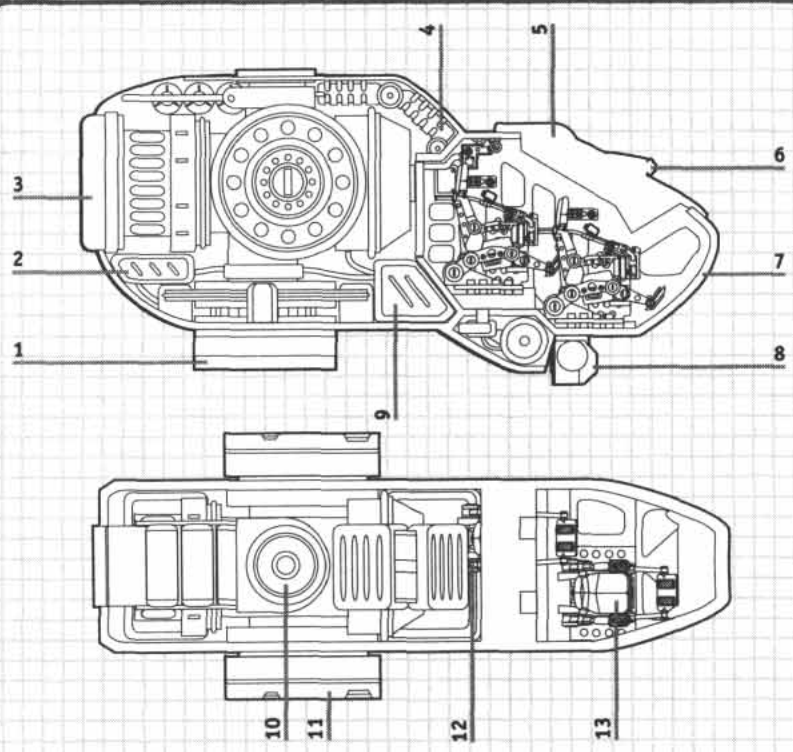
As might be expected, the sensor system is slightly more sophisticated, with radar and long-range communication capabilities available. Striders are sometimes used as battle coordinators or artillery vehicles, and the electronics carried vary with the design and the mission profile. Like Heavy Gears, strider units are equipped with a neural network to control the delicate balancing act of moving on two or more legs.

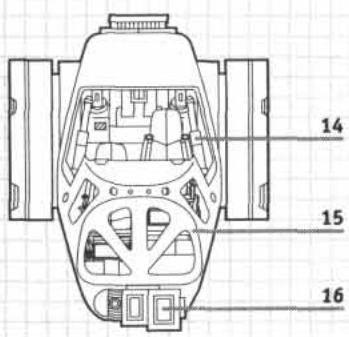
Strider crews are special as far as soldiers go. Although any multi-crewed military vehicle requires a certain amount of coordination and teamwork to function effectively in battle, synchronicity is crucial for strider crewmembers. The perpetual juggling act required by the machine's walking nature requires that the pilot and gunner(s) be "in sync" so as not to hamper each other's work. Even though the vehicle's computer will prevent any serious coordination problem, striders generally work better when the crew is used to working together.

Strider Operation ◆

To represent the dissimilar nature of Gear and strider operations, they each have their own Piloting skill. However, because they both relate to the operation of a walker machine, they can be interchanged — up to a point. Gear pilots can drive a strider and vice-versa, but at a penalty of two (2) skill levels (i.e., a level 3 Gear Pilot can drive a strider as if he had Strider Pilot at level 1). Gunnery skills, however, cannot be exchanged and must be learned separately.

A strider crew must train together for a minimum of 1d6+2 months before being able to operate their machine properly. Until they are ready, they are subject to a penalty of one (1) skill level (i.e., a new strider crew will have all its skills lowered by one level until the allocated months of training have passed).





MAMMOTH TORSO CUTAWAY

1 ... Upper torso support ring	9 ..... Forward Fuel Reserve
2 ..... Secondary Fuel Reserve	10 ..... Turret Rotation Collar
3 ..... Heat Sink/Access Panel	11 .. Shoulder Support Frame
4 Upper Phased Sensor Array	12 . Weapon Operator Station
5 ..... Main Cockpit Hatch	13 ..... Pilot Station
6 ..... Pilot's Periscope	14 .... Cockpit Hatch Actuator
7 ..... Reinforced Armor	15 ..... Torso Mainframe
8 ..... AFLIC Sensor Turret	16 ..... Main Imaging Sensors

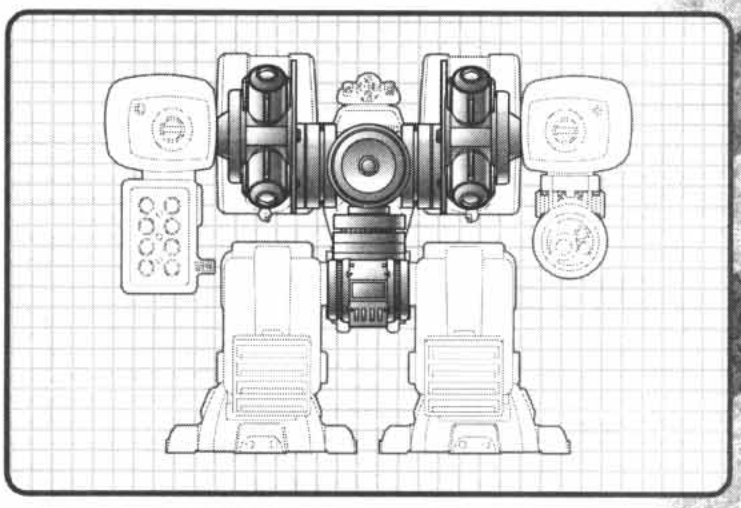
Bryce Hubbard (order #959915)

Powerplant - 5.3.2

Striders require a lot of energy to move their mass around. While the big walkers rarely weigh more than a light battle tank, they still pack quite a few kilos in those armored limbs. The inertia alone forces them to apply considerable force and torque to move their limbs about with any kind of speed, which in turn requires a strong powerplant.

A larger version of the V-engine has been developed for heavy vehicles and many strider designs are equipped with it. Sometimes, several V-engines are hooked together to provide increased power and redundancy. Diesel engines are also a viable alternative, as are high capacity batteries (though this greatly limits the vehicle's autonomy).

Secondary engines are not unheard of, especially on large striders that require lots of power in their limbs. These secondary engines drive booster pumps and are generally electric motors powered by either a generator located in the main body or superconducting loops placed within the limbs.

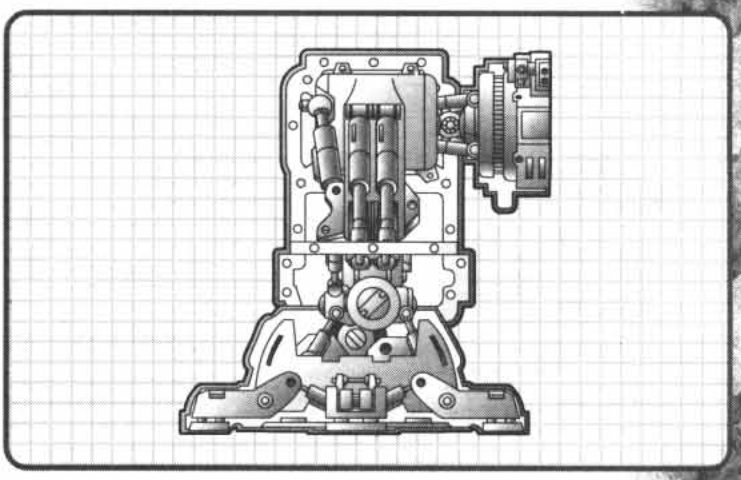


Transmission - 5.3.3

Striders share the same general transmission system as their smaller walker brethren, only stronger and more rugged. Hydraulic fluid is compressed and used to power great actuators that do the actual work, assisted by smaller motors distributed through the frame.

The internal layout of the joints, frame and actuators is slightly different from the configuration used in most Gears because the movement ranges are not quite the same. Striders tend to have longer moment-arms to provide the necessary power to their limbs without having to resort to impossibly huge engines, and this tends to be reflected in their outside appearance.

The actuators are larger and more powerful versions of those used in construction machinery. An interesting concept was found that increased battle survival: grouping several small sub-actuators into an armored sheath instead of relying on a single large piston. Thus, should the actuator be damaged, only a fraction of the total motive power is lost, rather than all of it.

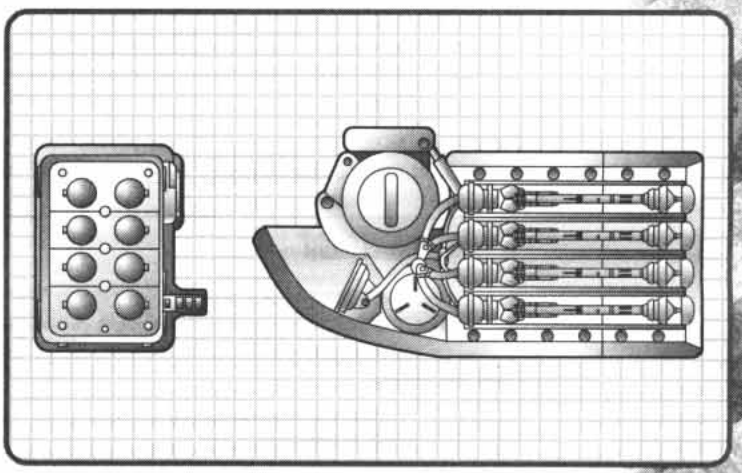


Weapons and Armor - 5.3.4

Because they are inherently more stable and powerful combat platforms than Heavy Gears, striders are able to carry heavier weapons and armor. Striders are commonly used as artillery carriers in regions where a tracked or wheeled carrier would bog down and airlifting is impractical.

Striders are able to transport and use high recoil weapons. These are generally mounted on the main body to ensure the walker's stability (even then, most machines must stop and anchor themselves before firing). Small caliber guns are frequently placed in turrets for anti-personnel purposes.

Strider armor is similar in composition to that used on tanks and Gears. Massive cast plates are used to protect the limbs and the main torso from damage. Smaller plates are segmented and articulated to allow a wide range of motion, yet still afford considerable protection. Even then, the joints of a strider remain a prime target for hostile units.



Bryce Hubbard (order #959915)

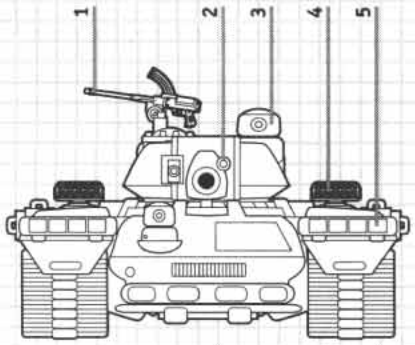
5.4 - Ground Vehicles

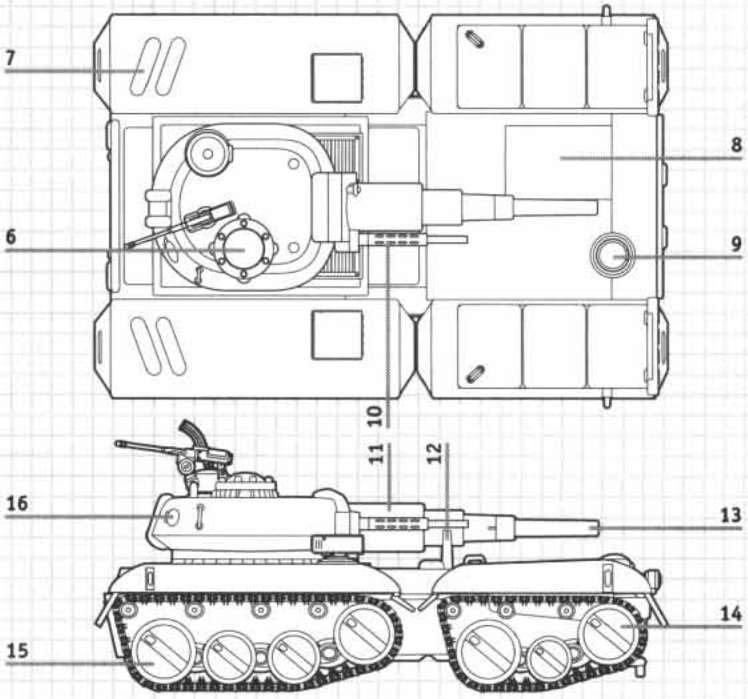
Conventional ground vehicles, either tracked, wheeled, or hover, are still widely used in the 62nd century. They are cheaper, sturdier and easier to maintain than the complex walker mechanisms of their more recent brethren.

Unfortunately, while they are superior on open terrain, vehicles fare poorly on broken or difficult ground. This has led to specialization: conventional vehicles are widely used for assault, transport and support duty while walkers are used either as powerful, highly mobile infantry units (Gears), or broken terrain transports (striders).

VISIGOTH MAIN BATTLE TANK

1 ..... Pintle Mount	9 ..... Optical Sensor Pod
2 ..... Main Targeting Sensors	10 ..... 25 mm Autocannon
3 ..... Laser Emitter Turret	11 ..... Thermal Sleeve
4 ..... Rocket Pod	12 ..... Gun Barrel Road Lock
5 ..... IR/UV Floodlight Banks	13 ..... 140 mm Field Gun
6 ..... Commander Hatch	14 ..... Drive Wheel
7 ..... Rear Hardpoints	15 ..... Armored Road Wheel
8 ..... Forward Access Panel	16 ..... Ejection Port





5.4.1 - Cockpits

Most vehicles do not use the sophisticated VR set-up of Heavy Gears because they don't need it. Either the crew has the means to look directly outside or it has a complete computer generated HUD to help operate the vehicle. Most tanks are equipped with a holographic display that is both easier to use and less cumbersome than Gear-mounted equipment. Sensory information is fed to the display using small sensor pods mounted on the hatches, turret or main body of the vehicle.

The cockpit of most line units ties into a neural network for increased control. Although the NNet is not specifically required for ground vehicles such as a tank, it was found that those that did carry one were better able to cope with the changing terrain conditions, warning their drivers about potential road hazards and improving the response time between the various parts of the transmissions. The resulting vehicle is much more useful and can maneuver more effectively in battle.

However, not all combat units carry such sophisticated equipment, either because of cost limitations or simply because their tactical role does not require it. The ubiquitous "jeep" or all-purpose, all-terrain vehicle is a good example of this design philosophy.

5.4.2 - Powerplant

Vehicles are powered by a variety of means, depending on their function. Common powerplants include internal combustion engines, gas turbines, V-engines and electrical motors. Most civilian vehicles are powered by electrical power (in large cities) or simple fuel engines (in the countryside) while military ones rely most often on advanced ceramic gas turbines and V-engines similar to those on Gears and striders.

Sometimes, a combination of powerplant types is used to get the advantages of both. For example, several scout vehicles have both an internal combustion engine and electric motors in order to get the range of gas power and the low signature of electric.

Bryce Hubbard (order #959915)

Transmission - 5.4.3

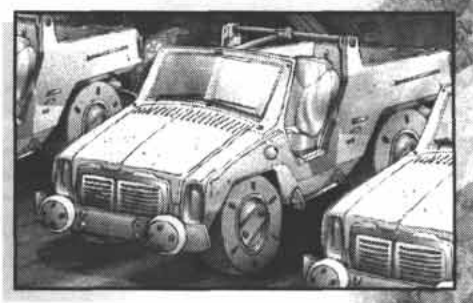
The great majority of fighting vehicles on Terra Nova are mounted on all-terrain wheels or treads. Advanced rugged suspensions and solid foamed-polymer core wheels absorb most of the shocks of off-road high speed travel, making military-grade wheeled suspension comparable to treads in performance (and in cost/complexity, unfortunately). Many front-line tanks have a hybrid suspension: they are mounted on road wheels that are quite capable of handling the vehicle's weight, yet are still surrounded by treads for enhanced rough terrain performance and reduced ground pressure.

Ground effect vehicles, although useful in the large deserts of the Badlands, have the unfortunate tendency to kick up lots of dust, making them hard to conceal. GE vehicles are most often used for quick transport between towns, both by military forces and civilians. Their ground-effect skirt, made out of multiple layers of composite cloth, is segmented and self-sealing.

Wheeled ◆

The wheel was one of the earliest and most useful inventions developed by Mankind, and it endures to this day. Wheeled vehicles are simple and cheap to produce, and consequently very popular and widespread. Out side the city-states, Terra Nova is still very much a frontier world, characterized by rough conditions. Super-highways exist at the poles, but they have a hard time crossing the desert Badlands, not to mention swamps and mountains. Most Terranovan wheeled vehicles hence have sturdy off-road suspension, making them suitable to the rough environment of the planet.

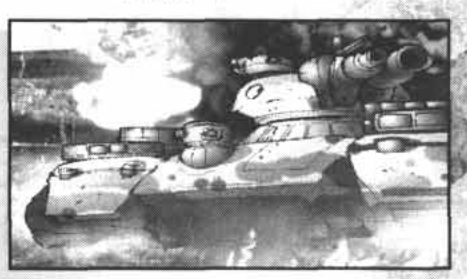
Badlanders are especially demanding on their vehicles and even off-road suspension has its limits. Many desert dwellers use tracked vehicles or riding beasts instead. Traditionalist prefer animals simply because they are low maintenance.



Tracked ◆

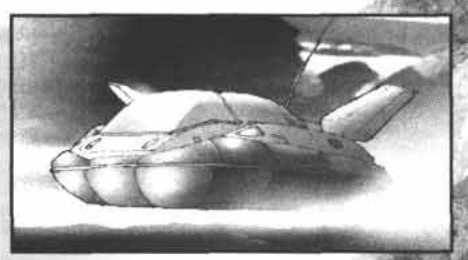
The problem with wheels is that they do not fare well on rough surfaces. Tracked vehicles solve the problem by effectively carrying their own road wherever they go. The road wheels drive wide articulated bands of metal elements called treads that distribute the weight of the vehicle over a wider section of the ground.

Tracked vehicles are more complex than a basic wheeled suspension, however, making them more prone to break-downs and meaning they require more day-to-day attention. They make up for this because they can drive into more types of terrain than wheeled vehicles. Among everyday civilians, this is not a beneficial trade-off and tracked vehicles are rare; for those who have to get into rough terrain, however, it's the best deal around.



Hover ◆

Hover vehicles move about on a cushion of air created by powerful blowers between the hull and the ground. Multi-leaf skirts, often armored with segmented panels for increased resistance, are used to hold the cushion in place to reduce the replenishment rate and thus increase the fuel efficiency. Hovercraft maneuver poorly but are extremely fast. Since they ride slightly above the ground, they can go anywhere on clear terrain, including sand, water, plain, etc. Hovercraft are rarely used on Terra Nova, however, mostly because there are few terrains suited to their use: the planet features few large bodies of water, and its plains and deserts harbor many debris and jagged rocks that can tear into the air cushion. Hovercraft also kick up a lot of dust in the Badlands, making them a poor choice for military operations, and there are too many forests and slopes at either poles.



Weapons and Armor - 5.4.4

Vehicles can carry a large variety of offensive and defensive systems. Exactly what systems are used depend greatly on the vehicle's intended role. For example, a scout car will boast powerful sensors, but very little in the way of weaponry, while a MBT (Main Battle Tank) will almost always mount a large caliber gun or missile launcher.

Just like the offensive payload, the defensive capacity can vary a great deal between vehicles. Non-combat or light attack vehicles such as jeeps or RRVs (Rapid Response Vehicles) rely on the sturdiness of their alloy frames and their superb maneuverability to survive combat, while tanks and IFVs (Infantry Fighting Vehicles) sport several centimeters of layered alloy and/or composite armor designed to stop a hyper-kinetic penetrator dead in its tracks.

Bryce Hubbard (order #959915)

5.5 - Hovertanks



When Earth attempted to invade Terra Nova in 6120 A.D., the military forces of Terra Nova were confronted by hovertanks for the first time. Early reports led Terranovan generals to think that Earth had discovered anti-gravity during the many years of separation. This confusion was easy to understand since scouts reported tanks without treads dropping out of aircraft and shuttles and floating to the ground. Fortunately for the Terranovan defenders, Earth had not progressed that far.

The hovertanks were Earth's answer to the unknown conditions their troops would face on the colony planets. A standard tank chassis is mounted on two or more powerful turbofans similar to those used on VTOL-capable jets. Atmospheric gases are taken in through armored intakes located on the upper surfaces of the vehicle. The thrust generated is channeled through articulated nozzles placed around the hull of the tank, making it more maneuverable than normal ground-effect vehicles. Although the engines are powerful enough to actually lift the tank off the ground, the machine usually rides on a cushion of air created underneath its body by the shape of the tank's hull, using the extra engine power only to jump above obstacles that might stand in its way. The resulting vehicle is fast and reasonably agile, though its autonomy is quite low when compared to other types of fighting vehicles.

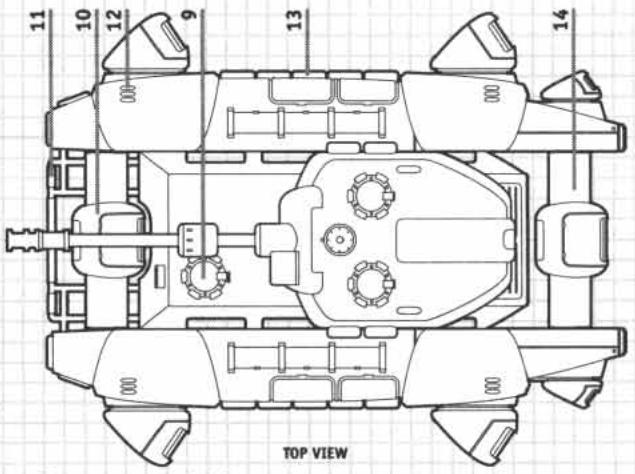
Hovertanks are combat units that are perfectly suited to the tactics and politics of the New Earth Commonwealth. They are fast and deadly, striking here one second, there the next. They were not exactly discrete, being awfully loud as they streaked low over the ground toward their target, kicking up clouds of dust as they did so. Hovertanks were the perfect war machines for an expansionist, aggressive government — but they make poor defensive weapons.

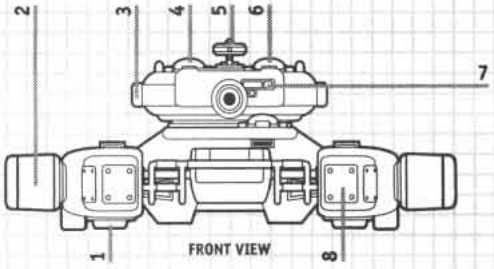
The first power Terranovan to use hovertanks was Port Arthur, a community of CEF expatriates who use salvaged HT-68s and other CEF models, usually stripped down with lesser weapons for easy maintenance. The Southern Republic has recently put into limited action its Scythian hovertank and the Humanist Alliance is also at work on its own model, developed with the help of Port Arthur.

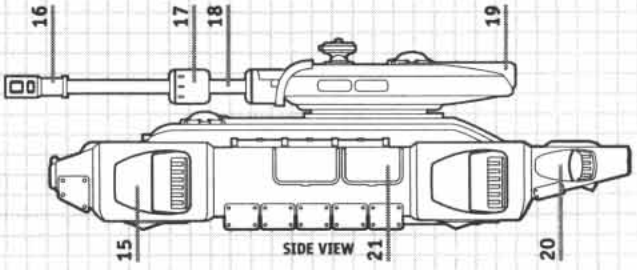
CEF HT-68 HEAVY ASSAULT-CLASS HOVERTANK

1 ..... Starboard front lift fan
2 ..... Starboard front thrust nozzle
3 ..... Starboard EM sensor array
4 ..... Commander hatch
5 ..... Optical sensor pod
6 ..... Tactical officer hatch
7 ..... Main gun targeting sensors
8 .... flight sensor and avionics array
9 ..... Pilot hatch
10 ..... Front airflow controller
11 ..... Crash bar
12 ..... Airflow sensors
13 ..... Starboard lift skirt armor
14 ..... Aft airflow controller
15 ..... Port front thrust nozzle
16 ..... Radiation shield emitter
17 ..... Drive coil power booster
18 ..... Particle accelerator
19 ..... Armored ring capacitor banks
20 ..... Port aft control nozzle
21 ..... Turbine maintenance hatch

Note: landing gear shown in retracted position.





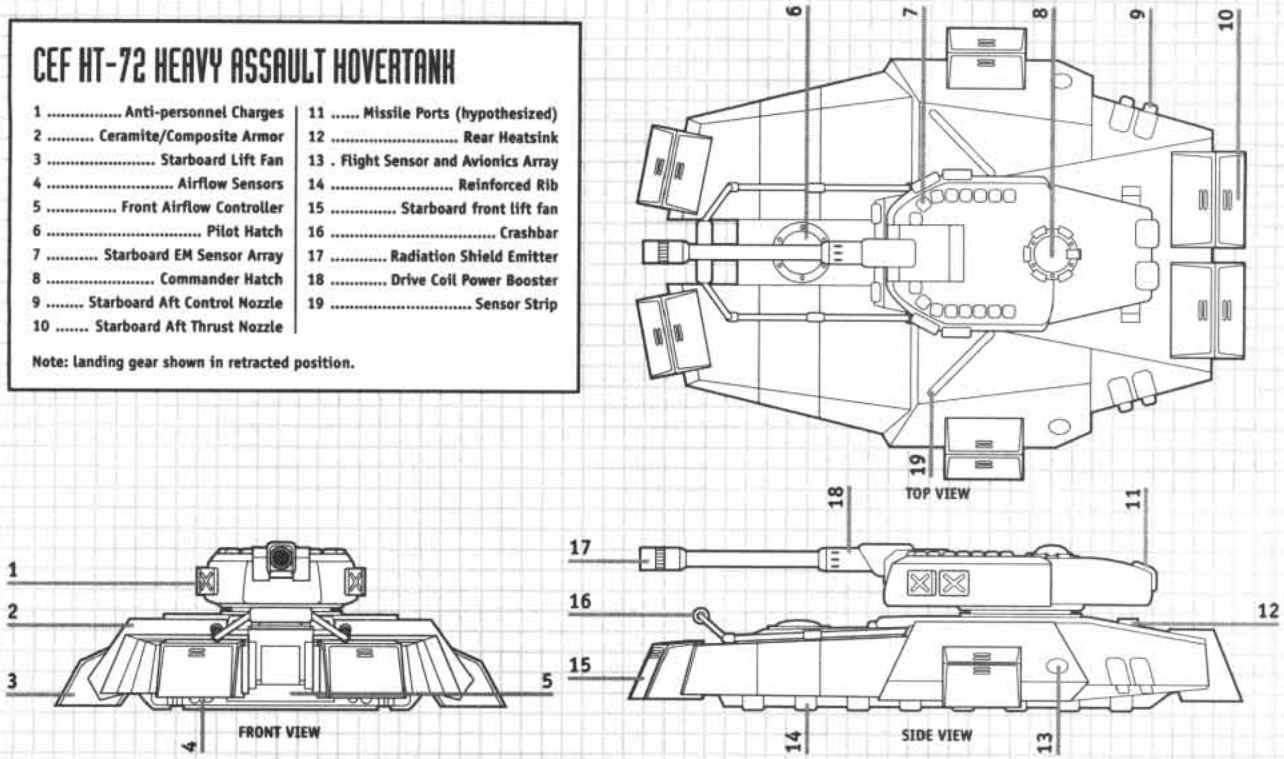


Bryce Hubbard (order #959915)

CEF HT-72 HEAVY ASSAULT HOVERTANK

1 ..... Anti-personnel Charges
2 ..... Ceramite/Composite Armor
3 ..... Starboard Lift Fan
4 ..... Airflow Sensors
5 ..... Front Airflow Controller
6 ..... Pilot Hatch
7 ..... Starboard EM Sensor Array
8 ..... Commander Hatch
9 ..... Starboard Aft Control Nozzle
10 ..... Starboard Aft Thrust Nozzle
11 ..... Missile Ports (hypothesized)
12 ..... Rear Heatsink
13 . Flight Sensor and Avionics Array
14 ..... Reinforced Rib
15 ..... Starboard front lift fan
16 ..... Crashbar
17 ..... Radiation Shield Emitter
18 ..... Drive Coil Power Booster
19 ..... Sensor Strip

Note: landing gear shown in retracted position.



Deployment - 5.5.1

When Earth attempted to invade the planet in TN 1913, Terranovan forces were confronted by hovertanks for the first time. The main body of the force was composed of a vehicle known only as the HT-68, pictured at left. A few of the HT-68 hovertanks were left behind by the invasion forces. They are now either in museums or with independent local forces, mostly serving with the Port Arthur's PAK.

A second type of hovertank, known as the HT-72, was fielded during the War, though in lesser quantities. Terranovan strategists believe it is the NEC's present mainstay vehicle, and that they sent a few to round out the "old war stock" they loaded the CEF with. The HT-72 is a much more advanced combat vessel than the older model. Its turbines are stronger and its streamlining better, both of which contribute to a significant increase in speed. The HT-72 suffers from the same problem as the older HT-68, however, in that its control surfaces and exhausts are exposed to hostile fire. The CEF has likely used the industrial planet of Caprice to produce larger numbers of the HT-72s.

Taking a hint from their one-time adversaries, many of the Terranovan factions have since then attempted to copy the hovertank design for use in their own cavalry and fast attack squads. Much of the advances have been accomplished by the Humanist Alliance, though they have kept their works extremely secret so far. The Southern Republic has also managed to field a few hovertanks of their own, mostly variants of their Scythian design. There are few reports of progress by the Northern powers, however; whether this is because of technical set-backs or because they do not put as much trust in the hovertank concept as their Southern counterparts, is currently unknown.



◆ Tactics

Most of the combat tactics used by forces deploying hovertanks are centered around hit-and-run strike where speed rules above anything else. Once their true nature was understood, many new strategies had to be developed to counteract the highly mobile vehicles. Heavy Gears performed surprisingly well against them, using a number of special tactics like throwing bags of corrosive Badlands white sand into the intakes.

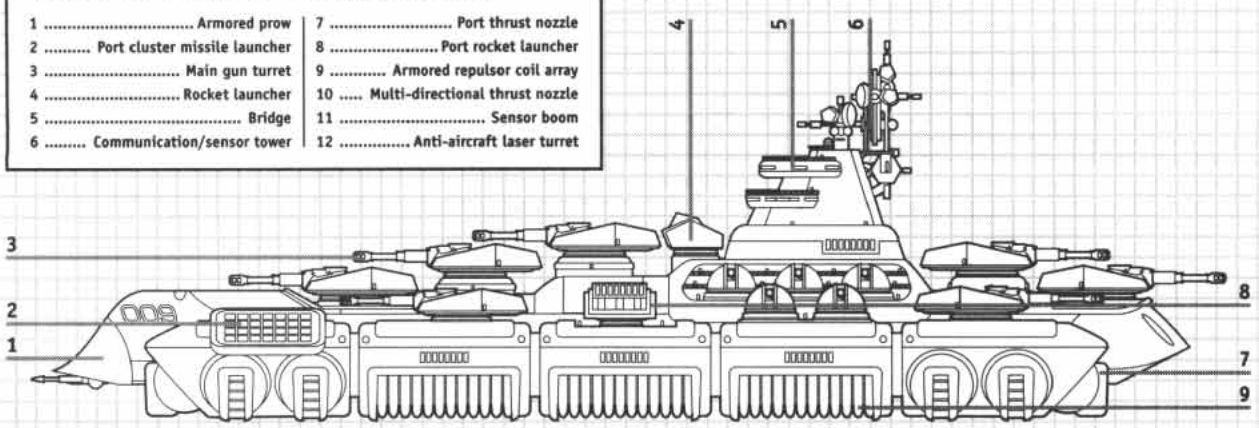
Bryce Hubbard (order #959915)

5.6 - Landships

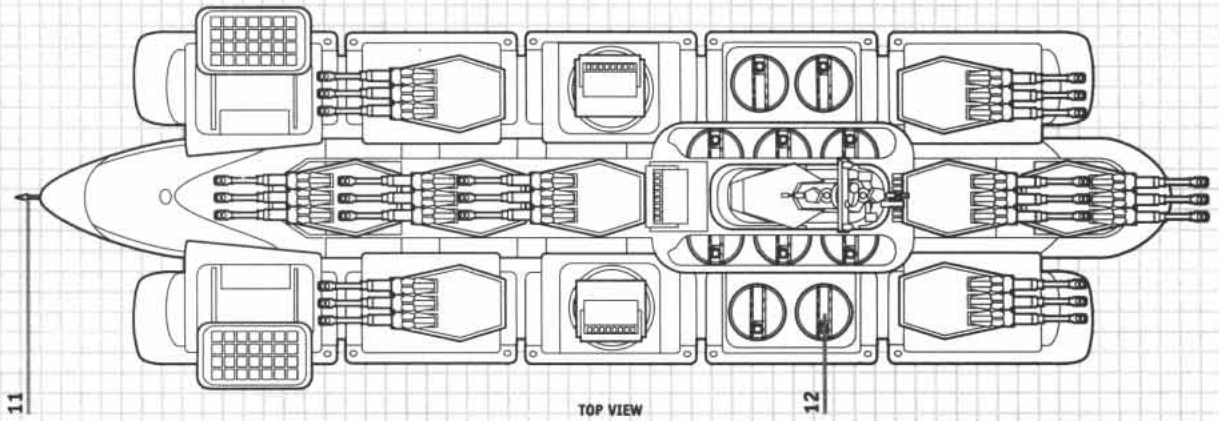
Terranovan Landships are quite a sight to behold. Together, they form the planet's equivalent of a wet navy and are best described as land-going ships. Using a combination of magnetic repulsion and ground effect technologies, these behemoths glide mere centimeters above the sandy surfaces of the Badlands and the polar savannahs, patrolling them as they would oceans. Landships would have been impossible anywhere else but on Terra Nova: the planet's peculiar magnetic properties, strengthened by the presence of large quantities of monopoles within its crust, allow considerable mass to be lifted if one knows how to generate and regulate the specific field required. The repulsor arrays of landships are calibrated precisely to avoid the deadly radiation and heat effects normally associated with high energy magnetic fields. The exact science behind the repulsors is still vague; it is said that only a handful of scientists ever fully understood the theory behind it, and new designs are merely extrapolations of their work. Most engineers agree that these repulsors work on deeper sub-atomic levels than simple magnetic repulsion (the energy normally required to lift such mass would fry anything within a few kilometers radius). Landships are expensive to build and maintain, so each league only has a few of the largest ones. Landship versus landship confrontations are rare and always very spectacular.

TYPHON-CLASS HEAVY CRUISER LANDSHIPS

1 ..... Armored prow	7 ..... Port thrust nozzle
2 ..... Port cluster missile launcher	8 ..... Port rocket launcher
3 ..... Main gun turret	9 ..... Armored repulsor coil array
4 ..... Rocket launcher	10 ..... Multi-directional thrust nozzle
5 ..... Bridge	11 ..... Sensor boom
6 ..... Communication/sensor tower	12 ..... Anti-aircraft laser turret



SIDE VIEW



TOP VIEW

5.6.1 - Powerplant

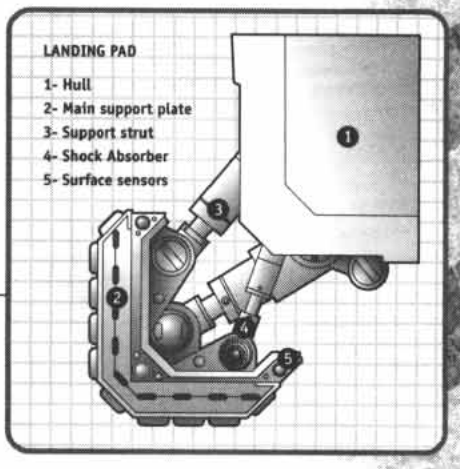
Most large Landships are equipped with a fusion generator since their magnetic repulsors and immense turbines require an enormous amount of power. The overall design of their engine room is similar to the one found aboard space ships. Smaller Landships, however, must rely on conventional engines since their size precludes the installation of a complex fusion plant. These Landships have large boiler rooms equipped with immense turbines that drive the generators. All Landships have a large armored engine room located deep in the bowels of the vessel. The hoverfans and magnetic repulsors are mounted in separate compartments to prevent catastrophic chain damage should one system be damaged or destroyed.

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Transmission - 5.6.2

Landships have massive hoverfans hidden under their armored hull. These only provide extra power for motion, however, as most of the lifting is accomplished by repulsor arrays that use the planet's magnetic properties to lift the vessel off the ground. These repulsors are heavily shielded and computer controlled to prevent them from interfering with the ship's internal systems and crew. Much of the repulsors' technology is derived from the science behind the fantastic particle accelerators and field generators of the Tannhauser Drive.

The underside of the Landship is heavily armored to protect the fragile repulsor coil elements. Even the fans and their intakes are shielded by mesh screens and thick baffles. Large reinforced pads are placed at many points to support the weight of the vehicle at rest.



The Danger Zone

The Danger Zone is the area directly below the landship's hull. It is called so because of the intense electromagnetic field generated by the ship's repulsor arrays. Although the field is fairly contained, ground crew are advised to wear protection when working near the hull. The Zone is one reason why Landship operations are usually limited to the Badlands and certain areas of the poles.

Cockpits and Sensors - 5.6.3

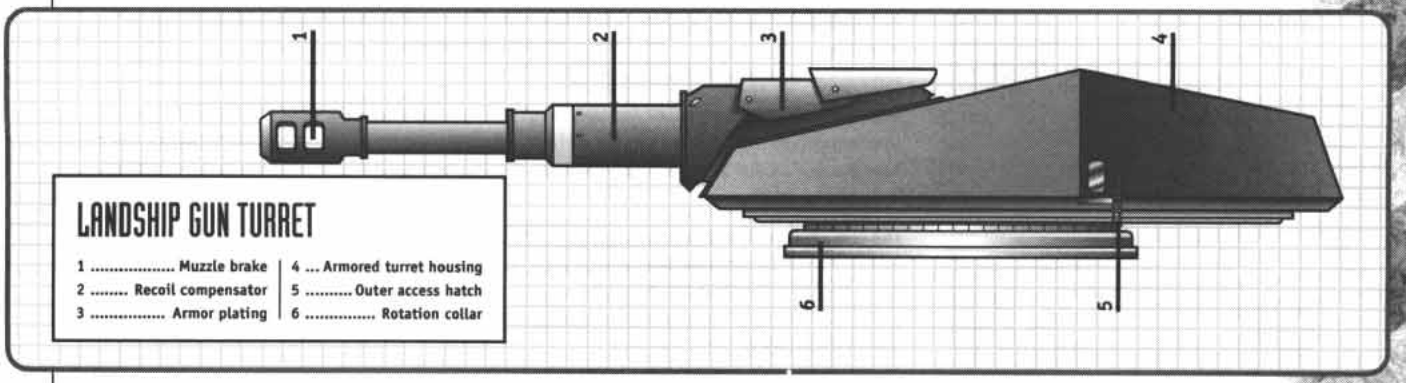
Landships do not have cockpits, but bridges. The bridge is usually located within a heavily armored "conning tower" located in the middle or rear of the ship, although some designs bury it in the hull for additional protection. The internal layout of the room is very similar to naval surface vessels of Earth's past, with piloting, navigation, sensor and command crew stations all grouped together around the captain and first officer's seats. Large holographic displays and computer-designed tactical screens fill the place, bathing the bridge and its crew in a ghastly electronic glow. See page XX for deck plans of typical bridges.

To provide the crew with the information it requires to function, Landships carry sophisticated sensor suites, often capable of detecting enemy units at great distances both on the ground and in the sky. Retractable mast-mounted "sweeper" radars and ladars provide excellent coverage of the surrounding countryside, while sensor pods located in armored housings in the ship's hull provide accurate and up-to-date information on the immediate vicinity. In addition to ship-carried sensors, many Landships have automated vehicle bays which house drones capable of flying deep into enemy territory.

Weapons and Armor - 5.6.4

Most of a Landship's armament consists of large projectile weapons and missile racks. Energy weapons, mostly anti-aircraft lasers, are sometimes used to take advantage of the powerplant's large energy reserve. Most of the armament is mounted in armored turrets to ensure a maximum field of fire. Often, the turrets can be lowered into the hull to protect the comparatively fragile weapons contained within, "popping up" only to fire.

Vehicle bays are built right into the hull, ready to disgorge their contents in the middle of the battlefield. Ramps, and sometimes cranes, are used to lower the vehicles to the ground. Landships are heavily armored, especially along their lower hull, to protect the fans and generators underneath. The destruction of these systems would not be critical, as the ship is barely floating above the ground, but it would completely immobilize it — not a good thing in modern warfare. Landships have often been likened to mobile bunkers. The heavier models can carry more than half a meter of composite armor on their turrets and sensor blisters, while the main hull can sport up to a meter (or more). Electronic countermeasure packages and point-defense weaponry complete the behemoths' defenses.



LANDSHIP GUN TURRET

1 ..... Muzzle brake
2 ..... Recoil compensator
3 ..... Armor plating
4 ... Armored turret housing
5 ..... Outer access hatch
6 ..... Rotation collar

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5.7 - Aircraft



Aircraft are still used in a variety of roles. Their general design has not changed much throughout the centuries. Planes of the 62nd century are lighter, more powerful and reliable, but they are still built along the same general lines as a 21st century vehicle. Airframes are sculpted with computer-aided techniques for better aerodynamics. Composites are used for most of the structure, while the engines are made out of ceramic components. The wings and/or rotors are able to slightly modify their shape to respond to outside conditions. All controls are routed through a "fly-by-wire" system, and planes can practically fly themselves.

Most if not all military aircraft are designed with stealth characteristics from the outset. Given the power and accuracy of modern sensors and weapons, aircraft and aerodynes are very vulnerable — once acquired, their chances of survival drop considerably. An aircraft's stealth characteristics go a long way towards ensuring its survival. The equipment generally varies from simple radar-elusive shapes and exhaust baffling to a complex and expensive absorbing skin that literally "drinks" the radar waves striking it.

The rules for designing flying vehicles are found on page 69 of this sourcebook. Military aircraft are often designed with the "Stealth" Perk to represent their radar-eluding shape and electronic equipment. Ratings vary from zero (civilian aircraft) to 5 (combat vehicles).

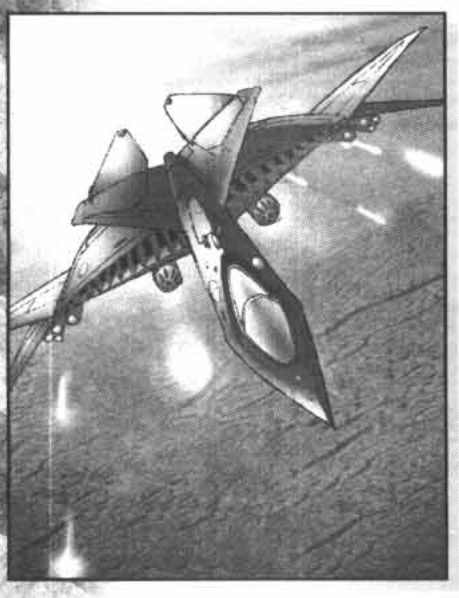
5.7.1 - Cockpit and Sensors

Aircraft, particularly combat ones, have greatly benefited from the advance of computer and data display technologies. Even the lowliest plane can now be equipped with a tiny flight computer, no larger than a matchbox, that monitors the health of the plane and assist the pilot in guiding it.

Modern flight displays are very similar to the ones used in ground combat vehicles, with ergonomically designed controls and several types of reprogrammable displays and HUD devices. Combat aircraft automatically integrate information from the aircraft's sensor systems and make them available to the pilot at the touch of a control. Some types of display even allow the pilot to fly the vehicle through a computer-generated environment, placing him "outside" the craft for a better view of both threats and surroundings.

Aircraft do have a great advantage over their ground cousins: their sensors and communication systems benefit from both a better perspective and a better platform to operate from. All those flat surfaces make great mounting points for electronic receptors, which are often woven directly into the outer skin of the vehicle.

5.7.2 Weapons and Armor



Mass remains, as always, a crucial element of aircraft design. For this reason, few aircraft carry actual armor, relying instead on agility and stealth to avoid damage. Some planes are fragile, flimsy things where toughness has been sacrificed for performance; others are built around extraordinarily tough structure that can take awesome amounts of damage before collapsing.

On the offensive side, payload is generally less varied than for ground vehicles. The usual standard consists of several missiles and at least one rapid-fire weapon, generally a projectile cannon of some sort. Bombs (missiles without propulsion systems) can be carried and dropped on enemy objectives with great precision. Some planes mount lasers, but their energy requirements make them somewhat impractical. Aircraft cannot, for obvious reasons, use melee or dueling weaponry (which does not mean it has not been tried before, though).

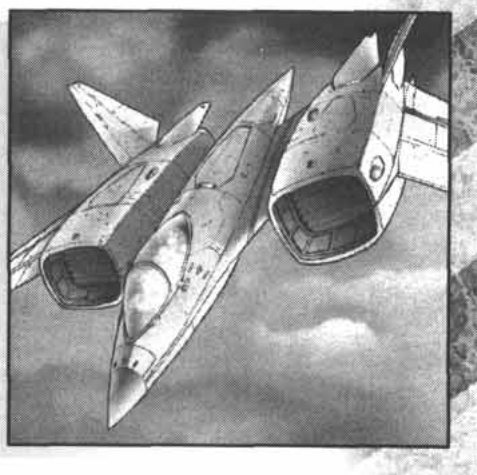
Guided missiles, once expected to make "dogfight" combat disappear, must face several layers of countermeasures from stealth, decoys and active counter-missile systems. Over the centuries, they have become smaller and more agile, and can now be used against both air and ground targets for increased versatility.

The same design philosophy that allows aircraft to survive the deadly attention of laser turrets and other anti-aircraft defenses have brought back the art of close -in fighting, with most fighter combat occurring within an envelope of ten kilometers or even less. Once more, the aces will rule the skies — until a burning laser beam or a high velocity missile bring them down, like Icarus, to a swift and dishonorable death.

Bryce Hubbard (order #959915)

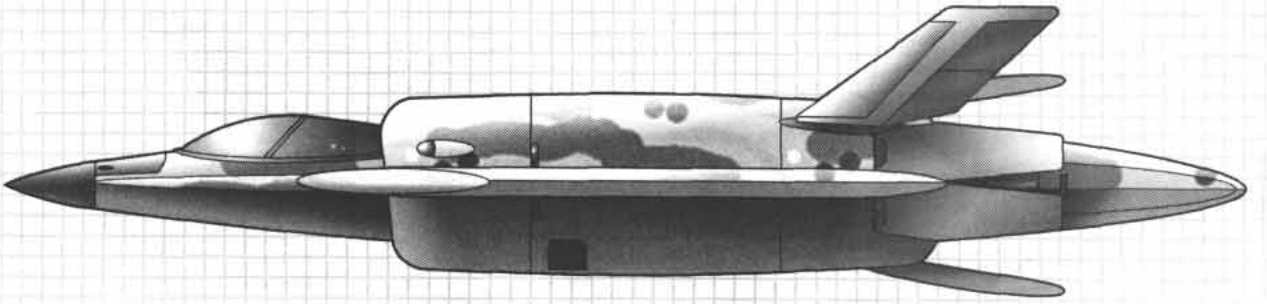
Conventional Aircraft - 5.7.3

The term "conventional aircraft" refers to the fixed wing designs that have been used by Mankind for the past few millennia. They are jet or turbine powered, with wings supplying the lift they require to stay aloft. Their main strength is endurance and fuel-efficiency, and they are thus preferred for long range transport, ground support and interception missions. This also makes them the fixture in the civilian market, with almost all civilian cargoes, passenger liners, and recreation aircraft being of the fixed wing type. Planetary weather conditions have made recreational flight relatively rare on Terra Nova, but it does exist. The Flitter one-man flyer is a popular sport vehicle, for example.



A few types of fighters can reach low-orbit by themselves by using hybrid engines, but they are somewhat inefficient and thus rare. It is generally better to have a sub-orbital transport carry the planes to their destination, and have dedicated combat spacecraft permanently in orbit, where they do not have to carry the useless mass of wings and air-breathing engines.

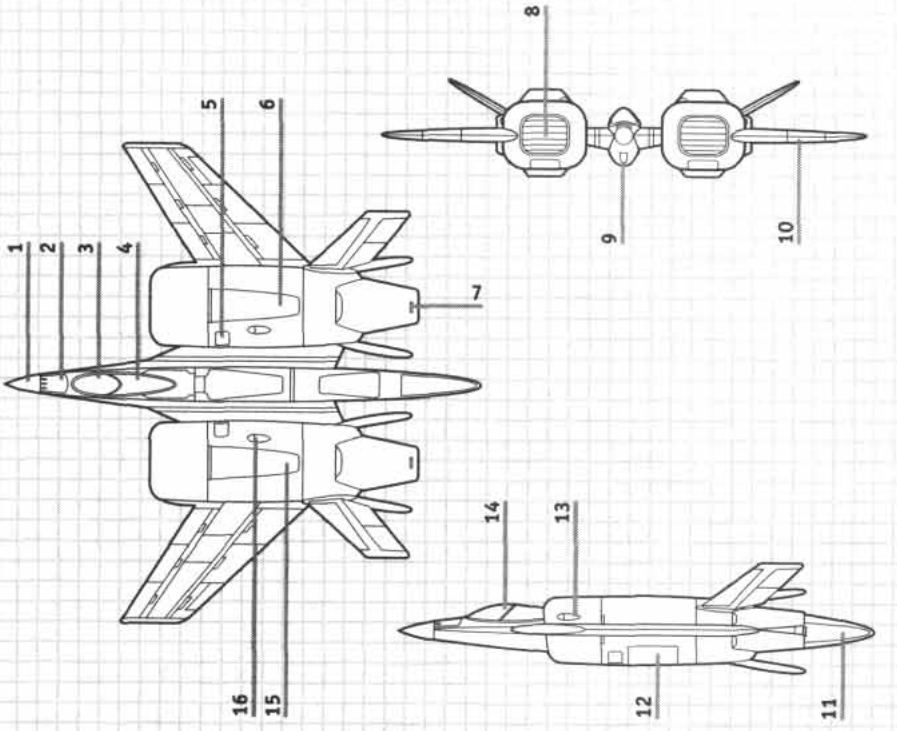
Conventional aircraft are very vulnerable to anti-aircraft assets, mainly missiles and laser weapons. They must keep out of sight, either by flying far enough from the action or by using the ground to mask their movement. While aircraft can be equipped with NOE (Nap Of Earth)-capable flight avionics, their speed and need to move forward at all times makes NOE flight almost as dangerous as facing enemy weapons.



QUETZAL FIGHTER-BOMBER

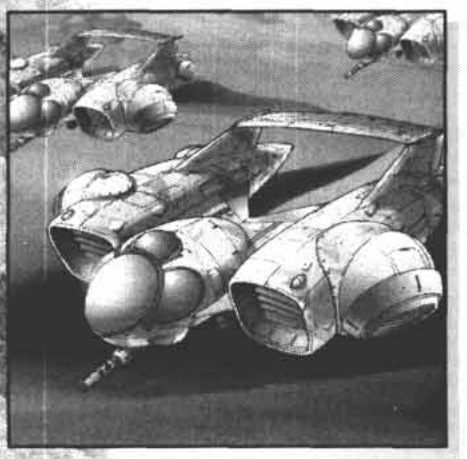
1 ..... Radome
2 ..... Upper Sensor Panel
3 ..... Commander Position
4 ..... Weapon Operator Position
5 ..... Access Panel
6 ..... Upper Airbrake
7 ..... Exhaust Masking Surface
8 ..... Starboard Intake
9 ..... Nose Landing Gear Housing
10 ..... Mission Adaptive Wing
11 ..... Aft Electronic Pod
12 ..... Main Landing Gear Housing
13 ..... Port Targeting Sensors
14 ..... Polarized Canopy
15 ..... Port Engine Access Panel
16 ..... Starboard Upper EM Sensor Array

Note: landing gear shown in retracted position.



Bryce Hubbard (order #959915)

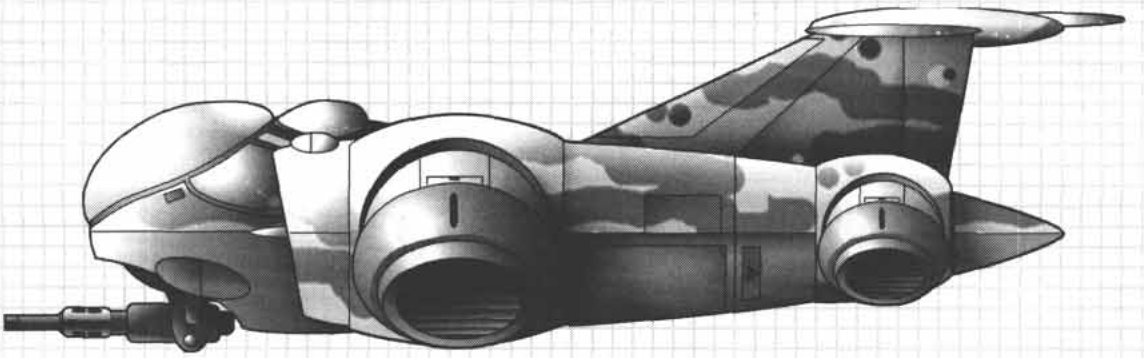
5.7.4 - VTOL Aircraft



VTOL (Vertical Take-Off and Landing) aircraft are jet or turbine powered vehicles that use direct thrust for lift. They can hover in mid-air and use almost any clear surface as a convenient landing pad. This category includes fixed wing planes with articulated thrust nozzles and the vectored thrust aerodynes commonly referred to as "hoppers." This type of aircraft is used mainly for short range ground support and interception, since VTOLs require lots of fuel to operate. They can, however, use nap-of-earth flying to improve their chances of survival, concealing themselves behind terrain features and using pop-up attacks.

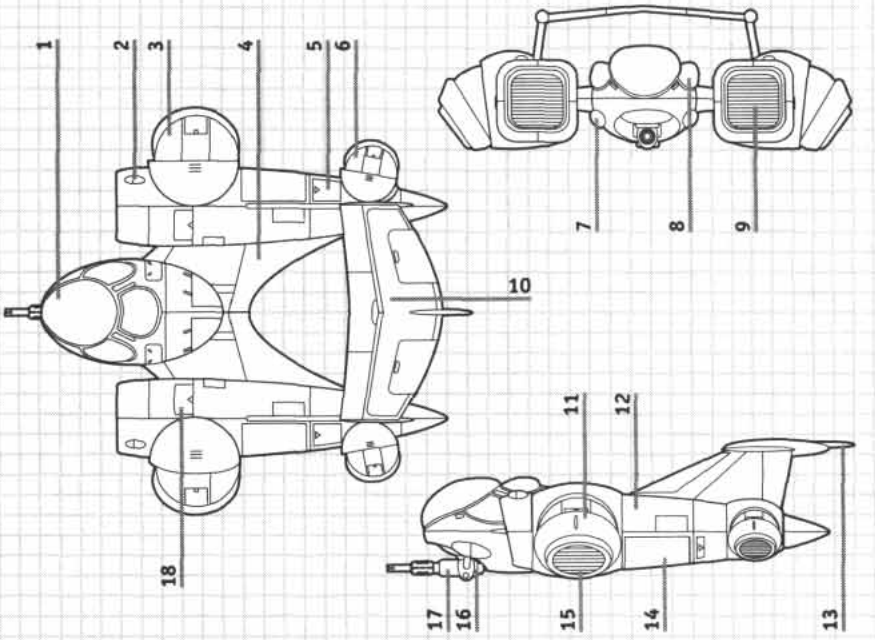
VTOL craft have several serious disadvantages, however, that limits their distribution. In addition to the aforementioned lack of endurance, they are highly vulnerable to engine hits, since they often rely entirely on their propulsion system for lift. This, in turn, means a high infrared signature, unless additional stealth devices are installed.

Vectored thrust vehicles can also be used for other types of missions if the environment is too difficult for rotary wing VTOL, such as search-and-rescue in hard weather. The Grasshopper is a popular VTOL offered both in a hopper and tilt-rotor models. The latter is most popular in the Badlands, where endurance and frugality are appreciated, but the first variant is faster.



VARIS HOPPER

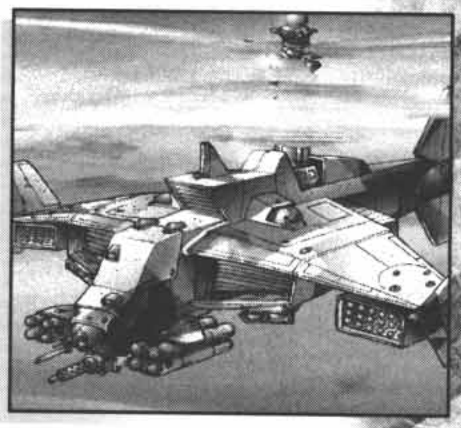
1 ..... Polarized Canopy
2 ..... Starboard Upper EM Sensor Array
3 ..... Starboard Main Vertol Nozzle
4 ..... Starboard Engine Support Strut
5 ..... Engine Access Panel
6 ..... Starboard Aft Vertol Nozzle
7 ..... Starboard Targeting Sensors
8 ..... Lateral Observation Blister
9 ..... Port Engine Intake
10 ..... Upper Sensor Panel
11 ..... Airflow Controller
12 ..... Port Turbofan Housing
13 ..... Superheterodyne Aerial
14 ..... Main Landing Gear Housing
15 ..... Directional Vector Slats
16 ..... Weapon Swivel Mount
17 ..... 20 mm Chaingun
18 ..... Maintenance Hatch



Bryce Hubbard (order #959915)

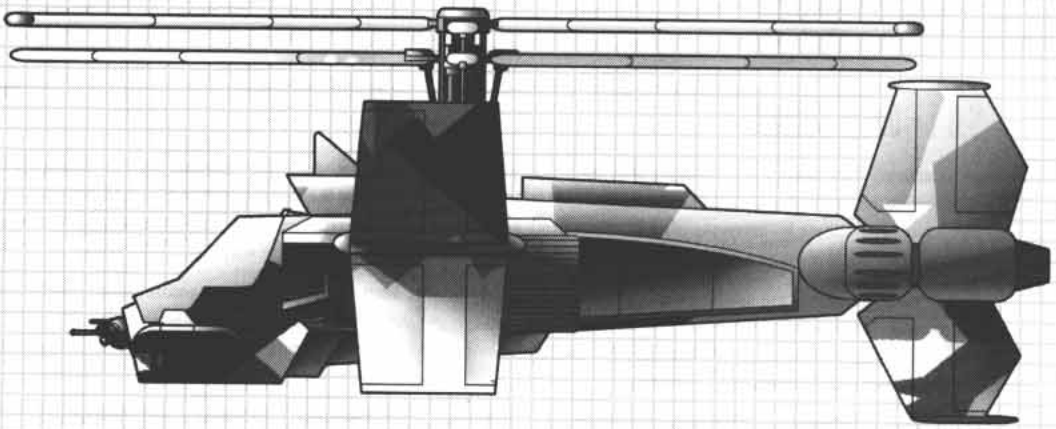
Rotary Wing Aircraft - S.7.5

Rotary wing aircraft use either propellers or rotors for lift, using power from jet or turbine engines. They are less costly than jet-powered VTOLs, but slower due to the aerodynamics involved with rotary wings. Rotary wing craft are sometimes hybridized with other types of propulsion systems to improve their flight performance, using configurations such as tilt-rotor designs or additional jet propulsion.



Rotary wing vehicles are ideally suited to close ground support and transport roles, in which they excel. Unlike vectored thrust vehicles, they have a built-in abort capability in case of engine failure: they can disengage their transmission and auto-rotate to safety. They can also use nap-of-earth flying to improve their chances of survival, using the same techniques as other types of VTOL. They do have some disadvantages, however. Most rotors have large "foot prints," requiring a comparatively large cleared area for take-offs and landings. Rotors are also somewhat noisy (the noise level depending on many factors), making them unsuited to infiltration and ambush missions.

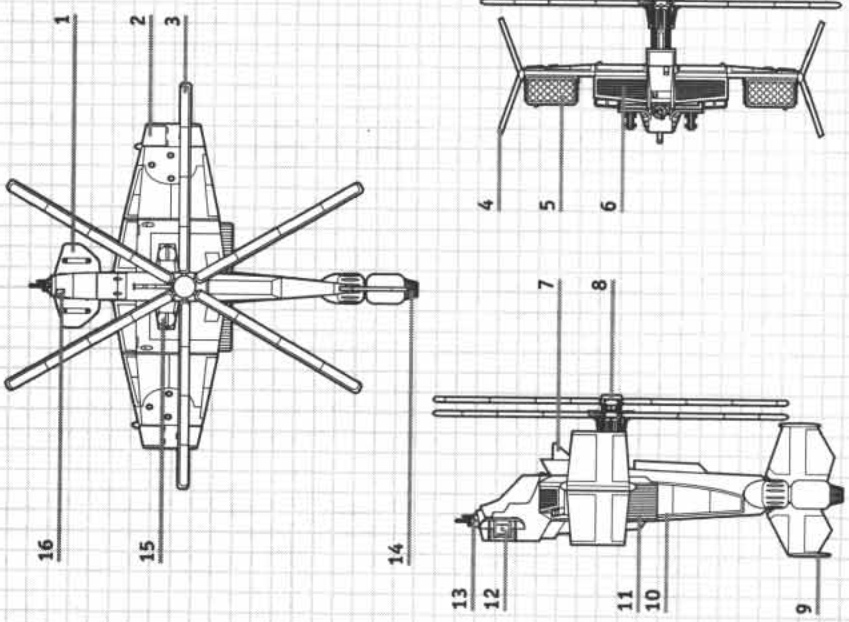
Rotary wing craft have a secure place in the military for the reasons listed above, and each confederate army field heavy attack helicopters (the Northern Scorpion and Southern Titan). They also are very popular in the civilian aircraft market.



SCORPION GUNSHIP

1 ..... Forward Canard Surface
2 ..... Starboard Wing
3 ..... Composite Rotor Blade
4 ..... Armor Baffle
5 ..... Rocket Pod
6 ..... Starboard Turbine Air Intake
7 ..... Upper Aerial
8 ..... Mast Sensor Pod Hardpoint
9 ..... Rear Emergency Skid
10 ..... Lateral Heat Shield
11 ..... Turbine Exhaust
12 ..... Forward Missile Hardpoints
13 ..... Main Sensor Array
14 ..... Secondary Propulsion Nozzle
15 ..... Port Secondary Sensor Array
16 ..... Pilot's Backup Vision Block

Note: landing gear shown in retracted position.



Bryce Hubbard (order #959915)

5.8 - Spacecraft



Spacecraft were first developed in the middle of the twentieth century, and they have been in use ever since. Of course, they have changed quite a bit since the days of the early space efforts: they have become more powerful, longer ranged and much, much safer. They still obey the laws of physics, however, and provide a pressurized, temperature-regulated environment for their crew as they take them from one planet to the other — or from one star system, through an interstellar Gate into a new system that lies beyond.

All current spacecraft are utilitarian or military in nature; space is too dangerous and costly to live in to have many other uses. Ships have thus evolved a somewhat blocky and pragmatic look, with massive hulls studded with antennae and sensor blisters. Ablative and reflective coatings, alloy and ceramite plates combine to give a dull greyish, patchwork appearance to all ship hulls, the faded patina of which is broken only by the phantom remains of a long-eroded garish paint scheme. Streaks of scorched paint and coating mark battle damage and uncleaned exhausts from overtasked maneuver engines.

The interior of the vessels generally has not fared much better, at least for the ships still in service with the various colonial navies. While they are scrupulously maintained and cleaned by their crew — after all, their lives depend on the good functions of the vessel — the corridors and rooms appear grimy and tired, as if they had been hurled from one side of the system to the other and now wished only to rest. This appearance is deceptive, however, as the spacecraft are strudily built and quite safe, despite their well-aged looks.

5.8.1 - Basic Layout

All spacecraft share some basic characteristics derived from the hostile milieu in which they operate. They all have a crew section, an engineering section and a cluster of engines, generally placed in that order. The hull is clad in thick but light composite armor plates, pierced here and there by antennae mounts, gun turrets and polycrystal viewports. Layers of rad-absorbing material protect the crew against the effects of cosmic radiation and the occasional particle beam fire from hostile vessels.

The propulsion systems are nearly always found at the rear of the hull. Most spaceships use a standard fusion thruster array called a fusion tube. These systems are efficient, well-understood, and can use almost any liquid or gas as reaction mass. They are based on the improved understanding of sub-atomic physics that came with the development of Tannhauser's theories, and use subquantic interactions to liberate massive amounts of energy.

Some vessels, mostly the smaller ones, rely on chemical propulsion, most often with liquid oxygen and hydrogen as fuel. Disposable solid fuel boosters are widely used to help reach higher velocity as they pose less problem than complex fuel pump systems and are less likely to break down. This is the case for small interstation shuttles and personal propulsion devices.

A third propulsion system is also sometimes used by deep space vehicles: the ion engine. This type of propulsion is capable of producing thrust for extended periods of time without much reaction mass. This thrust is very feeble, and cannot be used for large and/or rapid vessels; it is, however, very hard to detect.

5.8.2 - Offensive and Defensive Systems

Space is a very special environment for weaponry due to the absence of atmosphere and gravity. Increased range and lack of an atmospheric medium drasticallly change the operative profile of existing weapon systems. Most ship-borne weapons are simply more pwoerful versions of the systems used planetside. The main lasers develop megawatts and gigawatts of energy in order to affect a target that may lie thousands of kilometers away, while the missiles are equipped with powerful nuclear warheads that engulf the target in their large blast radius.

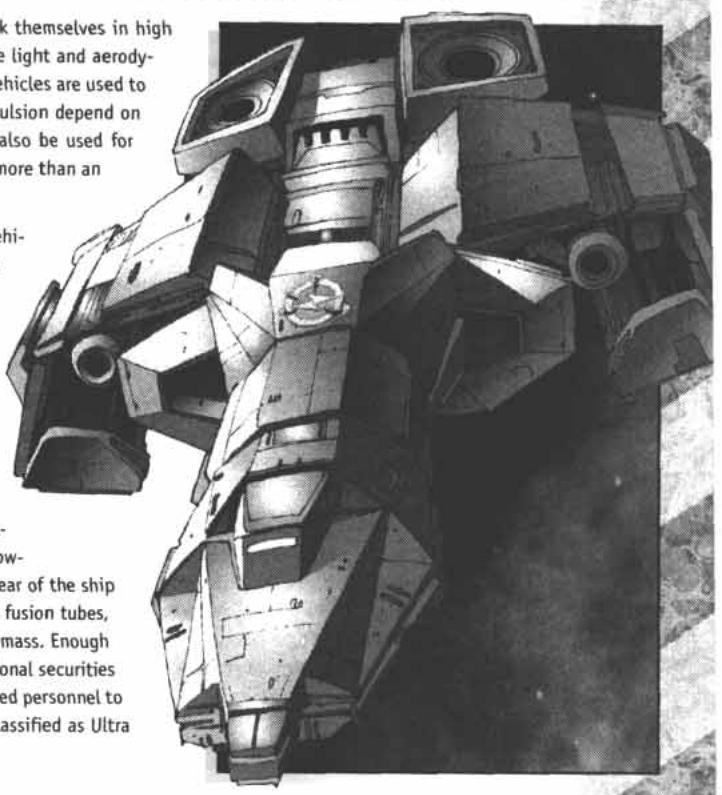
Unlike their ground-side cousins, however, space weapons are also capable of more than destruction. Lasers can be used to pulse encoded communication and messages over very long distance; kinetic kill weapons use the same basic technology as a reaction engine; a modified missile or ASAT can be used as a message torpedo or reconnaissance probe. For this reason, the lines sometimes blurs between the two, and even the peaceful civilian ore hauler may become a deadly danger if it turns its microwave radar emitter at full power toward its attackers.

Combat vessels often adopt a similar layout for their offensive systems, for their appearance is dictated by their functions. Drones and mines are stored in aft bays to be easily dropped when the ship is under acceleration, while ASATs and other missile systems benefit from the ship's velocity and are located forward in dedicated launch bays. Gun and laser turrets, when present, are located on the side.

Bryce Hubbard (order #959915)

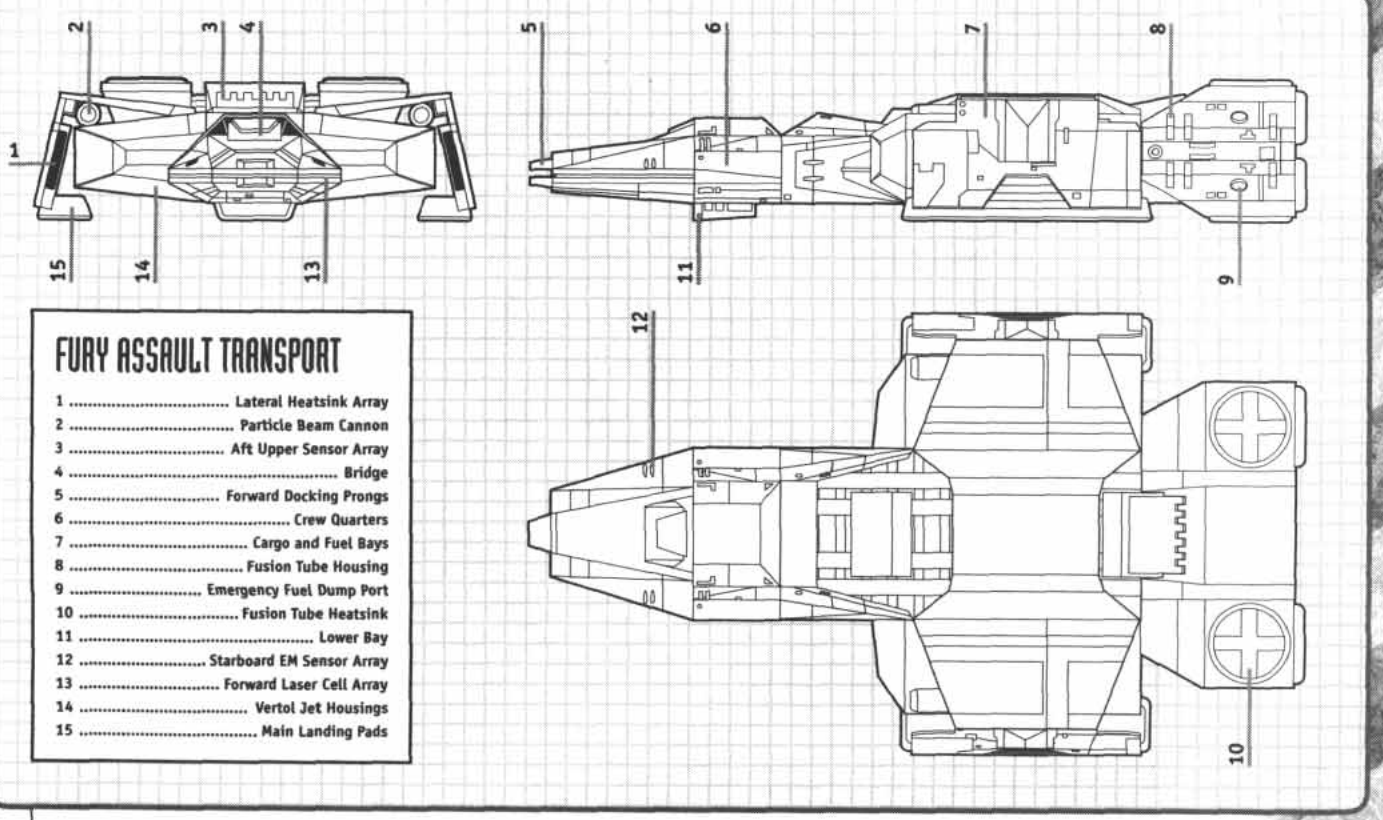
Aerospace Vehicles - 5.8.3

Gateships are too massive to descend onto a planet's surface. They can park themselves in high orbit, but that's about it. Most spaceships are not much better: very few are light and aerodynamic enough to be atmosphere-capable. Because of this, a wide variety of vehicles are used to fill the gap between orbit and ground. Their shape, size and method of propulsion depend on their function (cargo, passenger, military, etc.). These interface ships can also be used for fast planet-side transport via sub-orbital flight. no location on the planet is more than an hour's flight away.



The Fury-class Intersystem Assault Transport is a good example of interface vehicles. This fusion-powered spacecraft was already in the work prior to the start of the Interpolar War, but progress remains slow and impaired by the need for secrecy. Much of the craft's main hull and system are derived from the CEF's Sleipnir-class space plane, an advanced ground-to-orbit shuttle designed to carry high priority personnel and cargo across conquered planets. According to current Terranovan intelligence, the Sleipnir was itself based on the older Tarantula assault lander developed by the New Eurasian Commonwealth during World War III (see *CEF Spacecraft*, page 67).

The hull of the Fury is fairly angular due to the numerous stealth surfaces built into the design. The underside of the main body is covered with high temperature cerametal composites to withstand re-entry, while the rest is clad with low-density armor giving it strong protection all around. Hatches on the side and rear of the ship allows easy egress from the two main cargo bays. The Fury is propelled by four fusion tubes, all of the same modular design, that can use any high density fluid as reaction mass. Enough reserves are carried to get from a planetary surface to a Gate and back. Operational securities on all fusion tubes are patched to main ops and may be deactivated by authorized personnel to cause the vessel to self-destruct. All works on the Fury program is currently classified as Ultra Secret; knowledge of its existence is Need To Know Only.



FURY ASSAULT TRANSPORT

1 ..... Lateral Heatsink Array
2 ..... Particle Beam Cannon
3 ..... Aft Upper Sensor Array
4 ..... Bridge
5 ..... Forward Docking Prongs
6 ..... Crew Quarters
7 ..... Cargo and Fuel Bays
8 ..... Fusion Tube Housing
9 ..... Emergency Fuel Dump Port
10 ..... Fusion Tube Heatsink
11 ..... Lower Bay
12 ..... Starboard EM Sensor Array
13 ..... Forward Laser Cell Array
14 ..... Vertol Jet Housings
15 ..... Main Landing Pads

Bryce Hubbard (order #959915)

5.8.4 - FTL Vehicles

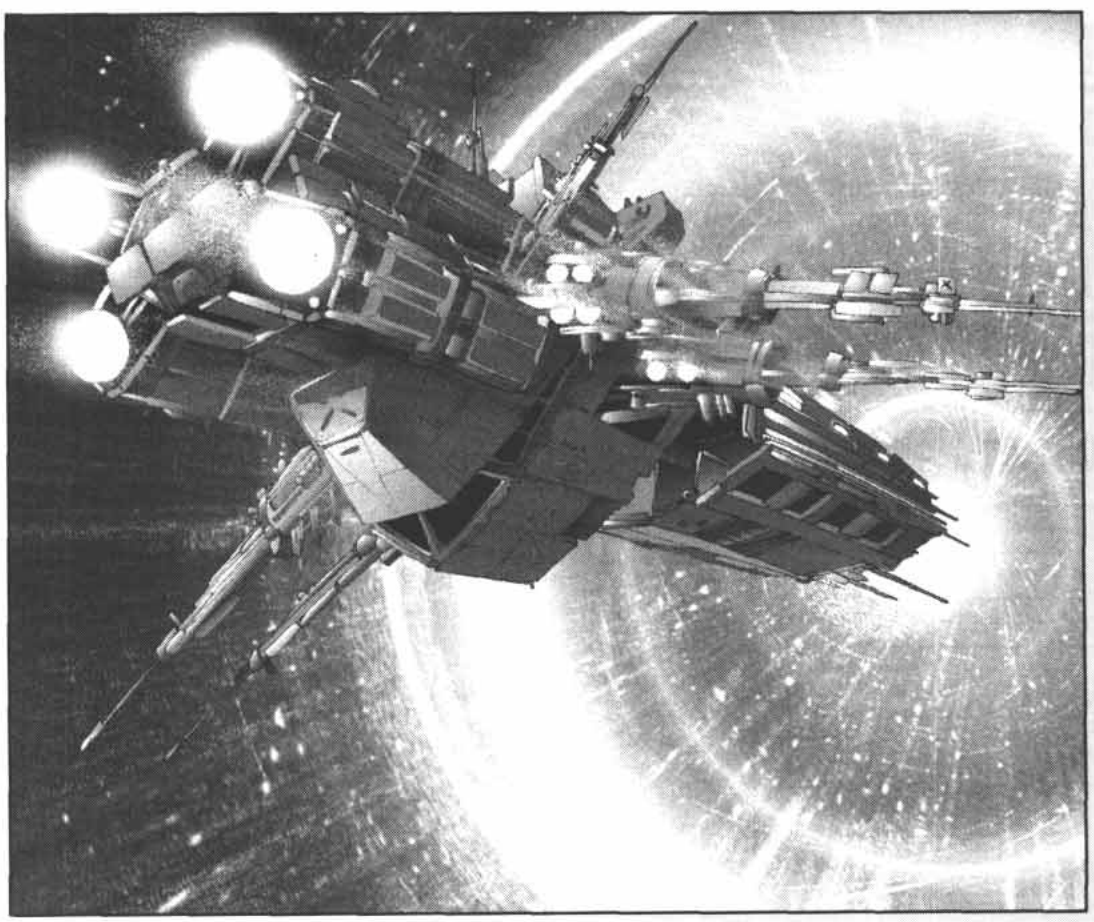
Faster-than-light (FTL) vehicles are large spaceships built around a massive and very specialized particle accelerator called a Gate Drive. They must be quite large in order to house the multiple fusion generators required to power the accelerator and open a Gate to a solar system that may lay thousands of light-years ahead. This, in turn, makes them extremely slow and ponderous, and they thus tend to act as mobile combat fortresses ases rather than combat spacecraft.

A Tannhauser Gate is a spatial discontinuity, a tiny point in space like a miniature black hole, only with a gravity field hundreds of times more powerful than its size should allow. This gravity field bends space to the degree that it folds back upon itself, creating a consanguinity between two distant points. An object entering the event horizon of the discontinuity would be crushed by the tidal stresses and ripped apart as it crossed the discontinuity and existed in two places at the same time.

Fortunately, it is possible to safely "cross over" by supplying a catalyst, a specially modulated beam of antimatter and exotic particles, to raise the energy level of the Gate to the "Opening Threshold." This alters the consanguinity so that the farther point becomes the only one for an infinitesimally small fraction of a second and creates a region of foldspace. An object close enough to the discontinuity's event horizon will be sucked in by a momentary surge in the gravity field and transferred to the far point.

A few cycles ago, astrophysicist Gawaïne Di Smit wrote an advanced thesis on the dynamic structure underlying the genesis of the Tannhauser-type space discontinuities. In layman's terms, it postulates the possibility of microscopic anomalies — additional Gates yet undiscovered. The presumed presence of CEF agents on Terra Nova (see opposite page) only confirms the existence of such "mini-Gates," since the main access points to the system are guarded day and night by the Terranovan fleets. The Gateship UMFGS Laban Emuros is being equipped with the sensors needed to search for these new anomalies.

The Gating process is extremely spectacular, due to the huge amount of energy invested in it. The Gate itself is largely invisible; most of the light emitted does not come from it, but from the interaction of the affected region with normal space. This "friction" rapidly depletes the Gate's energy and lowers its threshold, which causes the opening to collapse unless supplied with additional energy. The trip through the Gate lasts only a short while, but the experience is very unsettling. It has been described as being somewhat akin to hearing odors, seeing sounds and tasting colors while having a headache in the big toe. There are no lasting physical effects, but the experience is somewhat perturbing.

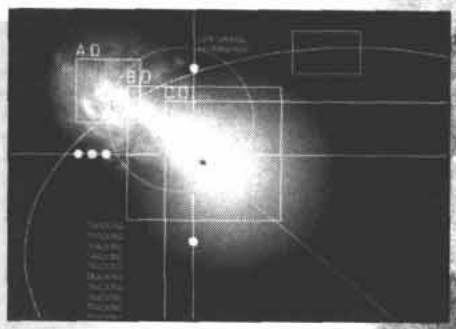


Bryce Hubbard (order #959915)

CEF Vessels - 5.8.5

CEF forces have used a large variety of spacecraft in attacking Terra Nova, and they retired with many of them still intact. Foremost among them is the AC-56 assault lander, code-name "Tarantula." The Tarantula was developed by the New Eurasian Commonwealth during World War III. The design later lead to the CEF's Sleipnir-class space plane, and Terranovan analysts believe that more variants and derived vessels may also be in use. The fusion-powered spacecraft is likely still deployed on Caprice and other Earth-held worlds, if any, to transport troops across vast distances.

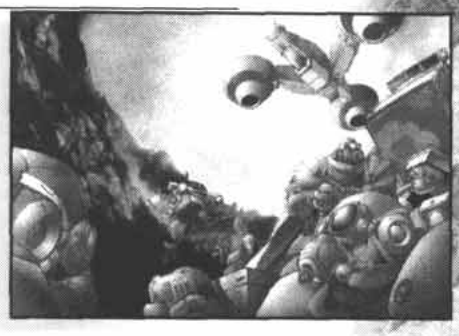
The Colonial Expeditionary Force also fielded a large number of warships and fighters in their assault and escaped with many of them during the debacle that followed the war of the Alliance. It is believed they still have a sizable fleet stationed in the Caprice system. According to historical files, the planet is also ringed with orbital defense platforms to protect it against the system's frequent asteroid storms.



◆ Gate Coffin

The recent discovery of the existence of the Gate Coffin, a small inter-system transport vehicle, has shocked the intelligence operatives of Terra Nova. The vehicle is extremely well stealthed and capable of taking one operative from one system to another, landing them without any other external sign than a banal meteor storm. One such vehicle was captured purely by coincidence; it is fairly certain to assume that several have been sent to Terra Nova, and probably other planets, by the CEF.

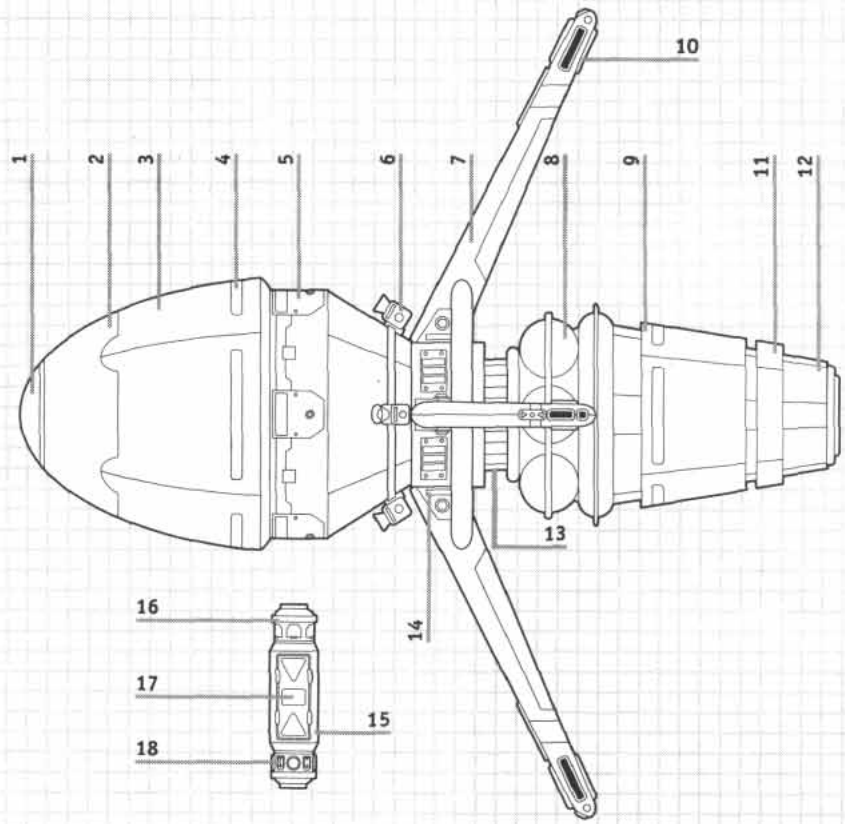
Current studies of the Earthers' project are known only by the code name of "Falling Star." All knowledge about Falling Star is currently considered Ultra Secret to avoid alerting New Earth Commonwealth sympathizers already in place. Knowledge is distributed on a need to know basis; even major government officials have been kept in the dark.



GATE COFFIN

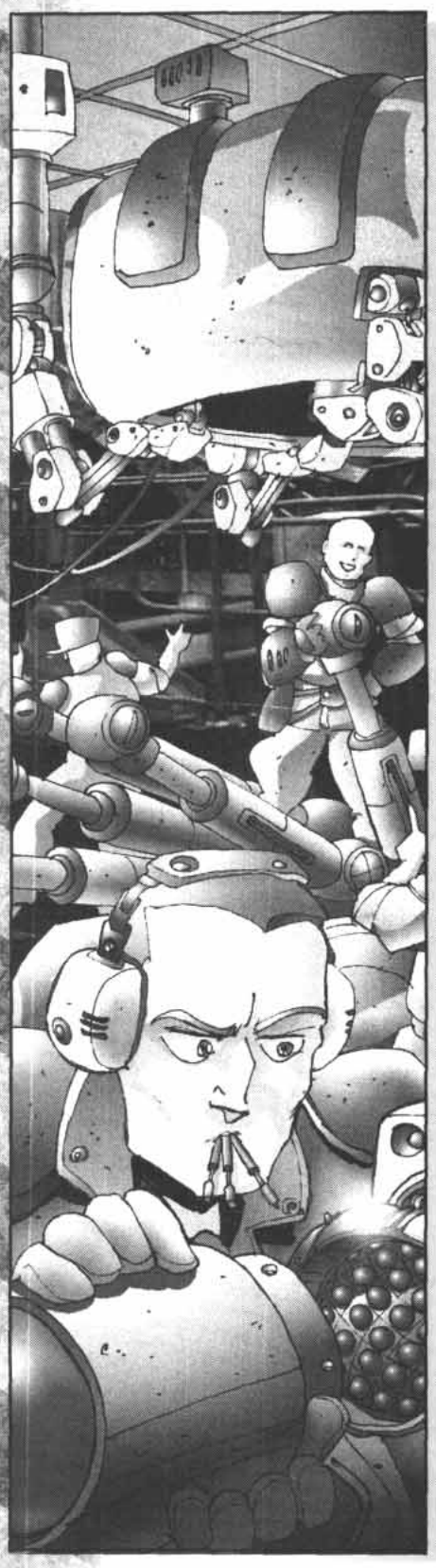
1 ..... Nose Cone
2 ..... Primary Ablative Shield
3 ..... RAM Coating
4 ..... EM Sensor Array
5 ..... Forward Hull Release Mechanism
6 ..... Breaking Thrusters
7 ..... Maneuver Engines Support Arm
8 ..... Primary Reaction Mass Reserve
9 ..... Thermal Core Housing
10 ..... Attitude Verniers
11 ..... Exhaust Collimator
12 ..... Exhaust Shield
13 ..... Main Hull Heatsink
14 ..... Support Arm Hinges (locked position)
15 ..... Delivery Pod
16 ..... Parachute Housing
17 ..... Cryo-tube Main Hatch
18 ..... Guidance Sensors

From its overall shape, it is assumed that the vehicle is towed to the Gate and then pushed through to make its way unassisted to the target planet. The vernier support arms probably fold back against the main hull for easier transport.



Bryce Hubbard (order #959915)

Nightcrawlers



Natalya stretched, her small frame exhausted from spending too many hours in front of the CAD screen. She rubbed her eyes and reached for her sixth cup of cawfee. Sipping the hot decoction, she examined the three dimensional display hanging in the air above her work station.

"Still here?!" The surprise was evident in Streven's voice. The young engineer was standing in the doorway, looking mildly annoyed. He was the one known for staying late and putting in extra hours, not the firm's whiz kid newcomer.

"Hi. Just finishing up some calculations." She pointed to the work station beside her, a tired smile on her lips.

"The //Thunder Lizard// project, right? I heard you were running behind schedule. Is it really that bad?" He plopped down into the second operator's chair.

"Not really. I just can't get it up to speed, not with the requested cargo load. And those weapon requirements are next to impossible to meet! I just don't know what to try next."

"Lemme see that." Streven's fingers flew over the keyboard. The schematic exploded, revealing inner components and intertconnected mechanisms. He frowned, made a gesture above the sensor pad to rotate the display, and frowned again. When he finally spoke, his voice was pensive.

"Why did you put four different cargo bays? It's a waste of space, plus, you've got four doors to armor instead of just one."

"I thought it would increase the vehicle's survivability..." Natalya looked perplexed.

"That's the correct reasoning for a cargo landship, not a troop transport. With a vehicle that size, any hit on the bay will probably destroy it piecemeal anyway. Group them together and increase the armor. You could also keep the armor as is and use the space liberated to install a bigger powerplant..."

"...Which would solve my speed problem." She stared at the display, then nodded her head. "Of all the... How could I miss that?" She started gathering her things. "Maybe I just have to go home and get some shut-eye."

"I'll close up, you go and rest. You've earned it." She started to protest, but he dismissed it with a wave of the hand. "Really, it's no problem. My bedtime is way past due and I don't usually need much sleep anyway." He winked.

"Okay. Good night, then." She gave him her best smile and left.

Quite a nice girl, thought Streven. Perhaps he should have considered asking her out. Unfortunately, after tonight it would be next to impossible. Reaching down, he carefully extracted the micro-disk from the hidden sole compartment of his left boot, then placed it in the downloading slot. Streven sighed and started copying the project's files.

Bryce Hubbard (order #959915)

6.1 - Designing Vehicles in Heavy Gear

This chapter covers the generation process for the statistics of the vehicles used in the game. It is not necessary to go through the construction system to play; there are hundreds of pregenerated vehicles available in the various **Heavy Gear** books. But to many, designing new vehicles and testing them is definitely an enjoyable part of the game.

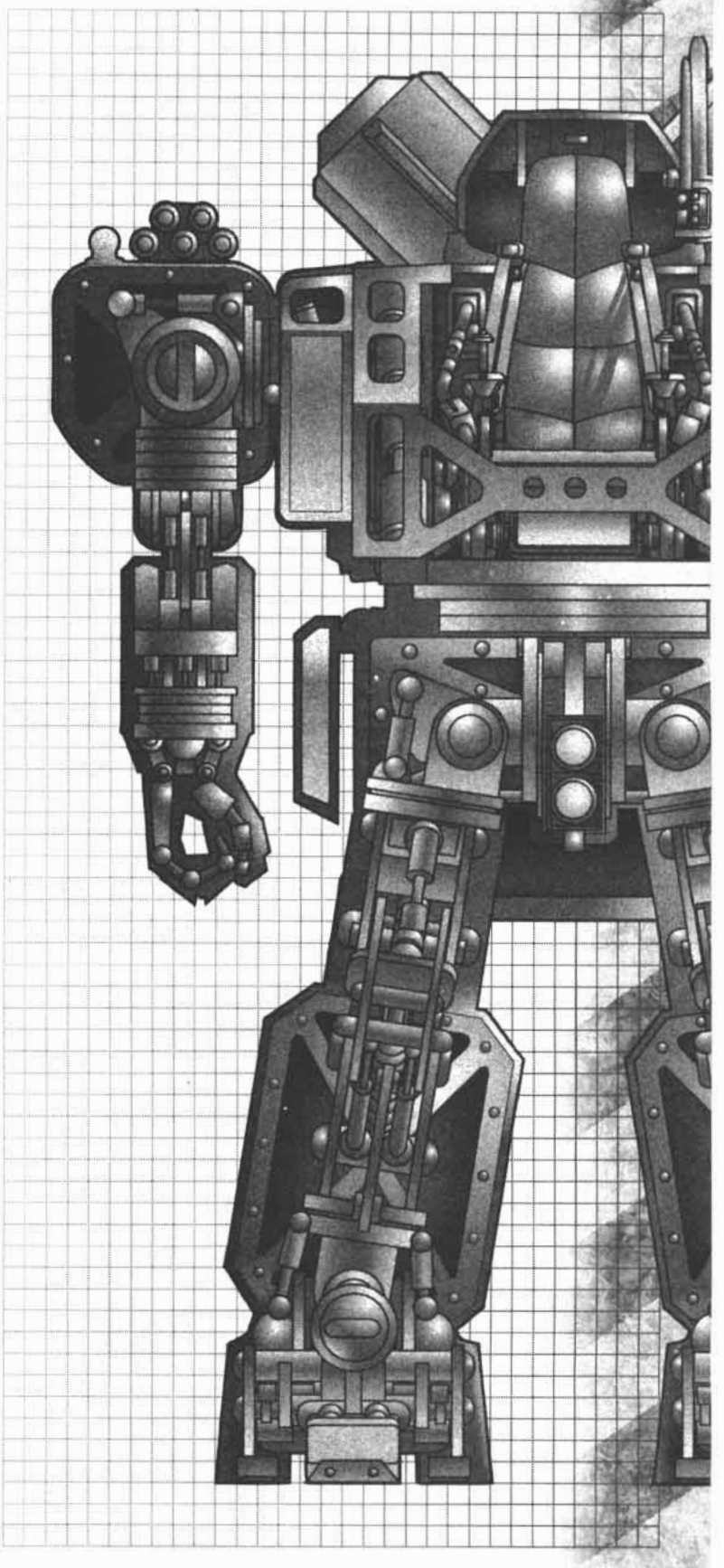
The Silhouette vehicle construction system (sometimes refered to as VCS) is quite liberal compared to the ones found in many other games. It is meant to provide interesting, "real" vehicle designs instead of just mere sets of game statistics pulled out of charts and complex formulas. It is based on the concept that, given a certain technological level, one can design a vehicle to almost any specification. There are no artificial space or weight limits placed on the components: if the vehicle *must* have a certain piece of equipment, the engineers will find a way to make it fit — even if they have to drill a hole through the hood to let that turbocharger through, or use that costly new ultra-light material just developed by the research lab on the moon.

However, while it is *theoretically* possible to build a tank that will sport heavy armor and weapons while still performing like a race car, there is a catch: the cost. That one tank will probably cost more — in resources, time and money — than an entire brigade of more regular tanks, and since it is so complex, it will probably be riddled with unavoidable defects (see *Lemon Rolls*, page 135). What's more, it probably be far too advanced for the **Heavy Gear** game world. Guidelines and technological limits are included and must be followed to prevent abuses of the sort, but one could still build monsters if left unchecked... Technical limitations should be respected.

Since this system was created to handle any vehicle type, it is non-linear in nature and does involves some calculations. These have been broken down in several easily manageable formulas for ease of play and reference, so they should not prove to be a problem. The trick here is not to let oneself be turned off by the few calculations necessary (see the *Roots and Exponents* sidebar). It is assumed that the reader has already read the basic and tactical rules set out in the main rulebook, and is reasonably familiar with them. In any case, all relevant game terms are fully defined in the Glossary (page 184).

Sharp-eyed players will notice that no limits have been placed on the number of weapons and equipment carried by a vehicle. This is intentional and is meant to simplify the game and the construction system. So what is preventing engineers from mounting twelve heavy autocannons on a single Gear? Nothing, except basic common sense. After all, the Gear would need a *huge* engine to move it (possible, but very costly) and the autocannons would have to be special recoilless ultra-light models (which means higher costs — if the technology is available at all). Anyway, the pilot could use no more than one or two autocannons, unless he is willing to take a -12 penalty to all his actions, or link them all and take his chance on missing with half of them. And just watch that Offensive Threat Value skyrocket...

Remember, nothing in life is free. Not even payload.



Bryce Hubbard (order #959915)

◆ Roots And Exponents

Although Silhouette is a fairly simple rules system, some math was bound to creep its way in. Roots and exponents, for example, were needed because of the non-linear nature of the construction system. Fortunately, most calculators have both the root and exponent functions, or at the very least the exponent function (refer to the calculator's manual if needed). If the calculator used is of the latter type, roots are still possible. Just invert the exponent (see examples below). The following format is used throughout: Squares are exponent 2, and Cubes are exponent 3. Higher levels of exponents are not used.

EXPONENT OF NUMBER = NUMBER ^{EXPONENT}:

square of 2 = 2^2 = 2 x 2 = 4

cube of 2 = 2^3 = 2 x 2 x 2 = 8

ROOT OF NUMBER = NUMBER$^{(1/ROOT\ NEEDED)}$:

square root of 16 = $16^{(1/2)}$ = 4

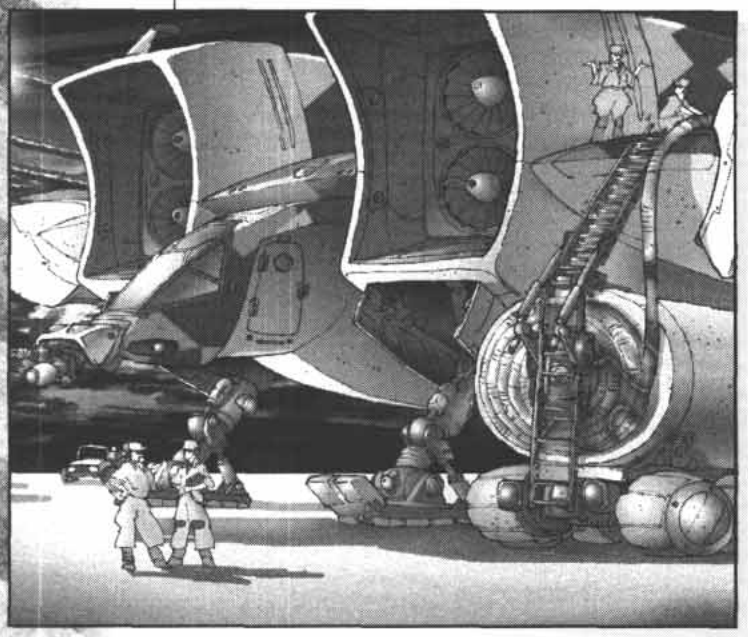
cube root of 8 = $8^{(1/3)}$ = 2

6.1.1 - The Basic Vehicle Concept

This is the first step in designing a vehicle, although it is not part of the construction process per se. The Player must answer a series of questions. What type of vehicle is it? What is its task? What does it look like? How does it move? What kind of armament would it carry, if any?

Next, the Player should jot down some statistics on paper (Size, speed, weapons, special systems, etc). Now, would a Scout Gear really be carrying a tank gun, or a tank really move at 200 kph on broken ground? Remember that the costs can increase exponentially, so make sure to use only what's really needed.

Compare the stat values to those provided for real vehicles. This is called the "reality test". It is important that the new creation remains within believable technological limits. Once this is done, the next step is to calculate the basic statistics.



◆ Target Size

It is a good idea to choose a reasonable Size value for the vehicle. Size is related to both weight and volume, in that it determines the actual weight of the vehicle, the amount of damage it will cause in the event of a collision, and the number of hexes it occupies on the tactical map. Some vehicles occupy more space than their Size would indicate — lighter-than-air craft, for example. This will be detailed further on.

Vehicles are assumed to occupy a basic volume (in cubic meters) equal to (Size/2 +1) cubed, rounded up. This includes access and maintenance space around it and within the hull. Knowing the volume is *not* required for the design process but is useful when doing "reality checking."

DETERMINING SIZE:

Maximum Mass = ((Size + 0.5) x 3) cubed

Size = ((cube root Maximum Mass)/3) - 0.5

The maximum mass for all Size categories is in kilograms (divide by 1000 to get metric tons). The mass is rounded up for all Sizes for simplicity. A pre-generated Size to Mass Table is available on page 102.

6.1.2 - Crew

How many individuals are required to operate the vehicle? Large crews improve a vehicle's combat efficiency, but they also increase expense and vehicle Size. Large vehicles often need sizable crews while small vehicles cannot cram many people inside. Don't forget that human crew can be replaced by automated systems (see *Perks and Flaws*, page 112).

Theoretically, the designer could maximize a vehicle's performance by allotting it an unusually large crew. A crew member, however, occupies almost two cubic meters of space (with seat, instruments and egress/ingress space) — sixteen people will not fit comfortably in a sub-compact car!

What's more, a good crew is expensive. Training and paying each crewman costs hundreds of thousands of marks or dinars. In fact, the crew is often worth more money than the vehicle, so most designers will put only the minimum amount of crew required for the job. In general, the minimum number of crew per ten Size points (or part thereof) is one.

Most combat vehicles have more than one crewmember to handle all the systems, with the exception of the Gears. In fact, the main distinction between striders and Gears is that the latter have only one crew; if a walker vehicle has two or more crew, then it is a strider.

◩ Design Example

Kurt is designing a mass-produced, soldier Gear to form the basis of his armed forces. Since all Gears are single-man vehicles, Kurt writes down "Crew: 1". The pilot will be sitting in the chest of the machine, using standard Gear controls. Kurt considers adding some automated systems to decrease the pilot's workload, but decides against it to keep costs down.

Bryce Hubbard (order #959915)

6.1.3 - Movement Systems

Movement types define how a vehicle moves along. Each movement type confers some advantages and some disadvantages, depending on the environment where the vehicle operates. Some are more versatile than others.

A vehicle may have more than one movement type. Common examples of this are fully amphibious vehicles (Ground and Naval), Gears with SMS (Walker and Ground), or any combination thereof. Although there is no limit to the number of movement types a vehicle may use, few have more than one or two — the cost simply outstrips the added flexibility. Having more than one movement type does not represent an actual transformation; all movement types are available at all times.

◆ Flight:

This movement type is used by all flight-capable vehicles. This includes aircraft of all types, helicopters and vectored thrust vehicles. Each aircraft's peculiar flight characteristics are provided by suitable Perks and Flaws (see *Perks and Flaws*, page 112).

◆ Ground:

Any wheeled or tracked vehicle. Wheeled vehicles are assumed to be equipped with large wheels and strong suspension for rough terrain and thus are grouped with tracked vehicles in the Ground movement type for simplicity. Ordinary wheeled vehicles such as city cars have the Poor Off-Road Capacity Flaw to represent the low clearance of their drive system (see *Flaws*, page 128).

◆ Hover:

This movement type is used by all vehicles which travel above but near the ground, such as ground-effect hover craft and other air-cushion vehicles. Ground-effect systems only work within an atmosphere; they are useless in vacuum.

◆ Naval:

Any conventional water vessels and hydrofoils, or anything that can float. This only makes the vehicle's hull water-tight, however: it is still susceptible to flooding and capsizing if swamped or turned upside-down.

◆ Rail:

Any vehicle which uses a rail or guide of some kind to move about is part of this category. This includes classic steel railroad trains, MagLevs, monorails and many others. These vehicles can only move along a rail line, and the rail(s) must be of the same type as the one the movement system was designed for.

◆ Space:

A vehicle equipped with reaction thrusters uses this movement system. This movement type does not confer the ability to perform standard atmospheric flight or reentry — these must be purchased separately.

◆ Submarine:

This movement type covers underwater craft of all sorts, which are fully watertight. Most Submarine vehicles also have the Naval movement type, but it is not required (some submarine vehicles fare very poorly on the surface).

◆ Walker:

This represents a multi-legged walking vehicle. The exact number of legs present is totally up to the designer and has no bearing on either speed and toughness, which are determined separately (see *Speed* below, and *Perks and Flaws*, page 112).

◆ Speed

A Top Speed, measured in kilometers per hour, must be selected for each individual movement type. Each Top Speed is divided by six (6) to get the Top Speed in Movement Points (MPs), rounding to the nearest whole number. The Top Speed MP value is divided in half to obtain the Combat Speed MP value for each movement type, rounding up.

Movement Point Formulas:

MPs (50 meters hex) x 6 = speed in kilometer per hour
Speed in kilometer per hour/6 = MPs (50 meters hex)

A vehicle's intended purpose often influences its speed. The Speed Table below lists some good movement speed values for most types of vehicles. These values should be the maximum speed possible for new designs. This is primarily a game balance tool for tactical combat — special vehicle designs can exceed them in a roleplaying setting, with the approval of the Gamemaster. The speed values below are assumed to be under optimum conditions (flat, clear ground/water).

Speed Table

Walker	
Sizes 1-7	72 kph/12 MP
Size 8+	48 kph/8 MP
Ground	
Walker's Secondary Mov.	90 kph / 15 MP
Sizes 1-5	240 kph/40 MP
Sizes 6-8	180 kph/30 MP
Size 8+	144 kph/24 MP
Hover	
Sizes 1-3	240 kph/40 MP
Sizes 4-5	210 kph/35 MP
Size 6+	180 kph/30 MP
Naval	
Hull	90 kph/15 MP
Hydrofoil	180 kph/30 MP
Submarine	
Sizes 1-3	120 kph/20 MP
Sizes 4+	90 kph/15 MP

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◆ Special Case: Flight

The Flight movement mode includes all manner of flying machines, excluding hover-based movement. The movement mode does not discriminate between fixed and rotary wing crafts. There is, however, a fundamental difference between VTOL (vertical takeoff and landing) crafts and other types of aircraft: the Stall Speed.

All vehicles with the Flight movement mode are given a Stall Speed. This indicates the minimum possible speed at which the aircraft can travel before stalling and falling out of the sky. A VTOL craft has a Stall Speed of 0, which means it can actually hover in place.

Most non-VTOL aircraft have a secondary movement type (usually Ground) to taxi around the runway, though it does not necessarily have to be motorized. In such case, the second system's speed is 0, and its MPs come from the Flight MPs. Many aircraft with Ground speeds have the Reduced Maneuverability Flaw. VTOL crafts rarely have a secondary movement type, as they often do not need to taxi.

Air Combat MPs represent about 30 kilometers per hour each, instead of 6 kph for vehicles in the basic tactical game.

◆ Special Case: Space

The Space movement mode includes all manner of thrust-based movement. As usual, precise description of how the vehicle functions is left to the designer. Space Combat MPs represent acceleration rather than speed: about 1 m/s² each (0.1 g), instead of the 6 kph for vehicles in the basic tactical game. Note that fractional MPs are allowed for vehicles with very low acceleration (solar sails, ion drives).

◆ Designer's Hint: Movement

The Silhouette vehicle construction system does not require the designer to buy a powerplant. It is assumed that the engineers in charge of the project know their job and will select an efficient engine that fits the chassis for the desired movement systems and speeds. If they don't... well, that's what Lemon Rolls are for (see page 135). It is always nice, but not required, to know exactly how the vehicle is powered, if only to give the game additional atmosphere.

Vehicles with multiple movement modes are rarely as fast as those with only one. If the design incorporates two or more, it would be wise to drop a Movement Point or two.

Design Example

Kurt wants his Gear to have both the Walker and Ground movement types. He wants a walking Top Speed of 42 kph (divided by 6, giving 7 MP) and a rolling Top Speed of 72 kph (divided by 6, giving 12 MP). This means that his Gear will have the following Combat Speeds: 21 kph walking (4 MP) and 36 kph rolling (6 MP).

Kurt writes down "Combat Speed: Walking 4 MP (21 kph)/ Ground 6 MP (42 kph)" on one line and "Top Speed: Walking 7 MP (42 kph)/Ground 12 MP (72 kph)" on the next line of his worksheet.

6.1.4 - Maneuver

Assign the vehicle a Maneuver Rating. This is how maneuverable and responsive the vehicle is. The Maneuver Rating also indicates how the craft reacts to its pilot; two otherwise similar vehicles can have different Maneuver Rating is they handle differently under the same conditions.

Zero is a generic "average" Rating for Gears, but more often than not, other vehicles are assigned lower values. Positive values denote nimbleness while negative values indicate a slower reaction time or poor turn radius.

MOVEMENT TYPE MANEUVER RANGE

Movement Type	Typical Maneuver
Walker	+3 to -3
Ground	+2 to -3
Hover	0 to -4
Naval	-2 to -10
Flight	+2 to -5
Rail	-2 to -10
Space	0 to -10
Submarine	-2 to -10

DETAILED MANEUVER RATING LIST

Maneuver	Typical Vehicle
+3	Very advanced, top-of-the-line Gear prototype
+2	Nimble Scout Gear, Dirt Bike
+1	Nimble Gear, Motor Bike, Dirt Buggy
0	Gear, Nimble Car
-1	Assault Gear, Car, Nimble Hovercraft
-2	Nimble Walker, Car, Hovercraft
-3	Large Walker, Truck, Tug Boat
-4	Large Hovercraft, Large Truck
-5	Patrol Boat, Unloaded Train
-6	Small Naval Vessel or Landship
-8	Large Naval Vessel or Landship
-10	Supertanker, Space Station

◆ Designer's Hint: Maneuver

If the vehicle is exceptionally agile, +1 or maybe even +2 (in exceptional cases) may be added to the suggested value for that type of vehicle. If the vehicle is slow to respond, perhaps -1 or possibly -2 should be added to the suggested value.

The Maneuver Rating also partly represents the sophistication of the vehicle's controls. An agile vehicle that is next to impossible to control in battle will earn a low Maneuver Rating. By using this in conjunction with the correct Perks and Flaws, extra "personality" can be given to the vehicle.

Design Example

Kurt wants his Gear to have an average maneuverability, so he writes down "Maneuver: 0."

Bryce Hubbard (order #959915)

6.1.5 - Deployment Range

The Deployment Range of the vehicle is selected next. It should be a whole number — i.e, no decimals. This is the maximum distance (expressed in kilometers) the vehicle can cover without refueling or maintenance, barring combat damage and any crew needs such as food and rest. This generally has no direct influence in the tactical combat game, but is extremely important in a campaign. It can also be used to establish scenarios and can be referred to in extended campaigns.

Just how much endurance to give the vehicle will depend in large part on its nature and intended function. Combat vehicles often have somewhat inefficient engines that guzzle their fuel or electric charge in just a few hours. Most ground vehicles can cover somewhere between 200 and 800 km before needing to be refueled or otherwise serviced. Understandably, aircraft tend to have pretty large Deployment Ranges. Fixed-wing planes have more autonomy than rotary wing aircraft: averages for the former range from 800 to 5,000 km, while for the latter it rarely exceeds 1,000 km. High performance machines will only be able to cover small distances before refueling or servicing. Others will have large fuel tanks and/or rugged systems that allow them to travel further.

In short, the Deployment Range really depends on the individual machine, so no "standard" value is given. One must remember, though, that the Deployment Range is factored in the total cost. The "generic" cost-efficient value for all designs is 500 km, though small vehicles will probably have a lower range.

In the course of the game, some vehicles may idle for a long while, spending fuel and energy as they do so. Space vehicles obviously cover far larger distances and, thanks to inertia, may not even need to expend fuel to do so. To cover these two special cases, consider that each hour of operation is functionally equivalent to one kilometer of Deployment Range.

◆ Designer's Hint: Deployment Range

Military vehicles need to have enough fuel to reach their objective, perform their mission, and return. This means that their effective combat range is normally a bit less than half of their listed Deployment Range because the vehicle must conserve enough fuel to return from its mission and maintain an extra reserve to consume in case of emergencies or combat. This is normally referred to as "Bingo" fuel, the minimum reserve required to go home safely.

Scout vehicles need to operate for long distances without access to support units, and thus require a slightly above average range. Fire support and siege vehicles generally have poor Deployment Ranges since they have near constant access to fuel and service. Urban and civilian vehicles also tend to have poor Deployment Ranges (in the low hundreds), for the same reason.

Though Terranovan vehicles have rugged engines capable of guzzling down a large variety of fuel, the use of non-standard fuels may well diminish the performances of the unit, if not wreck it in the short term (see *Non-Standard Fuels*, page 153). If the designers give their creation a low DR, expecting them to "live off the land," so to speak, they should also be prepared for extra maintenance time.

◆ Reaction Mass

This step applies only to vehicles with the Space movement type. Some kind of reaction mass (or fuel, in the case of older chemical engines) must be provided in order to propel the vehicle forward. The Reaction Mass Rating shows how many Burn Points (BPs) of reaction mass may be carried internally (one BP produces one MP of thrust).

The weight of the reaction mass will be added to the final weight of the vehicle after the design is completed; the *Burn Points Per Ton* table is used to determine its weight. It is important to note that the acceleration of the spacecraft, as selected in the Movement section, already takes this extra weight into account so that the stats will not have to be recalculated.

Reaction Mass and Deployment Range are the twin factors that will determine the autonomy of a space vehicle. It is useless to carry more reaction mass than can be used in the vehicle's entire Deployment Range, though the reverse is possible (the vehicle can always coast partway to its destination).

If the vehicle is intended to have ground-to-orbit capacity, it must carry enough Reaction Mass to allow its thrusters to operate long enough to reach escape velocity. This will be covered in the **Tactical Space Support** sourcebook.

The amount of Burn Points per ton will depend on the type of reaction mass used. Fusion tubes are extremely efficient, while primitive fuel rockets will often carry many times their empty weight in fuel.

Burn Points Per Ton

RM Type	Weight Multiplier	Volume per Weight
Hydrogen	0.00001 x total BP	0.071 ton/m³
Helium-3	0.00002 x total BP	0.142 ton/m³
Water	0.0002 x total BP	1 ton/m³
High Efficiency Rocket Fuel	0.01 x total BP	2 ton/m³
Low Efficiency Rocket Fuel	0.05 x total BP	5 ton/m³

Multiply the above Weight Multiplier by the empty mass of the craft to know the mass of the reaction mass or fuel.

The Volume per Weight is given for transporting Reaction Mass as payload in a cargo bay.

Design Example

Kurt wants his Gear to have a good operating range for extended operations. He thinks 500 km is a good range and should cover most situations (modern tanks can generally cover between 300 to 600 km), so he writes down "Deployment Range: 500 km" on his work sheet.

Bryce Hubbard (order #959915)

6.1.6 - Armor

Choose the Armor Rating for the vehicle. Even if the vehicle is not armor-plated, it still has an Armor Rating. This represents the mass of the vehicle stopping the damage. This Rating defines how resistant the vehicle will be to acident and weapon fire. No vehicle can have an Armor Rating below 1.

Just like weapon Damage Multipliers, armor value progression is not linear, that is, Armor 10 is not just twice as strong as Armor 5, it is *four* times as strong. The Armor Rating does not only represent the thickness and angle of the armor plating, but also the general resistance of every component in the vehicle averaged together. In fact, the Armor Value represents the best defense the vehicle can offer against an attack.

For the military enthusiasts, the Armor Rating of a vehicle is related, as per the following *Armor Thickness Comparison* formula, to a *very* approximate real world armor equivalence in millimeters of armor-grade rolled steel. By the way, most late twentieth century tanks have Armor Ratings between 14 and 25 (between 200 to 600 mm equivalence).

ARMOR THICKNESS COMPARISON

Base Armor Rating = Square Root (mm of armor grade steel)

The number of damage points required to produce Light Damage, Heavy Damage and Overkill results are equal to once, twice and three times the Base Armor Rating, respectively.

Typical Armor Ratings

Civilian Vehicle	1 to 8
Utility Vehicle	3 to 8
Heavy Gear	10 to 20
Armored Personnel Carrier	10 to 20
Large Walker	15 to 30
Tank	20 to 40
Typical Car	4
Typical 6-wheel Truck	6
T-72 Tank (20th Century)	16
Challenger Tank (20th Century)	22
M1A1DU Tank (20th Century)	25
Battleship Hull (20th Century)	50 to 150

Designer's Hint: Armor

A good rule of thumb for choosing a vehicle's Armor Rating: unarmored or slightly armored vehicles have Armor Ratings roughly equal to their Size Rating to represent their structural strength. Lightly armored vehicles have Armor equal to roughly twice their Size. Moderately armored vehicles have Armor equal to about two and half times their Size. Heavily armored vehicles have Armor equal to roughly three times their Size. Anything with an Armor Rating greater than three times its Size is either incredibly slow or completely unrealistic.

Due to the severe weight restrictions required by the mechanics of flight, aircraft rarely have an Armor Rating that is more than twice their actual Size. For military craft, the Armor Rating is usually just under that limit.

Design Example

Kurt wants his Gear to have armor that is comparable to a 20th century T-72 tank. After a bit of reflection, he decides to make his Gear's armor just a bit weaker than that of the T-72, if ony to save a bit on the point value. Noting that the T-72 has a base Armor Rating of 16, Kurt writes down "Base Armor Rating: 15" (or about the equivalent of 225mm of steel plate).

6.1.7 - Weapons

Choose the weapons that the vehicle will be armed with, if any. Also, choose the arc of fire of each weapon. The following table is an abbreviated version of the vehicular weapon section. For more detail about the different weapon systems, the reader is invited to refer to the *Weapon Tables* section (page 76).

Weapon descriptions are intentionally left vague. Only the actual game effects (as identified by the weapon's code, such as LAC, LRP/24, and so on) are rigidly defined. It is up to the designer to assign both name and form to his vehicle's armament. The actual location of the weapons has no bearing on the game mechanics, but is nice to know — again, designer's choice.

Ammunition must be purchased for each weapon. The Maximum Ammunition Load table (shown on the lower next page) show how many shots can be carried for each weapon by cross-referencing the Min. Size with the difference between it and the vehicle's planned final Size. This is only the maximum value — the actual amount of ammunition carried can be lower than this.

For example, an average Gear (Size 6) cannot carry more than 160 shots for its light autocannon (Min. Size 4, +2 difference with Size). Transporting a lot of ammunition for a given weapon system makes it bigger and heavier, effectively raising the Size required to carry it.

Handheld Weaponry Option

If Manipulator Arms are present on the vehicle, any of its weapons can be designed as "hand-held" in a rifle-like mount. Rifles are somewhat more fragile, since they depend on the arm carrying them, but they are also more flexible tactically.

Weapons in rifle form use the arm's Size Rating for Minimum Size determination. Each arm can handle up to one and a half (rounded down) its Size Rating in weapons. For example, a Rating 6 arm can bear a LAC and a LGL (4 + 4 is lower than 1.5 x 6), but not two HACs (2 x 5 is higher than 1.5 x 6). Multiple arms can be used to carry oversized rifles.

Rifles can be picked up or put away at the cost of one action, as long as the manipulator is still functional. It costs no action to drop a rifle. If the Manipulator Arm is destroyed, or if the rifle is dropped, the rifle can be picked up by another Manipulator-equipped unit that has a free hand. Hand-held weapons are affected by any damage suffered by the arm.

Bryce Hubbard (order #959915)

◆ Designer's Hints: Weapons

Vehicles should have a weapon complement that reflects their mission. Fire support models have weapons capable of guided attacks or area saturation. Scouts carry light weapon loads because they are supposed to avoid combat. General purpose combat vehicles carry an assortment of medium-strength weapons to deal with a variety of situations.

Loading down a vehicle with tons of weapons just for the sake of having more is not only pointless, but wasteful. Most vehicle crews are only capable of firing one or two weapons per combat round without incurring penalties. Linking two or more weapons provides a solution, but tends to be costly in ammunition if the gunner misses.

Choosing a balanced amount of ammo for each weapon is also very important. Vehicles often get disabled in battle; when that happens, all the points spent on extra ammo and guns are wasted. Better to assign a reasonable ammunition load and buy more vehicles than build a single gun-bristling monster that can be disabled by one lucky hit.

A good indicator of the number of weapons that can be carried by a vehicle is its Size Rating. While it is not a hard limit, if there are more weapon systems than Size points, the design is probably overarmed. Another suggested control method would be to say that a vehicle can carry one weapon of its own Size, then (Size - Min. Size)^2 for lesser weaponry. For example, a Size 12 vehicle could carry two Min. Size 11 weapons, or thirty-six Min. Size 6 weapons.

◩ Design Example

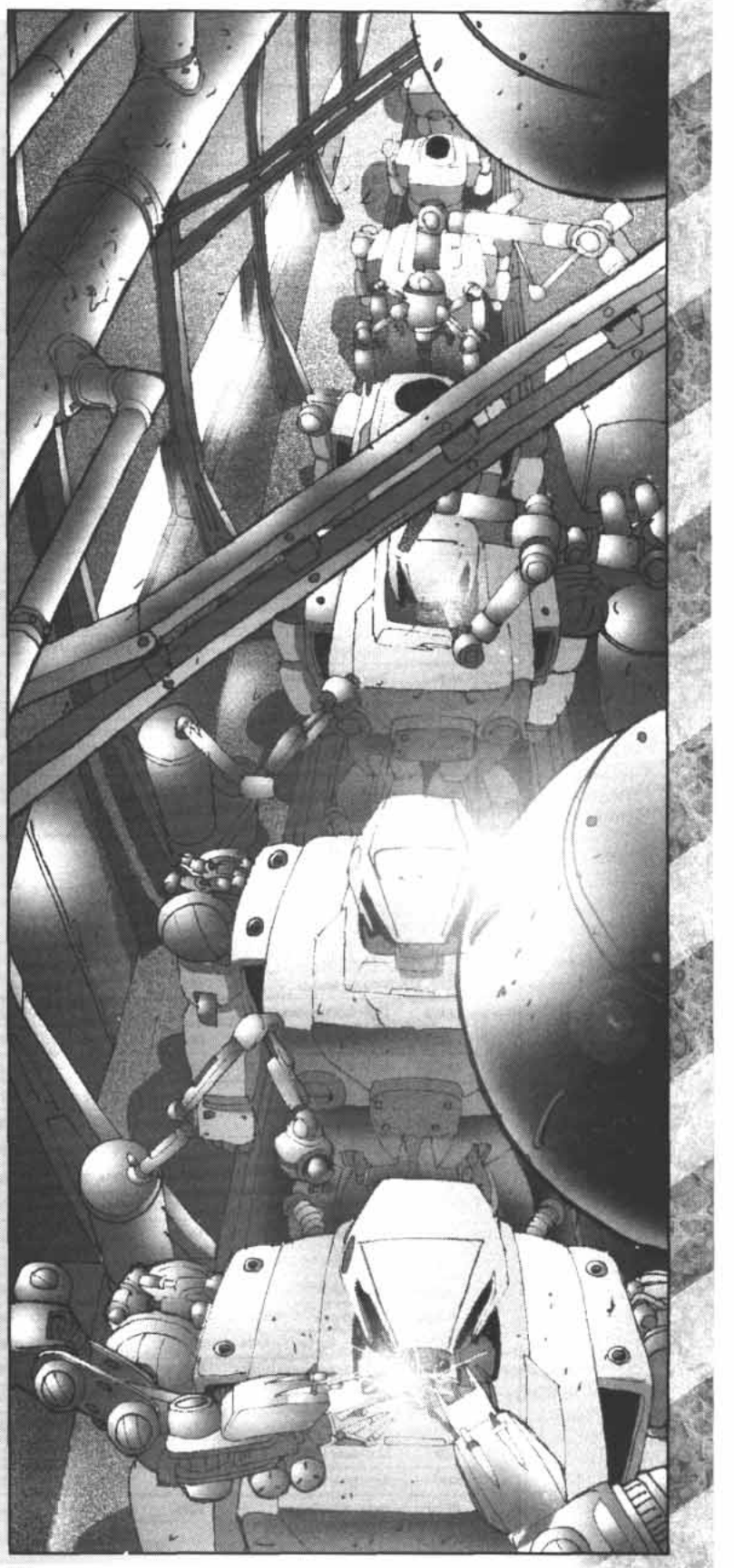
Kurt chooses his Gear's weapons: a hand-held 25mm Riley M222 light autocannon (LAC), a shoulder-mounted 52mm RP-109 "Pepperbox" rocket pack (LRP/24), and a 44mm Mk IV grenade launcher (APGL) for anti-personnel work. Three hand grenades (HG) and a vibroknife (VB), both hip-mounted, complete the armament.

He notes all of these weapons down, along with their cost. He also adds a few extra ammo packs, just in case.

◫ Maximum Ammunition Load Table

Increase in Weapon's Minimum Size* Weapon's Base						
Min. Size	0	+1	+2	+3	+4	+5
1	625	2500	10,000	40,000	160,000	640,000
2	80	320	1280	5120	20,480	81,920
3	25	100	400	1600	6400	25,600
4	10	40	160	640	2560	10,240
5	5	20	80	320	1280	5120
6	3	12	48	192	768	3072
7	2	8	32	128	512	2048
8 to 9	1	4	16	64	256	1024
10 to 19	1	3	9	27	81	243
20+	1	2	4	8	16	32

*The Increase in Weapon's Minimum Size is the difference between the weapon's Min Size and the vehicle's final Size.



Bryce Hubbard (order #959915)

6.2 - WEAPONS TABLE

Cannons

Code	Name	Rating	Range	Dam.	Acc.	RoF	Ammo (ea.)	Min. Size	Special
VLMG	Very Light Machinegun	25	1/2/4/8	x2	0	+3	0.02	2	Anti-Inf.
LMG	Light Machine Gun	52	1/2/4/8	x3	0	+4	0.05	3	Anti-Inf.
HMG	Heavy Machine Gun	59	1/2/4/8	x4	0	+3	0.09	3	Anti-Inf.
FGC	Frag. Cannon	195	1/2/4/8	x7	+1	0	0.75	5	Anti-Inf., Frag Ammo
VLRF	Very Light Rifle	44	2/4/8/16	x6	0	0	0.18	3	-
LRF	Light Rifle	92	3/6/12/24	x8	0	0	0.36	4	-
MRF	Medium Rifle	165	4/8/16/32	x10	0	0	0.66	4	-
HRF	Heavy Rifle	209	4/8/16/32	x12	0	0	0.85	5	-
DPG	Deployable Pack Gun	58	2/4/8/16	x8	-1	+2	0.15	3	Disposable
LAAC	Light Anti-Air. Cannon	121	2/4/8/16	x8	0	+6	0.28	4	-
MAAC	Medium Anti-Air. Cannon	176	3/6/12/24	x10	0	+4	0.51	4	-
HAAC	Heavy Anti-Air. Cannon	230	3/6/12/24	x12	0	+3	0.68	5	-
VLAC	Very Light Autocannon	69	2/4/8/16	x6	0	+2	0.18	3	-
LAC	Light Autocannon	108	2/4/8/16	x8	0	+2	0.28	4	-
MAC	Medium Autocannon	163	3/6/12/24	x10	0	+1	0.51	4	-
HAC	Heavy Autocannon	220	3/6/12/24	x12	0	+1	0.68	5	-
VHAC	Very Hvy Autocannon	324	3/6/12/24	x15	0	+1	1.01	5	-
LAG	Light Artillery Gun	1107	25/50/100/200	x12	-2	+1	4.4	8	Ind. Fire, AE=0, Min. Range 10
VLFG	Very Lt Field Gun	525	5/10/20/40	x20	-1	0	2.10	6	Indirect Fire
LFG	Light Field Gun	915	5/10/20/40	x22	0	0	3.65	8	Indirect Fire
HFG	Heavy Field Gun	1945	8/16/32/64	x28	0	0	7.78	10	Indirect Fire
VHFG	Very Hvy Field Gun	3134	10/20/40/80	x33	0	0	12.54	12	Indirect Fire
SC	Snub Cannon	524	1/2/4/8	x28	-1	0	2.10	6	-

Rockets & Missiles

Code	Name	Rating	Range	Dam.	Acc.	RoF	Ammo (ea.)	Min. Size	Special
VLRP/8	Very Lt. Rocket Pack/8	114	1/2/4/8	x8	-1	+3	0.26	3	Indirect Fire
VLRP/32	Very Lt. Rocket Pack/32	129	1/2/4/8	x8	-1	+4	0.26	3	Indirect Fire
VLRP/128	Very Lt. Rocket Pack/128	165	1/2/4/8	x8	-1	+6	0.26	3	Indirect Fire
LRP/8	Light Rocket Pack/8	194	1/2/4/8	x12	-1	+1	0.58	3	Indirect Fire
LRP/16	Light Rocket Pack/16	209	1/2/4/8	x12	-1	+2	0.58	3	Indirect Fire
LRP/24	Light Rocket Pack/24	226	1/2/4/8	x12	-1	+3	0.58	3	Indirect Fire
LRP/32	Light Rocket Pack/32	245	1/2/4/8	x12	-1	+4	0.58	3	Indirect Fire
MRP/9	Med. Rocket Pack/9	425	2/4/8/16	x18	-1	+1	1.33	4	Indirect Fire
MRP/18	Med. Rocket Pack/18	469	2/4/8/16	x18	-1	+3	1.33	4	Indirect Fire
MRP/36	Med. Rocket Pack/36	494	2/4/8/16	x18	-1	+4	1.33	4	Indirect Fire
IRP/10	Inc. Rocket Pack/10	339	1/2/4/8	x13	-1	+1	1.02	4	Ind. Fire, Slow Burn Inc.
IRP/20	Inc. Rocket Pack/20	363	1/2/4/8	x13	-1	+2	1.02	4	Ind. Fire, Slow Burn Inc.
IRP/30	Inc. Rocket Pack/30	390	1/2/4/8	x13	-1	+3	1.02	4	Ind. Fire, Slow Burn Inc.
HRP/24	Heavy Rocket Pack/24	596	3/6/12/24	x20	-1	+3	1.71	5	Indirect Fire
HRP/48	Heavy Rocket Pack/48	623	3/6/12/24	x20	-1	+4	1.71	5	Indirect Fire
HIRP/24	Hvy Inc. Rocket Pack/24	606	3/6/12/24	x16	-1	+3	1.70	5	Ind. Fire, Slow Burn Inc.
HIRP/48	Hvy Inc. Rocket Pack/48	641	3/6/12/24	x16	-1	+4	1.70	5	Ind. Fire, Slow Burn Inc.
AAM	Anti-Aircraft Missile	2066	8/16/32/64	x10	+1	0	8.30	7	Guided, Min. Range 10
ABM	Airburst Missile	508	3/6/12/24	x10	0	0	2.00	6	AE=1
AGM	Anti-Gear Missile	756	3/6/12/24	x15	+1	0	15.12	4	Guided,Indirect Fire
ATM	Anti-Tank Missile	1956	3/6/12/24	x25	+1	0	39.12	6	Guided, Indirect Fire
HATM	Heavy AT Missile	3075	5/10/20/40	x30	+1	0	61.50	9	Guided, Indirect Fire

Bryce Hubbard (order #959915)

Recoilless Weapons

Code	Name	Rating	Range	Dam.	Acc.	RoF	Ammo (ea.)	Min. Size	Special
LPZ	Light Panzerfaust	14	1/2/4/8	x10	-1	0	-	2	Disposable
MPZ	Medium Panzerfaust	30	1/2/4/8	x15	-1	0	-	2	Disposable
HPZ	Heavy Panzerfaust	55	2/4/8/16	x20	-1	0	-	3	Disposable
RFB	Rapid-Fire Bazooka	278	1/2/4/8	x14	0	+2	0.79	4	-
LBZK	Light Bazooka	234	2/4/8/16	x15	0	0	0.93	4	-
MBZK	Medium Bazooka	409	2/4/8/16	x20	0	0	1.63	4	-
HBZK	Heavy Bazooka	634	2/4/8/16	x25	0	0	2.53	5	-

Support Weapons

Code	Name	Rating	Range	Dam.	Acc.	RoF	Ammo (ea.)	Min. Size	Special
LFL	Light Flamer	14	0/0/0/0	x5	+1	0	0.06	2	Slow Burn
MFL	Med Flamer	68	0/0/0/1	x7	+1	+1	0.17	2	Slow Burn, Indirect Fire
HFL	Heavy Flamer	134	0/0/1/2	x9	+1	+2	0.27	3	Slow Burn, Ind. Fire
APM	Anti-Personnel Mortar	95	2/4/8/16	x4	0	0	0.36	3	Anti-Inf., Ind. Fire, AE=0, Min Rg 2
LGM	Light Guided Mortar	304	3/6/12/24	x15	-1	0	6.05	4	Guided, Ind. Fire, Min Range 3
HGM	Heavy Guided Mortar	632	5/10/20/40	x20	-1	0	12.60	5	Guided, Ind. Fire, Min Range 5
LFM	Lt. Field Mortar	522	4/8/16/32	x15	-1	0	2.09	5	Indirect Fire, AE=0, Min Rg 4
MFM	Med. Field Mortar	947	5/10/20/40	x20	-1	0	3.79	6	Indirect Fire, AE=0, Min Rg 5
HFM	Hvy Field Mortar	1516	6/12/24/48	x25	-1	0	6.06	7	Indirect Fire, AE=0, Min Rg 6
APGL	Anti-Personnel G.L.	29	1/2/4/8	x3	-1	0	0.10	2	Anti-Inf., Indirect Fire, AE=0
LGL	Light G.L.	316	1/2/4/8	x15	-1	+2	0.90	4	Indirect Fire
HGL	Heavy G.L.	529	2/4/8/16	x20	-1	+1	1.63	5	Indirect Fire

Advanced Weapons

Code	Name	Rating	Range	Dam.	Acc.	RoF	Ammo (ea.)	Min. Size	Special
LPA	Light Particle Acc.	270	2/4/8/16	x10	+1	0	1.07	6	-1 Dam. per R.B., Haywire
HPA	Heavy Particle Acc.	672	3/6/12/24	x15	+1	0	2.68	8	-1 Dam. per R.B., Haywire
LRG	Light Railgun	603	5/10/20/40	x14	0	+2	1.93	7	-
HRG	Heavy Railgun	3339	10/20/40/80	x35	0	0	13.35	12	-
SLC	Sniper Laser Cannon	371	5/10/20/40	x12	+1	0	1.48	4	-1 Dam. per R.B.
HGLC	Gatling Laser	350	2/4/8/16	x16	+1	+1	1.06	4	-3 Dam. per R.B.
LLC	Light Laser Cannon	483	5/10/20/40	x16	+1	0	1.93	5	-2 Dam. per R.B.
HLC	Heavy Laser Cannon	623	5/10/20/40	x20	+1	0	2.48	5	-3 Dam. per R.B.
LPLC	Lt Pulse Laser Cannon	474	3/6/12/24	x20	+1	0	1.90	5	-3 Dam. per R.B.
HPLC	Hvy Pulse Laser Cannon	642	3/6/12/24	x24	+1	0	2.57	5	-4 Dam. per R.B.

Close Combat

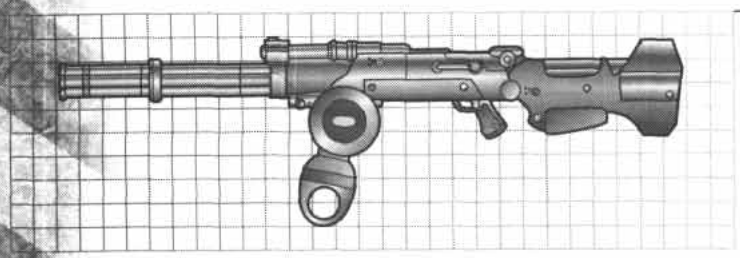
Code	Name	Rating	Range	Dam.	Acc.	RoF	Ammo (ea.)	Min. Size	Special
CR	Chassis Reinfor.	Veh. Size	0/0/0/0	+1 Dam.	0	0	n/a	n/a	Physical Attack Only
MF	Mauler Fist	61	0/0/0/0	x9	+1	0	n/a	3	Armor Crushing
HWP	Haywire Whip	110	0/0/0/0	x7	+1	0	0.44	4	Entangle, Haywire
CS	Chain Sword	20	0/0/0/0	X9	0	0	n/a	3	-
VB	Vibroblade	16	0/0/0/0	x8	0	0	n/a	3	Physical Attack Only
VR	Vibrorapier	27	0/0/0/0	x6	+1	0	n/a	3	Armor Piercing
VA	Vibroax	34	0/0/0/0	x10	-1	0	n/a	3	Armor Crushing
SKG	Spike Gun	38	0/0/0/0	x12	-1	0	0.15	3	-
HSKG	Heavy Spike Gun	66	0/0/0/0	x14	-1	0	0.27	4	Armor Piercing
HWG	Haywire Grenade	10	0/0/0/0	x10	-1	0	n/a	2	Haywire
HG	Hand Grenade (1)		0/0/0/0	x15	-1	0	11	2	Anti-Infantry
HHG	Heavy Grenade	21	0/0/0/0	x25	-1	0	n/a	2	-
SDG	Self-Destruct Grenade	60	0/0/0/0	x30	-1	0	n/a	2	AE=0

Bryce Hubbard (order #959915)

Cannons

Cannons include any weapon that can accelerate one or more projectiles using a chemical explosion. Various types of cannons are the basic weapon type used by armored vehicles on Terra Nova. The high caliber fully automatic autocannon class of weapons is featured on almost every military Gear on the planet, while single-shot rifles and anti-infantry machineguns are mainstays of tanks and striders. Regardless of their application, they are all rugged, adaptable and effective, which is why they are very popular. They are also easy to maintain and the ammunition can be readily manufactured with minimal facilities, unlike complex guided missiles or capacitor banks.

Cannons can take a variety of forms, from single barrelled guns to rotating multi-barrelled "gatling"-type weapons. Most modern cannons include an autoloader and/or a belt-feeder mechanism, or are clip-fed for easy reloading. Advanced heat-resistant alloys make them less dependent on cooling systems than was previously the case, permitting greater rates of fire. The Riley M222 autocannon is undoubtedly the most popular cannon in the North.

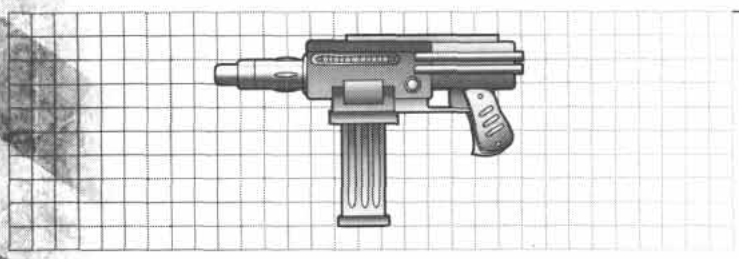


Very Light Machinegun

Purpose:	Anti-Infantry
Effective Range:	400 m
Penetration:	5 mm
Accuracy:	Average
Mode of Fire:	burst
Usual Ammo Load:	1000-5000 bullets

The Very Light Machinegun is a standard infantry support weapon that has been adapted for vehicular use. It is usually attached to a motorized pintle mount to avoid exposing the gunner. While the machinegun is useful against unprotected infantrymen, it is nearly worthless against vehicles, even unarmored ones.

The Brucker M769 is a functional and rugged machinegun capable of firing belt-fed, standard 7 mm cased ammunition. It is often pintle-mounted on jeeps, trucks and other support vehicles.

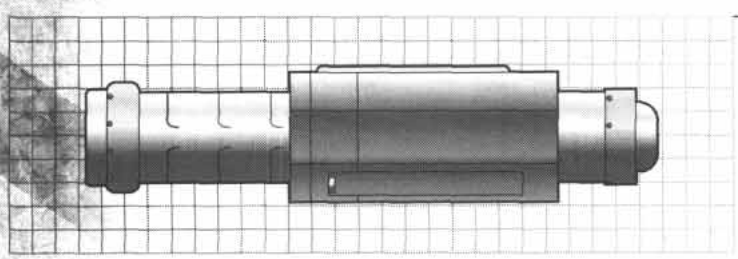


Light Machinegun

Purpose:	Anti-Infantry
Effective Range:	400 m
Penetration:	15 mm
Accuracy:	Average
Mode of Fire:	burst
Usual Ammo Load:	800-5000 shells

The Light Machinegun is a small caliber, rapid-fire cannon used mostly for anti-personnel purposes. It has a lower damage potential than other vehicle-mounted weapons, but has a vastly increased rate of fire. This makes Light Machineguns expensive to field (rapid wear of the barrel(s), high ammo cost, etc.).

The 7.7mm Territorial Arms MGU-77 Minigun is a typical Light Machinegun used by the Spitting Cobra Gear. Infantrymen have learned to fear this gun as "the Death Buzzer" because of the high pitched sound it makes when fired.



Heavy Machinegun

Purpose:	Anti-Infantry
Effective Range:	400 m
Penetration:	18 mm
Accuracy:	Average
Mode of Fire:	burst
Usual Ammo Load:	400-3000 shells

The Heavy Machinegun is a bigger machinegun with a larger caliber. This allows it to cause more damage, but at the cost of a slightly lower rate of fire. HMGs are also sturdier than LMG.

A typical HMG is the 10mm NORTHCO GU-10 Gatling Unit, the main anti-personnel weapon of the Grizzly Gear. It is a rare design in that it is fixed on the left side of the Gear's body, just under its ammo bin.

Bryce Hubbard (order #959915)

Very Light Rifle

Purpose:	Anti-Vehicle
Effective Range:	800 m
Penetration:	38 mm
Accuracy:	Average
Mode of Fire:	burst
Usual Ammo Load:	60 shells

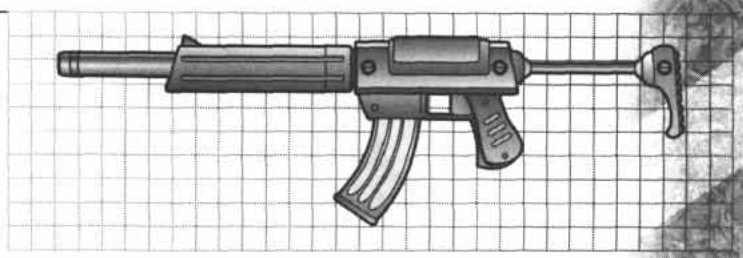


The Very Light Rifle is a very small vehicle gun designed as a backup weapon for light scouting vehicles. Its 20 mm shell can pierce the skin of most light vehicles, but not much else. It is popular with rovers because its simplicity makes it easy to maintain in the field.

The "R"-series includes single shot weapons ranging from light guns to field artillery. The R127 VLRF is a single shot cannon that has been likened to an enlarged infantry gun. Its battlefield usefulness is limited except when delivering custom ordnance.

Light Rifle

Purpose:	Anti-Gear
Effective Range:	1200 m
Penetration:	65 mm
Accuracy:	Average
Mode of Fire:	single
Usual Ammo Magazine:	30 shells

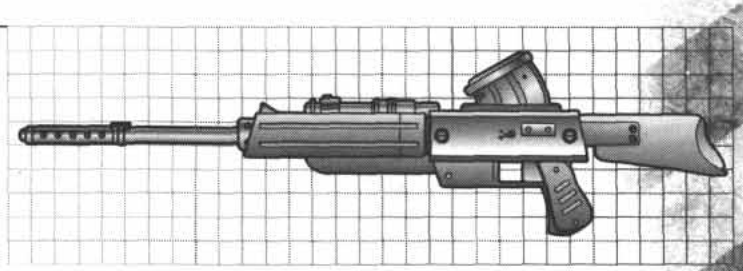


The Light Rifle is a simpler version of the Light Autocannon, but does not have the capacity for automatic fire. The barrel is slightly longer with a correspondingly superior accuracy and it fires higher caliber bullets.

The Riley R223 is a rework of the well-known Riley M222 20 mm autocannon. Both weapons use the same ammunition, but the R223 has a slightly longer barrel and a simplified breech mechanism. The rifle is also manufactured without the stock and the identification R224.

Medium Rifle

Purpose:	Anti-Gear
Effective Range:	1600 m
Penetration:	105 mm
Accuracy:	Average
Mode of Fire:	single
Usual Ammo Magazine:	25 shells

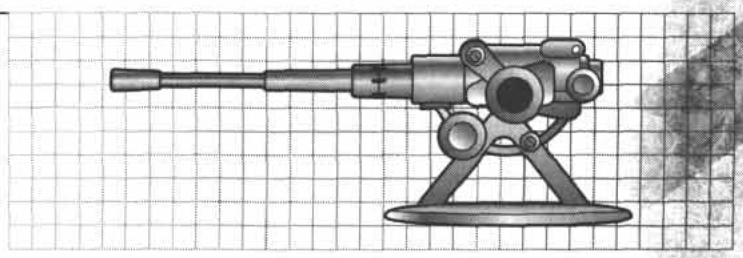


The Medium Rifle is similar in overall performance to the Medium Autocannon, though the caliber and barrel length are both increased at the expense of the automatic fire capacity. Medium Rifles make good Heavy Gear weapons because of their increased range compared to autocannons (the standard Gear weapon).

The Rucker Group RF-12 Medium Rifle is an alternate weapon selection for most front-line units. The RF-12 is rugged, reliable and easy to maintain, and it can fire a large variety of specialized ammunition.

Heavy Rifle

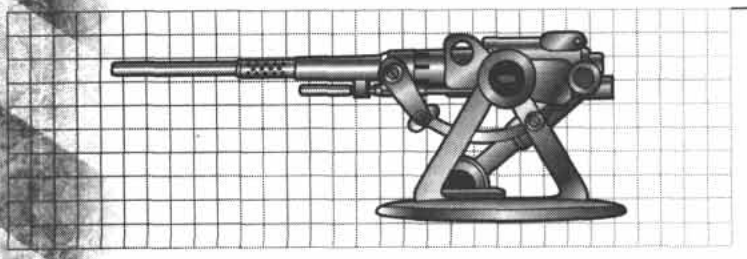
Purpose:	Anti-Gear
Effective Range:	1600 m
Penetration:	150 mm
Accuracy:	Average
Mode of Fire:	single
Usual Ammo Magazine:	15 shells



The largest rifle-type weapon, the Heavy Rifle is the poor man's light tank gun. Most heavy rifle designs use either binary liquid or gel propellants and, in certain cases, an additional electro-thermal plasma boost. They are prized for their ability to fire a variety of ammunition, just like the larger tank guns, but without the associated cost.

The Rucker Group RF-19 Heavy Rifle is, in every way, a standard Rucker product: rugged, reliable and inexpensive. Many armored car designs use it as a main turreted gun.

Bryce Hubbard (order #959915)

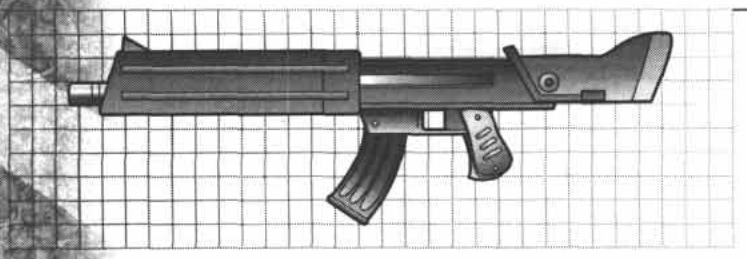


Very Light Autocannon

Purpose:	Anti-Gear/Anti-Infantry
Effective Range:	800 m
Penetration:	38 mm
Accuracy:	Average
Mode of Fire:	burst
Usual Ammo Load:	60 shells

The Very Light Autocannon lies somewhere between a heavy infantry machinegun and a vehicle-mounted autocannon. Although its armor-piercing shells are not very useful against infantry, the VLAC is a perfect back-up, anti-armor weapon for light vehicles.

The Riley M202 is a well-known example of the Very Light Autocannon. The single barrelled, air-cooled weapon fires non-standard 15 mm shells, but will accept similar rifle ammunition of the same caliber.



Light Autocannon

Purpose:	Anti-Gear/Anti-Infantry
Effective Range:	800 m
Penetration:	65 mm
Accuracy:	Average
Mode of Fire:	burst
Usual Ammo Load:	60 shells

Light Autocannons are popular weapons because they are rugged, simple to design and inexpensive to field. Most come in the form of a Gear-sized rifle which uses clip or belt-fed ammunition. They are mounted in the turret and hull of several armored vehicles as secondary weapons.

The 25mm Riley M222 Autocannon is one of the most reliable weapons ever produced. It is used by almost all Hunter-class Gears and has been the basis for several designs. The southern Jäger trooper Gear uses a practically identical weapon made by Paxton Arms.

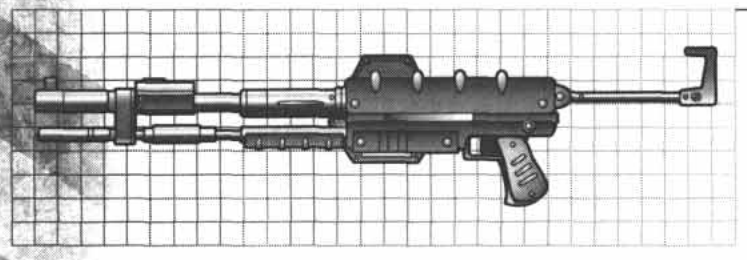


Medium Autocannon

Purpose:	Anti-Gear
Effective Range:	1200 m
Penetration:	105 mm
Accuracy:	Average
Mode of Fire:	burst
Usual Ammo Load:	50 shells

Medium Autocannons are the next most popular Gear weapons. Caliber and barrel length are both increased at the cost of the high rate of fire, resulting in a higher damage and range.

The 30mm Paxton MR25 Machinecannon is standard issue for the Black Mamba Gear. The Jaguar's main weapon, formerly a smaller autocannon, has been upgraded to a similar weapon.



Heavy Autocannon

Purpose:	Anti-Gear
Effective Range:	1200 m
Penetration:	150 mm
Accuracy:	Average
Mode of Fire:	burst
Usual Ammo Load:	30 shells

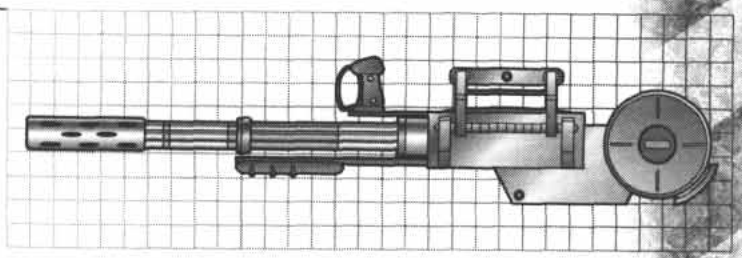
A large rapid-loading automatic cannon, the Heavy Autocannon is often the main armament of light tanks and the heavier Gear models. Most of the weapon's mass is taken up by the barrel (or barrels, as many heavy autocannons follow a gatling-like setup) and the large autoloading system. Although most of the handheld Gear versions are clip fed, heavy autocannons are generally belt fed.

The 40mm Riley M225 and its counterpart, the Paxton MR60 Autocannon, are heavy autocannon rifles designed to be carried as main armament by the large Gear models such as the Grizzly or the Spitting Cobra.

Bryce Hubbard (order #959915)

Very Heavy Autocannon

Purpose:	Anti-Gear/Anti-Armor
Effective Range:	1200 m
Penetration:	230 mm
Accuracy:	average
Mode of Fire:	burst
Usual Ammo Load:	30-60 bursts

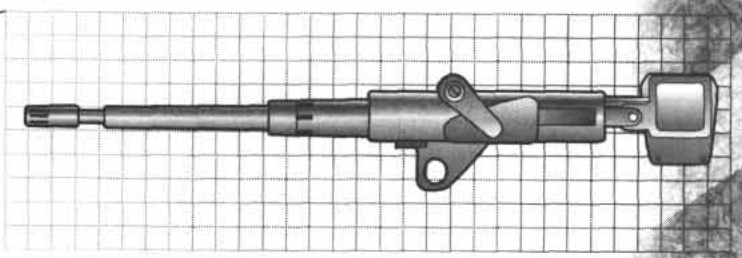


The Very Heavy Autocannon is an electrically-driven multi-tube weapon capable of delivering an awesome amount of ammunition in a very short time. Even in "single fire" mode, each shot sends many tightly-grouped rounds hurling toward the target.

A typical VHAC is the awesome Junglemower-10 autocannon carried by the Support Cobra. This six-tube weapon is electrically driven, air-cooled and fed through a rear-mounted ammunition drum that contains 400 bullets (enough for 40 "single" shots).

Very Light Field Gun

Purpose:	Anti-Armor
Effective Range:	2000 m
Penetration:	400 mm
Accuracy:	poor
Mode of Fire:	single
Usual Ammo Load:	60 shells

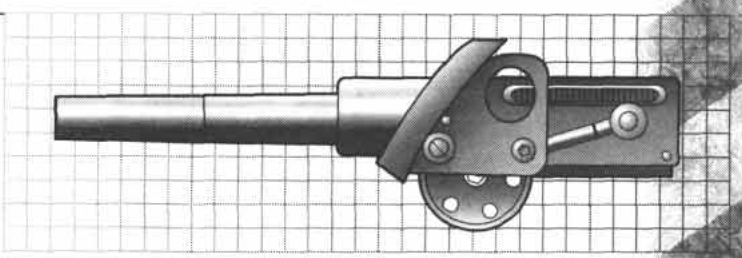


The Very Light Field Gun is the smallest single-shot, anti-armor weapon in use at the moment. It is slightly less accurate than other weapons of its type, mainly because of its short barrel. It can be easily carried by a large Heavy Gear. VLFGs are also often mounted on gun carriages and defensive bunkers.

The LTV-28 is a VLFG mounted on the back of the Support Cobra. The clip-fed weapon is mounted on an articulated hydraulic hardpoint and fires over the Gear's shoulder.

Light Field Gun

Purpose:	Anti-Armor
Effective Range:	2000 m
Penetration:	490 mm
Accuracy:	Average
Mode of Fire:	single shot
Usual Ammo Load:	50 shells

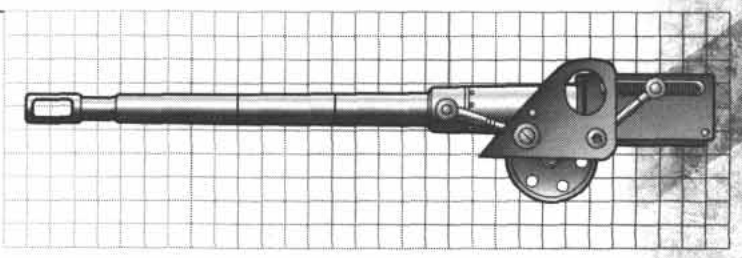


Unlike autocannons, field guns do not have any rapid-fire capacity. They make up for it with a longer range and higher hitting power. Most use Advanced Hyper-Kinetic Penetrator (AHKP) technology, with a secondary burn stage and molecular-aligned shaped alloy tips.

The 90mm Rucker Group LAU-44 is a self-loading cannon mounted in the turret of some of the Hun light tank variants. The gun has good penetration and accuracy considering the short length of its barrel.

Heavy Field Gun

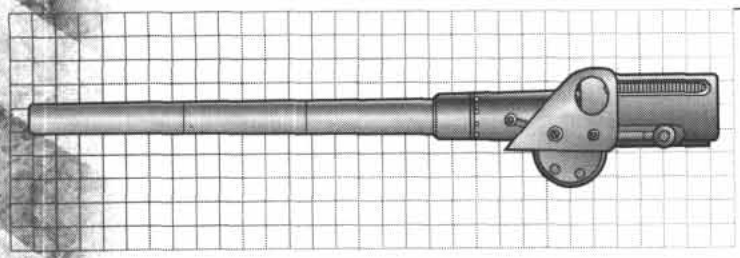
Purpose:	Anti-Armor
Effective Range:	3200 m
Penetration:	800 mm
Accuracy:	Average
Mode of Fire:	single shot
Usual Ammo Load:	40 shells



The Heavy Field Gun is a large gun capable of crippling or destroying an armored target in one shot. It is much too heavy to be carried by Gears and often constitutes the main armament of battle tanks. Heavy Field Guns use some of the most powerful types of gel propellants, sometimes relying on binary liquid compound injection for primary projectile acceleration.

The 140mm Ebirus Co. MAGISTER II Cannon is the main weapon of the main battle tanks used by the forces of the Southern Republic. It is a rugged, reliable cannon with good performance.

Bryce Hubbard (order #959915)

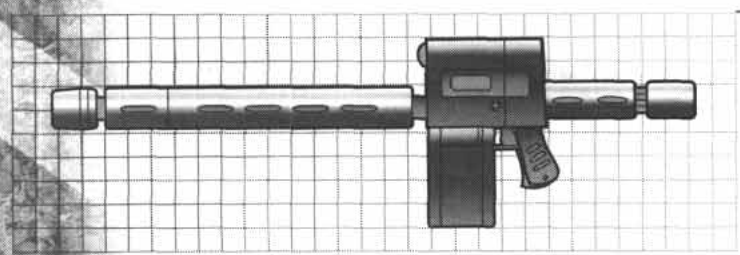


Very Heavy Field Gun

Purpose:	Anti-Armor
Effective Range:	4000 m
Penetration:	1100 mm
Accuracy:	Average
Mode of Fire:	single
Usual Ammo Load:	10 shells

The Very Heavy Field Gun is practically an artillery piece. Its wide 200 mm barrel can propel shells nearly 4 km and still hit and destroy a moving target with unnerving accuracy. The shells it fires are similar to the ones used by Snub Cannons, except that they are boosted faster and further by the gun's long barrel.

VHFGs are only carried by landships and the largest of tanks. The PK-12 shown in the illustration below is normally mounted in the front turret of the Empereur-class landship of the Southern Republic.

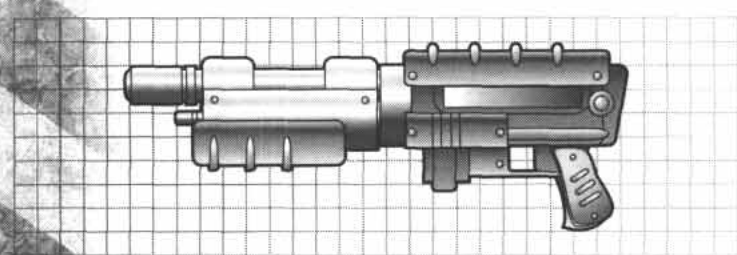


Snub Cannon

Purpose:	Anti-Armor/Anti-Infantry
Effective Range:	400 m
Penetration:	1000 mm
Accuracy:	poor
Mode of Fire:	single shot
Usual Ammo Load:	3 shells

The Snub Cannon is a heavy auto-loading cannon with a smooth bore and a short or medium barrel. It is mostly used for demolition and tank-hunting purposes. Its stubby ammo can transfer massive amounts of kinetic energy at short range, butwith little accuracy.

The 106mm Paxton LGPC "Little Joe" Snub Cannon is commonly assigned to one Gear in a squad. This gunner Gear provides the team with hard hitting, if slightly inaccurate, firepower.

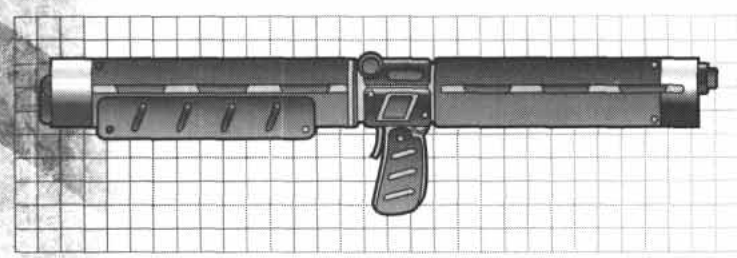


Fragmentation Cannon

Purpose:	Anti-Infantry/Anti-Gear
Effective Range:	400 m
Penetration:	50 mm
Accuracy:	good
Mode of Fire:	single shot
Usual Ammo Load:	16 shells

The Fragmentation Cannon is a cousin of the Snub Cannon. Its main function is to provide highly accurate firepower at close quarters; the gun usually fires fragmentation ammunition to increase the chance of a solid hit.

The 45mm Territorial Arms SG20 Fragmentation Cannon is a Gear-sized shotgun which was first designed for the Water Viper Gear. The weapon is well designed and deadly. It fires a special ceramic "Buckshot" ammunition which is very effective.



Disposable Pack Gun

Purpose:	Anti-Gear
Effective Range:	800 m
Penetration:	65 mm
Accuracy:	poor
Mode of Fire:	burst
Usual Ammo Load:	30 shells

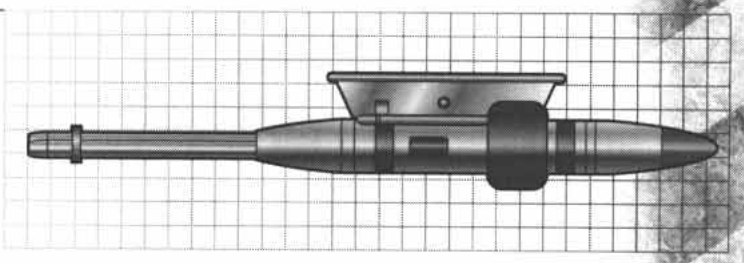
A Disposable Pack Gun is a polymer auto-loading weapon that can be stored on the hip plates or the backpack of the Gear. It is similar to a light autocannon in its general performance profile, but with a lower accuracy due to its shortened barrel. In its folded ("packed") position, it takes very little space. Once empty, the gun is generally discarded and a new one used.

The 25mm Riley M25 "Pack Gun" Disposable Rifle is a standard scout Gear weapon. However, it is so versatile that many other units carry one for backup firepower. Several versions of the Grizzly carry one folded under their left arm or on their left hip armor plate.

Bryce Hubbard (order #959915)

Light Anti-Aircraft Cannon

Purpose:	Anti-Aircraft
Effective Range (air):	4000 m
Penetration:	65 mm
Accuracy:	Average
Mode of Fire:	burst
Usual Ammo Load:	200-1000 shells

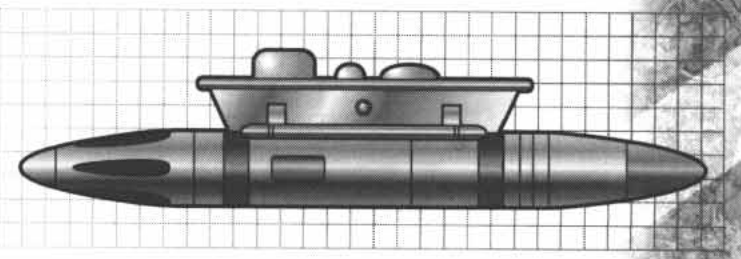


The Light Anti-aircraft Cannon is a high velocity, small-caliber weapon with an extremely high rate of fire, allowing it to fill a large area with deadly projectiles. An electric auto-loader brings fresh ammunition rounds, often caseless, from a magazine.

The LAAC-76 20 mm cannon mounted on Norlight attack planes is representative of this class of weaponry. The cannon is placed in an external pod underneath the fuselage, while its ammunition is carried in a helicoïdal magazine in the pod's rear section.

Medium Anti-Aircraft Cannon

Purpose:	Anti-Aircraft
Effective Range (air):	6000 m
Penetration:	100 mm
Accuracy:	Average
Mode of Fire:	burst
Usual Ammo Load:	200-1000 shells

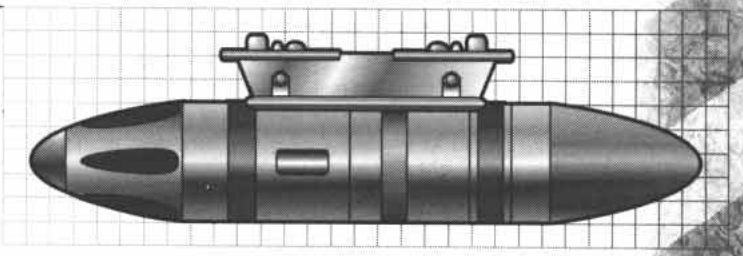


The Medium Anti-aircraft Cannon is a larger version of the previous weapon. It has a slightly lower rate of fire, but makes up for it with bigger shells, usually in the 30-40 mm caliber. Each shell has either a collapsed alloy penetrator for increased damage or a light explosive charge. Often, both are mixed within the magazine for optimum effect.

The Territorial Arms' Air Division Model 954 autocannon is a rugged multi-barrelled gun that is liquid cooled and automatically belt-fed. The ammunition is held in an easy to reload magazine that can be slipped in and out of the aircraft in a few minutes.

Heavy Anti-Aircraft Cannon

Purpose:	Anti-Aircraft
Effective Range (air):	6000 m
Penetration:	144 mm
Accuracy:	Average
Mode of Fire:	burst
Usual Ammo Load:	200-1000 shells

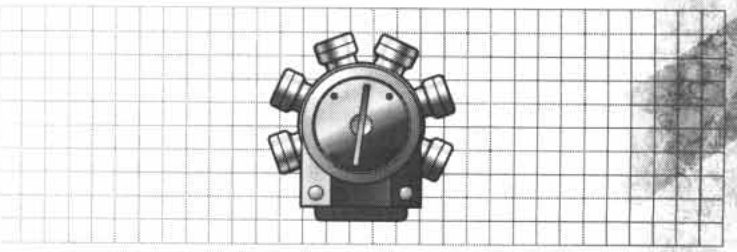


The Heavy Anti-Aircraft Cannon is the largest high velocity, rapid-fire cannon available. Its electric loader labors to feed its ravenous appetite for large 40 to 50 mm shells. Its overall rate of fire must be limited to prevent excessive barrel wear and overheating.

The monster Matrel Mark IV HAAC is composed of five ceramic composite barrels activated by a heavy duty electric motor. The overall length of the weapon (over six meters) takes up almost half the fuselage of the HF-12 air and ground attack plane.

Anti-Personnel Grenade Launcher

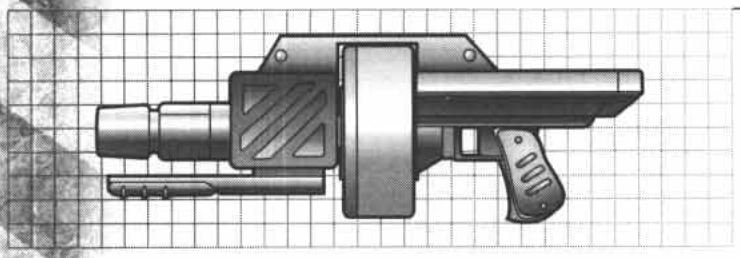
Purpose:	Anti-Infantry
Effective Range:	400 m
Penetration:	9 mm
Accuracy:	poor
Mode of Fire:	single shot
Usual Ammo Load:	6 grenades



Also translated as All Purpose Grenade Launcher, the APGL is a generic code for short range, small payload, low-velocity cannons. They are mostly used to launch anti-personnel grenades (hence the designation), but can be loaded with any of the small grenade types (smoke, gas, etc.). Their standard anti-personnel load covers an area nearly 25 meters in radius with deadly shrapnel.

The 44mm Dimaean MK IV is a small grenade launcher built in a barrel-like configuration. Each grenade has its own launch tube and propellant cartridge which spin the unit when fired to place a new barrel in firing position.

Bryce Hubbard (order #959915)

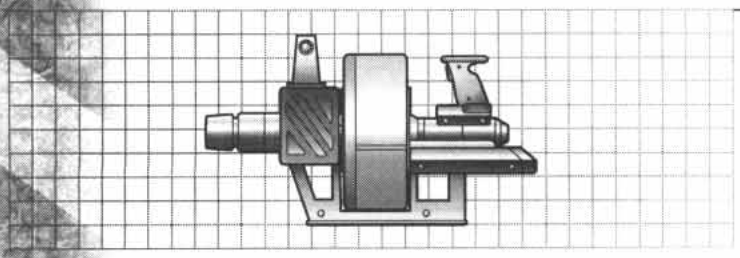


Light Grenade Launcher

Purpose:	Anti-Infantry/Anti-Vehicle
Effective Range:	400 m
Penetration:	225 mm
Accuracy:	poor
Mode of Fire:	burst
Usual Ammo Load:	20 grenades

The Light Grenade Launcher fills the battlefield gap between the direct-fire autocannons and field guns and the indirect fire guided mortars. Although not very accurate, the weapon offers good firepower. It is also very versatile since it can fire a variety of grenades.

The 60mm direct-fire Grenade Launcher made by Ankerson Works (a subsidiary of Northco) is a fully automatic grenade rifle designed to be handheld by most Heavy Gears. It stores the grenades in a drum-shaped ammo clip which is quick to replace and reload.



Heavy Grenade Launcher

Purpose:	Anti-Vehicle
Effective Range:	800 m
Penetration:	400 mm
Accuracy:	poor
Mode of Fire:	burst
Usual Ammo Load:	12 grenades

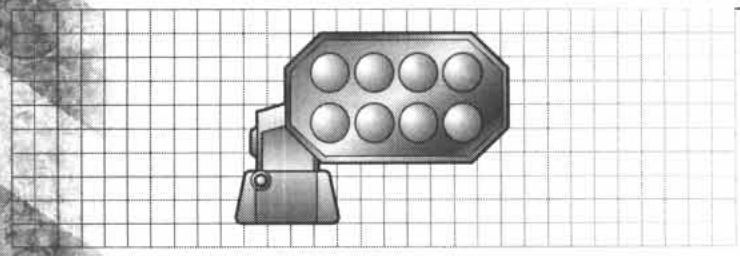
A larger version of the Light Grenade Launcher, this weapon packs a considerable punch and a good rate of fire at the cost of accuracy. The Heavy Grenade Launcher can also propel its grenades much further than its smaller brother. The grenades used can be of several different types. Unfortunately, because of the grenades' large size, the ammunition capacity is often quite small.

A large weapon, the 70mm LK-70 Heavy Grenade Launcher offers the triple advantage of good rate of fire, long range and high firepower. The autofire capacity is very effective in laying down a curtain of fire. As with other grenade launchers, ammunition capacity is low.

Rockets and Missiles

This type of weapon consists of a high-explosive, shaped charge warhead propelled by a rocket motor. Guided rockets are referred to as "missiles." They have the advantage of a guidance system and control vanes capable of redirecting the missile in flight; the guidance systems fall into several categories: laser, radar, thermal or visual (nose camera).

The simpler rockets are more popular because they give effective firepower to light vehicles unable to handle the recoil of the large battlefield guns.



Very Light Rocket Packs

Purpose:	Self-defense
Effective Range:	400 m
Penetration:	65 mm
Accuracy:	poor
Mode of Fire:	burst
Usual Ammo Magazine:	8, 16, 32 or 128 rockets

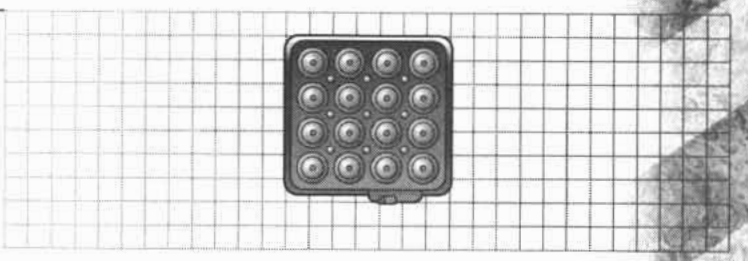
Very Light Rocket Packs are loaded with little more than explosive charges sitting on top of a miniature rocket motor. Sometimes, a small chip controls the fins, permitting minimal flight control. Individually, Very Light Rockets are not very accurate or powerful, but more than make up for it by saturating the target area and attacking multiple targets at once.

Paxton manufactures only one type of VLRP, the semi-modular Paxton RP-070 launcher. The RP-070 consists of a fire control computer mated with a launch rack housing up to eight 45 mm rockets. The rack is mounted on rails that can be hooked to a storage bin, enabling more rockets to be quickly and efficiently loaded into the launcher.

Bryce Hubbard (order #959915)

Light Rocket Packs

Purpose:	Anti-Vehicle
Effective Range:	400 m
Penetration:	140 mm
Accuracy:	poor
Mode of Fire:	burst
Usual Ammo Load:	8, 16, 24 or 32 rockets

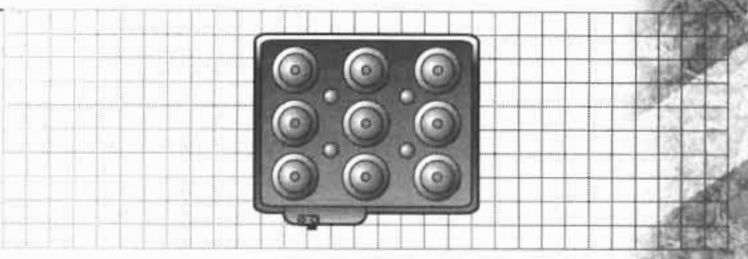


Light Rocket Packs are loaded with little more than explosive charges sitting on top of a rocket motor. A small chip controls the fins, allowing minimal flight control. They are not very accurate, but make up for it by saturating the target area.

The 52mm Paxton RP-109 "Pepperbox" is standard equipment on many front line and scout Gear models. It is not very accurate or powerful, but the large number of rockets in the pack allows for rapid covering fire.

Medium Rocket Packs

Purpose:	Anti-Armor
Effective Range:	400 m
Penetration:	325 mm
Accuracy:	poor
Mode of Fire:	burst
Usual Ammo Load:	9, 18 or 36 rockets

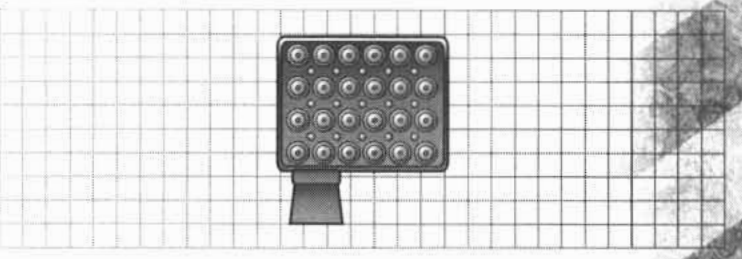


Medium Rocket Packs are very similar to LR packs. They simply use larger rockets, which allows each projectile to carry a bigger warhead and more fuel for as longer range.

The 71mm Territorial Arms Vesper-A MRP is commonly seen as a secondary weapon on the shoulder hardpoints of many Gears. It is cheap and rugged and provides extra firepower at crucial moments.

Heavy Rocket Packs

Purpose:	Anti-Armor
Effective Range:	1200 m
Penetration:	400 mm
Accuracy:	poor
Mode of Fire:	burst
Usual Ammo Load:	24 or 48 rockets

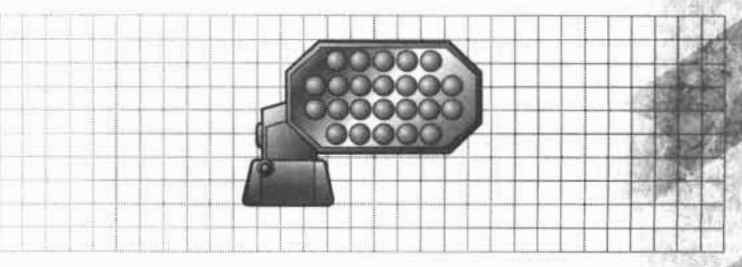


Heavy Rocket Packs use some of the largest unguided rockets on the battlefield. They are most often used for fire support and area saturation. The weapon occupies most of the back of the vehicle on which it is mounted and is fired overhead in an arcing trajectory.

The 82mm Territorial Arms SCRP Heavy Rocket Pack is a common support weapon. Its simple design and high rate of fire have made it extremely popular with commanders and pilots alike. Because of the SCRP abbreviation and the weapon's massive damage potential, enemy troops often call this weapon the "Scrapper."

Incendiary Rocket Packs

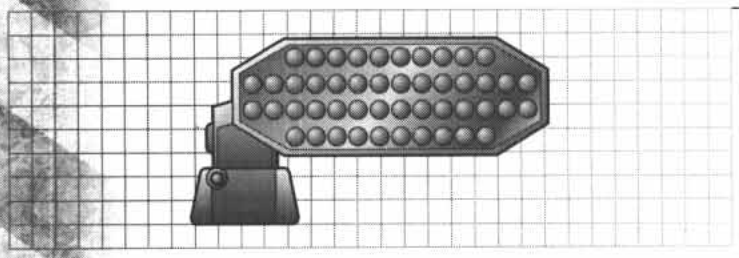
Purpose:	Anti-Gear/Scorched Earth
Effective Range:	400 m
Penetration:	170 mm
Accuracy:	poor
Mode of Fire:	burst
Usual Ammo Load:	10, 20 or 30 rockets



The Incendiary Rockets are similar to the Light Rockets but carry an incendiary warhead (most often a white phosphorous/napalm type chemical gel). They are mostly used for mass destruction.

The 59mm Paxton RP-114 "Chilibox" is a nasty weapon. Its rockets are equipped with chemical warheads that spray the target with a burning compound that sticks and keeps on burning for several minutes.

Bryce Hubbard (order #959915)

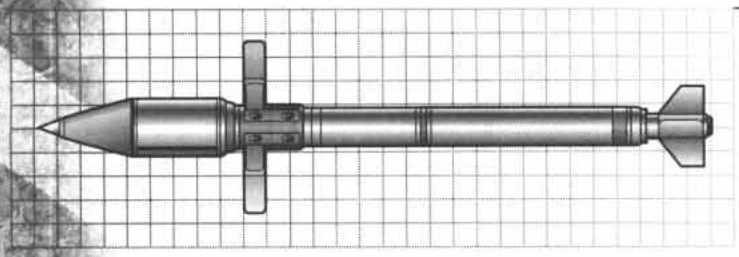


Heavy Incendiary Rocket Packs

Purpose:	Anti-Vehicle/Scorched Earth
Effective Range:	1200 m
Penetration:	260 mm
Accuracy:	poor
Mode of Fire:	single or ripple
Usual Ammo Magazine:	24 or 48 rockets

Heavy Incendiary Rockets are similar to Heavy Rockets, but carry an incendiary warhead (usually a white phosphorous/napalm-type chemical gel). The warheads spread a viscous burning liquid that keeps affecting the target for some time after the hit.

Northco does not produce many rocket launchers (or weapon systems for that matter), but their 24-rocket HI-8 pack is well known for its brutal efficiency and smooth operation.

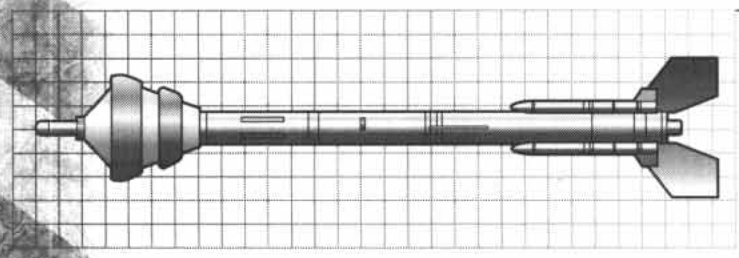


Anti-Gear Missile

Purpose:	Anti-Gear
Effective Range (air):	6000 m
Penetration:	225 mm
Accuracy:	good
Mode of Fire:	single
Usual Ammo Magazine:	2 to 4 missiles

The Anti-Gear Missile is a smaller, lighter version of the anti-tank missile. The warhead is useless against heavy armor, but can handle just about any other armored vehicle. The majority of AGM designs are wire guided using a very thin optic fiber, but a few models are laser or radio guided. Because of their reduced size, multiple AGMs can be carried within a single launcher.

The Hammerstrike-II missile can be fired from a ground launcher or, with the aid of an additional solid fuel booster, from an aircraft or other vehicle. The small projectile is powerful enough to dispose of most light armored vehicles and, of course, Gears.

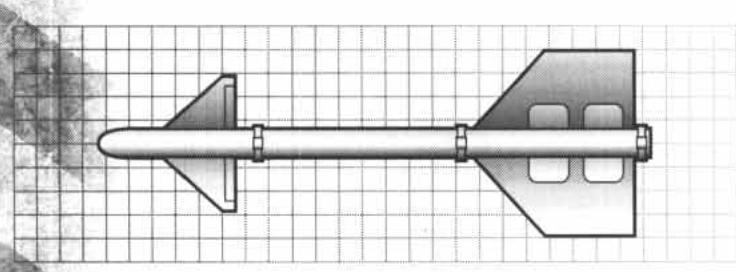


Anti-Tank Missile

Purpose: Anti-Armor	
Effective Range:	1200 to 2000 m
Penetration:	625 to 900 mm
Accuracy:	good
Mode of Fire:	single
Usual Ammo Load:	1 missile

The name Anti-Tank Missile covers a variety of anti-vehicular guided missiles. The majority of ATM designs are wire-guided through a very thin optic fiber, but a few are laser or radio guided. The ATM comes in many shapes. If a launcher can accommodate more than one missile, the notation is ATM/# where # is the number of missiles in the launcher. One missile can be launched per action. A heavier, larger version of the missile also exists. It has a similar flight performance but carries a more destructive warhead and has more fuel.

The DiMaean RAVEN Missile System is the main armament of the Klemm light tank used by the Northern Lights Confederacy.



Anti-Aircraft Missile

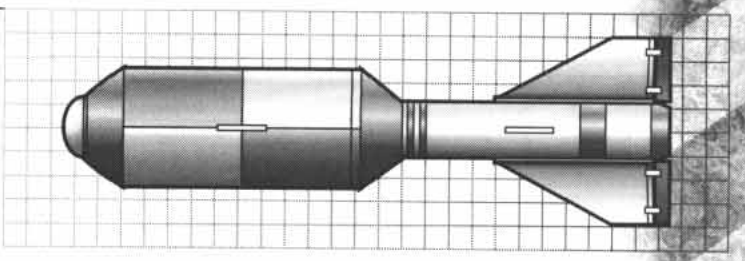
Purpose:	Anti-Aircraft
Effective Range (air):	16,000 m
Penetration:	100 mm
Accuracy:	very good
Mode of Fire:	single
Usual Ammo Magazine:	1 or 2 missiles

The Anti-Aircraft Missile is primarily an air-to-air weapon, although a ground-launched version is available for specialized air defense units. Its solid fuel booster requires nearly 2000 meters to reach its peak thrust, making close-range operation difficult at best. However, once past that range, its advanced seeker warhead almost guarantees a kill every time.It can use both TV and millimeter wave radar to acquire its target and can discriminate against most counter-measures, which make it almost impossible to shake off.

Bryce Hubbard (order #959915)

Airburst Missile

Purpose:	Area Saturation
Effective Range (air):	6000 m
Penetration:	100 mm
Accuracy:	average
Mode of Fire:	single
Usual Ammo Magazine:	2 missile



The Airburst Missile is a rather large missile that contains several smaller sub-projectiles. Once the missile approaches its target, the nose cone splits open and fires its sub-munition payload to cover a larger area at once. Airburst missiles are very effective for engaging several targets at once.

The Agerstond ASM-588 contains a simple auto-guidance system that uses data downloaded from the aircraft's fire control system just prior to firing. It contains 21 armor-piercing warheads that can cover a zone nearly 150 meters across.

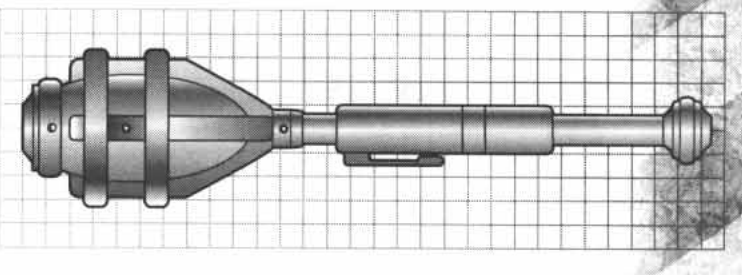
Panzerfausts

Panzerfausts (Eurogermanic for "armored fist") are used for hard-hitting firepower and one-shot-one-kill capacity in combat situations. They are composed of a heavy anti-armor warhead mounted on a quick-burning propellant charge. The projectile is held within a simple launch tube equipped with an electric trigger. The Gear only has to point the Panzerfaust toward the target and thumb the ignition; recoil is counteracted by a stream of gases ejecting out of the launch tube.

Panzerfausts require the presence of a functional Manipulator Arm in order to be used. They are HEAT weapons and are affected by both anti-missile fire and HEAT-resistant armor.

Light Panzerfaust

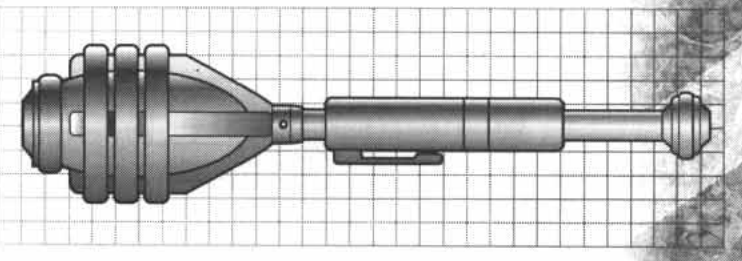
Purpose:	Anti-Armor
Effective Range:	400 m
Penetration:	100 mm
Accuracy:	poor
Mode of Fire:	single
Usual Ammo Load:	single shot



Light Panzerfausts were originally manufactured by the early settlers during the chaotic years of the Age of Isolation. By modifying standard shaped-charge digging explosives and mounting them on simple rockets, the settlers produced a cheap but effective weapon that could breach almost any kind of armor. In those troubled times, it was not uncommon to see modified Work Gears carrying several of these weapons on top of their makeshift armor.

Medium Panzerfaust

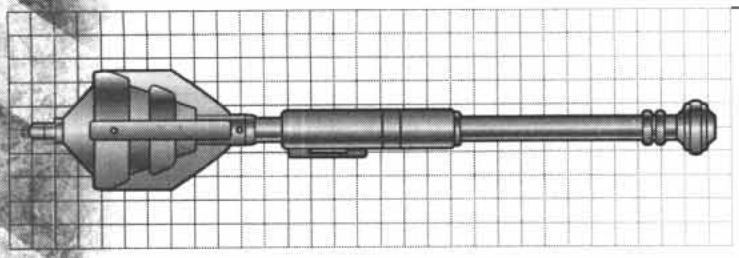
Purpose:	Anti-Armor
Effective Range:	800 m
Penetration:	225 mm
Accuracy:	poor
Mode of Fire:	single
Usual Ammo Load:	single shot



As the city-states emerged on Terra Nova and started assembling armies, it was found that the classic makeshift weapon called Panzerfaust was an excellent and inexpensive way to deal with enemy armored forces. Although their simplicity made them poor conventional vehicular weapons, Panzerfausts proved very popular with the new soldiers known as Gear pilots, who finally found a weapon that took full advantage of the humanoid nature of their combat vehicle. Panzerfausts allow even a simple Gear to hold its own against much larger opponents, though its operating range is too short for comfort.

The PKSF-65 is a standard Medium Panzerfaust manufactured by Republic Weapon Technology. Its technical simplicity allows Republic to manufacture it with unskilled labor and simple robot machine tools. Many MILICIA units have been issued this inexpensive weapon.

Bryce Hubbard (order #959915)



Heavy Panzerfaust

Purpose:	Anti-Armor
Effective Range:	1200 m
Penetration:	400 mm
Accuracy:	poor
Mode of Fire:	single
Usual Ammo Load:	single shot

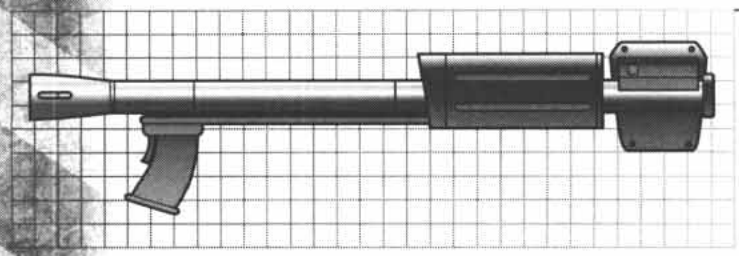
The extremely heavy composite armor of large MBTs simply soaks up the light warhead used by most panzerfaust designs. To resolve the problem and keep the low cost advantage of the panzerfaust weapon system, engineers modified a field mortar shell to serve as warhead on a heavier and deadlier version. The weapon can now take on MBTs , but its short range and inaccuracy make it dangerous to use.

The UBP-100 is a typical Heavy Panzerfaust derived from the well-known UBM-100-6 mortar shell used by several Northern forces. Although the warhead lost much of its area effect, the projectile is still feared by tankers for its ability to penetrate the heaviest armor.

Bazookas

Bazookas are heavy rocket cannons. They are used for hard-hitting firepower and one-shot-one-kill capability in combat situations. The main drawback of bazookas is their poor ammunition capacity.

Bazookas are generally used by Gears on heavy assault missions, because they can be used to punch through tanks and striders with decent accuracy. They do have relatively short ranges, however, which explains why most tanks use guided missiles or field guns as their main anti-armor weapons. Mounted on a fast Gear, however, a bazooka can be deadly.

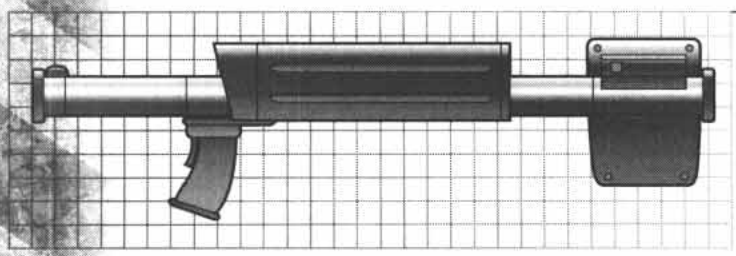


Light Bazooka

Purpose:	Anti-Armor/Anti-Gear
Effective Range:	800 m
Penetration:	250 mm
Accuracy:	Average
Mode of Fire:	single shot
Usual Ammo Load:	5 rockets

The Light Bazooka is a recoilless rocket cannon which is commonly used by Gears for dependable, hard striking firepower. Although a bit large, the Light Bazooka is a good compromise between weight and firepower. The rockets are usually loaded in clips that can be rapidly exchanged for reloading. The projectiles are typically short, the primary ejection charge being stored separately within the main body of the bazooka itself.

The SureFire-60 Recoilless Cannon is a sturdy weapon which was designed especially for Gears. It fires tiny dart-shaped rockets which are propelled by a two-stage solid propellant motor. A small charge ejects the rocket out of the barrel, and the rocket ignites its propellant 50 meters downrange to boost it for another 150 meters.



Medium Bazooka

Purpose:	Anti-Armor/Anti-Gear
Effective Range:	800 m
Penetration:	450 mm
Accuracy:	Average
Mode of Fire:	single shot
Usual Ammo Load:	3 rockets

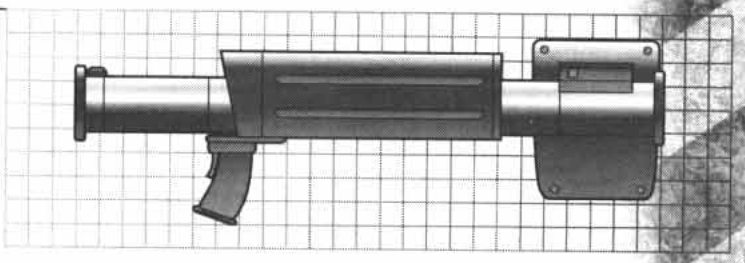
The Medium Bazooka is a larger model of recoilless cannon which can cause great amounts of damage to a target. The rockets are contained within a detachable magazine which can be quickly replaced by a fresh one; Gears often carry several additional ammo packs for this weapon. Like the Light Bazooka, a separate charge ejects the rocket from the barrel, the motor igniting nearly 60 meters from the muzzle to prevent any damage to the firing unit.

The Riley B-300 and Territorial Arms LRB-17 are two classic examples of a medium-sized bazooka which can be carried as the main weapon of a Gear on a strike mission. Both rely on clipped ammunition for ease of reloading and a steady rate of fire. Most experienced Gear pilots can change a clip in under ten seconds.

Bryce Hubbard (order #959915)

Heavy Bazooka

Purpose:Anti-Armor/Anti-Gear	
Effective Range:	800 m
Penetration:	625 mm
Accuracy:	Average
Mode of Fire:	single shot
Usual Ammo Load:	3 rockets

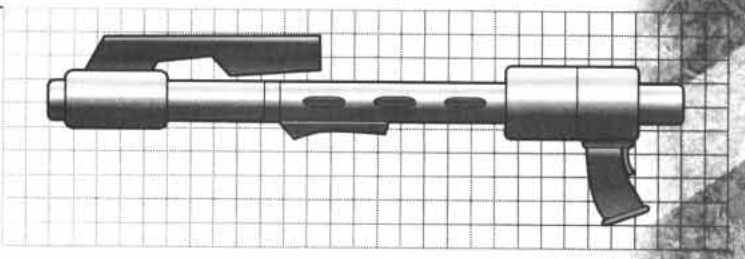


The largest recoilless cannon available on the battlefield, the Heavy Bazooka is so large and unwieldy that only assault Gears and front-line combat vehicles can carry it. Although it has a shorter range, the bazooka's damage is comparable to an ATM's.

The Territorial Arms LRB-30 has been described as "one darn big gun" by the soldiers using it. The LRB-30 uses rockets which are practically anti-tank missiles with the guidance system removed, making ammunition cheap and easy to come by.

Rapid-Fire Bazooka

Purpose:Anti-Gear	
Effective Range:	400 m
Penetration:	200 mm
Accuracy:	Average
Mode of Fire:	burst
Usual Ammo Load:	30 rockets



Take a standard infantry rocket launcher; make it bigger, tougher, and fully automatic; give it a good-sized clip, and you get a good description of the Rapid-Fire Bazooka. This rocket cannon is especially deadly when used in burst fire mode.

The Paxton RFL-2 "Soothsayer" Rapid-Fire Bazooka uses the same ammo as the common Paxton infantryman's rocket launcher, so ammunition is easy to come by. It is light and compact and thus often carried by light Gear designs.

Mortars

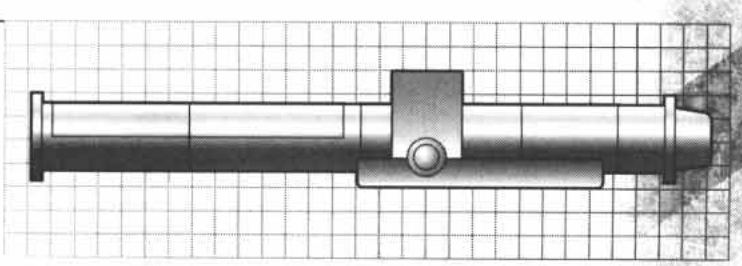
Mortars are weapons that accelerate one or more projectiles using a chemical explosion. Because of their configuration, they lob the shell along a very high trajectory. This makes mortars unsuitable for close fighting, but allows indirect firing. There are two basic types of mortars, field mortars and guided mortars. The major difference is the latter's guided warhead, but the weapons themselves also include fire-control and guidance systems absent in simple field models.

Because they are more powerful and less accurate than mortars firing guided ammunition, field mortars are usually reserved for general area bombardment. Guided mortars are more commonly used by attackers targetting specific units, even infantry. They are more common on Gears, included in both the standard Grizzly and Spitting Cobra designs.

Terranovan mortar designs take a variety of forms. In the case of Heavy Gears, mortars are often mounted on the backpack, firing over the head of the machine. In some designs, stabilizer struts extend from the mortar assembly to transfer the gun's high recoil directly to the ground, greatly reducing the stress on the Gear's legs. This is only the case when using especially heavy mortars, however, and can be risky because it reduces maneuverability.

Anti-Personnel Mortar

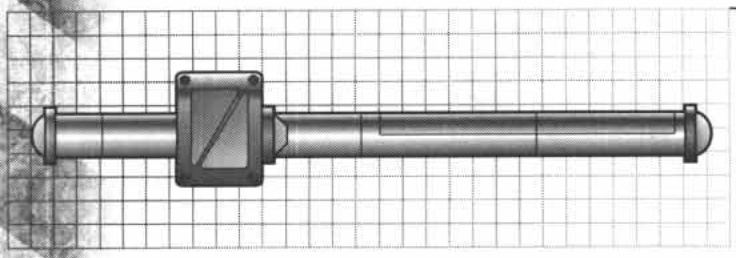
Purpose:	Anti-Infantry
Effective Range:	800 m
Penetration:	15 mm
Accuracy:	Average
Mode of Fire:	single shot
Usual Ammo Load:	9 shells



The Anti-Personnel Mortar is a small caliber mortar for use against opposing infantry units. Its indirect fire capability and explosive charge are very effective for this task, allowing a vehicle to clear a path without endangering itself too much. The blast usually covers a radius of nearly 25 meters.

The 50mm NORTHCO MR-3 Mortar is a simple mortar unit which was specifically designed to get rid of enemy infantry units in cover. It is cheap and easily made. Each mortar is factory loaded and discarded once empty.

Bryce Hubbard (order #959915)

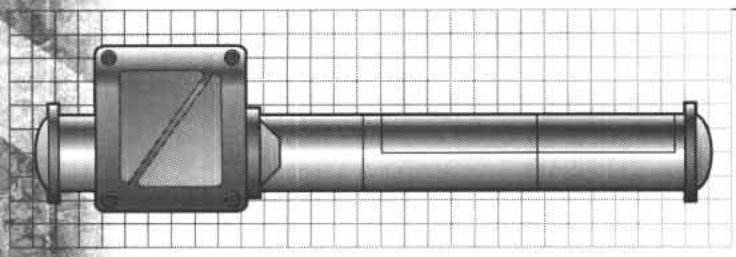


Light Field Mortar

Purpose:	Bombardment
Effective Range:	1600 m
Penetration:	225 mm
Accuracy:	poor
Mode of Fire:	single
Usual Ammo Load:	20 shells

The Light Field Mortar is a low-velocity howitzer that lobs large warheads in an arcing overhead trajectory. Although very similar in operation to the Guided Mortar, the Field Mortar trades its more sophisticated cousin's accuracy for increased range and punch. This is accomplished by replacing the shell's guidance system with a larger warhead.

The 90 mm UBM-22 is an inexpensive mortar unit that was specifically designed for area bombardment. It fires a high explosive shell similar in destructive power to a Gear's hand grenade, but can also fire other types of ammunition such as smoke rounds.

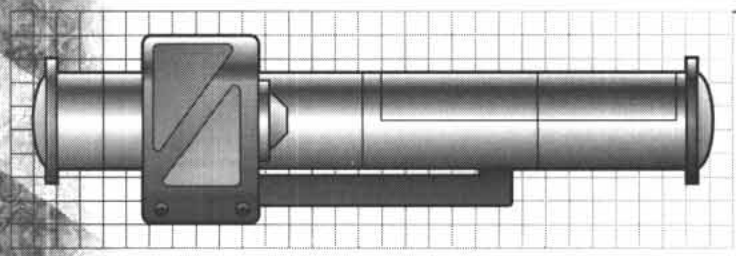


Medium Field Mortar

Purpose:	Bombardment
Effective Range:	2000 m
Penetration:	400 mm
Accuracy:	poor
Mode of Fire:	single
Usual Ammo Load:	12 shells

The Medium Field Mortar is a slightly larger version of the Light Field Mortar. It fires a bigger shell and has a longer barrel to boost the projectile further. Superficially, the MFM is very similar to the more sophisticated Heavy Guided Mortar, and the two are sometimes confused. Performance-wise, the Guided Mortar is more accurate, but the Field Mortar has a larger area effect.

The UBM-100 Mortar Unit is a Medium Field Mortar carried by the Rabid Grizzly. Since it uses the same mounting brackets as the Northco FSGM Heavy Guided Mortar, the UBM-100 is sometimes used on other Grizzlies when guided ammunition is in short supply.

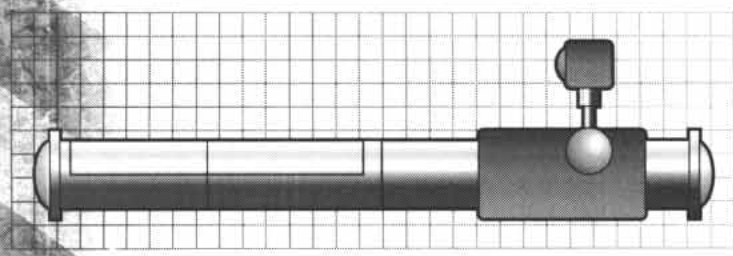


Heavy Field Mortar

Purpose:	Bombardment
Effective Range:	2400 m
Penetration:	625 mm
Accuracy:	poor
Mode of Fire:	single
Usual Ammo Load:	5 shells

A large bombardment weapon, the Heavy Field Mortar is sometimes classed in military registers as an artillery piece. It can hit a mobile target over 2.5 kilometers away: The shell used is composed of several sub-warheads for greater area coverage. Heavy Field Mortars are usually mounted on tracked vehicles since they are very heavy and have a high recoil.

The SDpzk-16, also affectionately known as the "Stormhammer," is a typical Heavy Field Mortar. The rugged 160 mm weapon has an air-cooled armored jacket for extended firing and general protection. It is most often mounted on a modified Klemm light tank chassis.



Light Guided Mortar

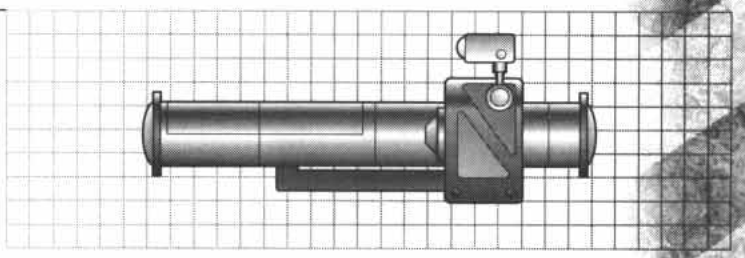
Purpose:	Anti-Armor
Effective Range:	1200 m
Penetration:	225 mm
Accuracy:	Average
Mode of Fire:	single shot
Usual Ammo Load:	12 shells

The Light Guided Mortar is a low-velocity cannon that lobs its warheads in an arcing overhead trajectory. The warheads have some limited control over their flight path through small fins that extend from the back of the shell once it clears the barrel. Using the laser seeker sensor in their tip, the projectiles can be directed to a target illuminated by a friendly spotting unit with a target designator.

Bryce Hubbard (order #959915)

Heavy Guided Mortar

Purpose: Anti-Armor	
Effective Range:	2000 m
Penetration:	400 mm
Accuracy:	Average
Mode of Fire:	single shot
Usual Ammo Load:	6 shells



The HGM is a heavy vehicle-mounted mortar designed for range and offensive power. Its shells are guided to their target by an allied target designator, vastly increasing the probability of a hit.

The 102mm NORTHCO FSGM (Fire Support Guided Mortar) has been designed specifically to be mounted on the back of the Grizzly. The mortar fires shells which are small missiles guided by a tight beam laser transmission to their target. The FSGM is very useful for attacking well-defended positions.

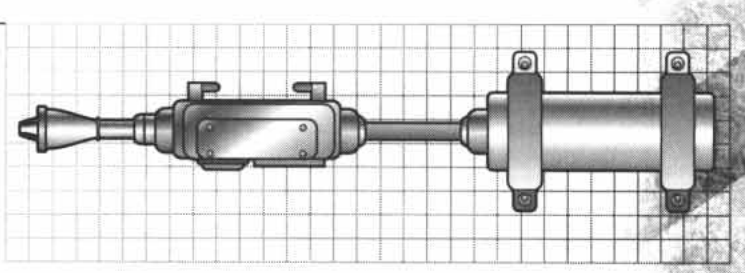
Flamers

Flamer are vehicle or fortification-mounted versions of the classic infantry flamethrower. Instead of using projectiles or energy to damage their target, flamers propel a stream of highly flammable liquid or gas that is ignited once it leaves the weapon's nozzle. This creates a wide and very hot cloud of flames that engulfs the target. Targets who are unprotected, most especially infantry, suffer catastrophic damage when trapped in this deadly cloud.

Flamers, although somewhat short-ranged, are very useful. The large stream of flames means that the weapon requires little aiming, bathing the target in searing heat and practically incinerating it on the spot. Flamers are also very powerful psychological weapons: Northern entrenched infantry has been known to beat a rapid retreat when the Flammjägers begin their advance. Flamers are also used for brush clearing and demolitions.

Light Flamer

Purpose:	Demolition
Effective Range:	1 to 20 m
Penetration:	N/A
Accuracy:	good
Mode of Fire:	single
Usual Fuel Capacity:	15 shots

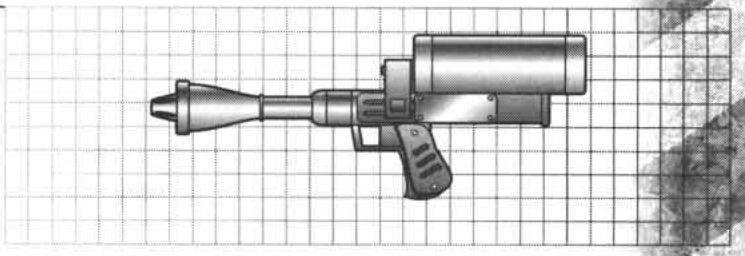


The Light Flamer is a small vehicle-mounted version of the infantry flamethrower. Like its portable cousin, it propels a stream of burning liquid toward the target. The large stream of flames requires little aiming, and is very effective against unprotected infantrymen.

The Paxton Matchstick II is a typical Light Flamer designed for anti-personnel work. It is compact and efficient and is usually mounted in a fixed position on the hull. Some Heavy Gear variants have been known to carry it on forearm mounts.

Medium Flamer

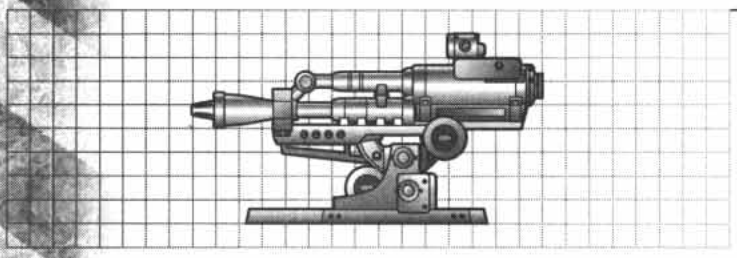
Purpose:	Demolition
Effective Range:	1 to 60 m
Penetration:	N/A
Accuracy:	good
Mode of Fire:	burst
Usual Fuel Capacity:	25 shots



The Medium Flamer is a larger version of the Light Flamer that was exclusively designed to be mounted on vehicles. The higher pressure and greater tank capacity allow more area coverage, while keeping the large cloud of flames that makes aiming less important with flamer weapons. The stream of burning liquid can even be propelled above intervening cover such as walls.

The Medium Flamer shown in the illustration below is the common Firemoth-16 flamer, a sturdy rifle-like weapon used almost exclusively by Heavy Gears. The Firemoth-16 is entirely self-contained, the fuel being found in twin top-mounted armored canisters. Each canister holds only one of two chemical gels; both are required for combustion. This reduces the risk of accidental detonation should the flamer be hit by enemy fire.

Bryce Hubbard (order #959915)



Heavy Flamer

Purpose:	Demolition
Effective Range:	1 to 120 m
Penetration:	N/A
Accuracy:	good
Mode of Fire:	burst
Usual Fuel Capacity:	30 shots

The Heavy Flamer is the largest vehicle flamethrower. Its powerful hose can bathe a large area with seething flames, igniting any flammable material almost instantly. Even when used for short bursts, the weapon lets out a large tongue of fire that engulfs the target. Like the Medium Flamer, the Heavy Flamer is powerful enough to propel the stream of fuel over intervening cover.

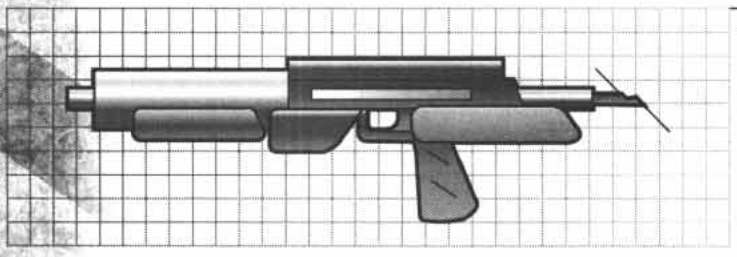
The BURN-9p is a typical Heavy Flamer. This brutal weapon is mounted in the forward turret of the Hittite, a dangerous anti-infantry vehicle based on the successful Hun light tank chassis.

Laser Weaponry

Laser is an acronym for Light Amplification by Stimulated Emission of Radiation. This type of weapon fires a beam of coherent energy, generally light, in the near-visible frequency range using millennia-old High Energy Laser (HEL) techniques.

Almost all battlefield lasers are cumbersome, specialized weapons whose efficiency is impaired by the presence of atmospheric dust and water vapor. Their main advantage is their high accuracy: there is no lead time, and an acquired target is quite simply a dead target. This makes lasers prefered anti-aircraft weapon.

Because of its limitations and expense, laser weaponry is generally only employed in two capacities: for commando operations and as anti-aircraft weapons. In the former situation, lasers provide stealth Gears with sniper capabilities that make them extremely deadly. In the latter function, lasers provide effective AA coverage for most main battle tanks and some light tanks.

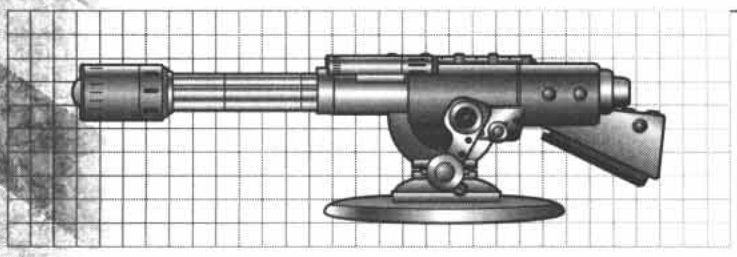


Sniper Laser Cannon

Purpose:Anti-Vehicle Sniper	
Effective Range:	2000 m
Penetration:	145mm (up to 250 m range)
Accuracy:	good
Mode of Fire:	single
Usual Energy Charge:	20 shots

The Sniper Laser is an energy cannon which is designed for long range performance: efficient power converter, slow beam dispersion, superior focusing lenses. Although the weapon is an energy hog — each superconducting loop powering it can only hold enough juice for a few shots — it is extremely efficient for sniper operations because of its range and high penetration.

The Territorial Arms TU-16 sniper laser rifle is the main weapon of the South's dreaded Snakeye Black Mamba stealth/commando Gear. The TU-16 is capable of picking off enemies at 2 kilometers with deadly accuracy.



Gatling Laser Cannon

Purpose:	Anti-Vehicle
Effective Range:	800 m
Penetration:	260 mm (up to 100 m range)
Accuracy:	good
Mode of Fire:	burst
Usual Energy Charge:	40 shots

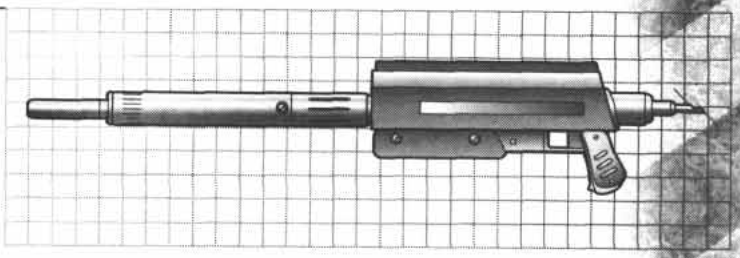
The Gatling Laser is a specialized, rapid-firing energy beam weapon that uses multiple lasing chambers to recharge its capacitors faster and to better dissipate the heat of continuous fire. The resulting "machinegun effect" can be used to attack multiple targets. Although the increased energy pumped into each shot dissipates quickly in atmosphere, the Gatling Laser can spread its fire over a larger area than other continuous-firing lasers.

FyStar Weapon Works recently introduced its brand new Helios-series high-power laser. Although it is low-powered for a battlefield weapon, the Helios uses three 10 MW lasing chambers located around a central core, activated by an electric motor on a separate circuit.

Bryce Hubbard (order #959915)

Light Laser Cannon

Purpose:	Anti-Vehicle
Effective Range:	2000 m
Penetration:	196 mm (up to 250 m range)
Accuracy:	good
Mode of Fire:	single
Usual Energy Charge:	15 shots

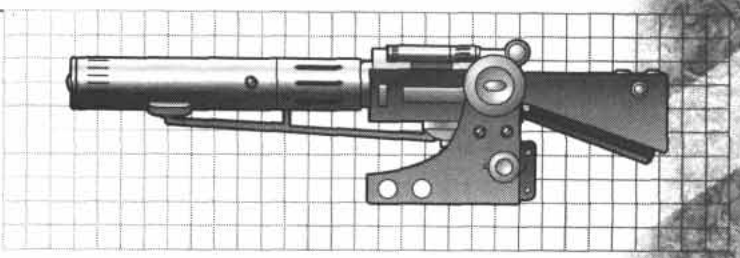


A larger version of the common Sniper Laser, the Light Laser Cannon delivers more raw energy to the target. Atmospheric attenuation and beam dispersion drops the damage fairly rapidly over distance, but the gun's high accuracy and (almost) line of sight range makes it useful for a variety of tasks. It shares a laser's tendency for high energy consumption.

The SRWI LZ-213 is a manipulator held Gear laser rifle used by the Hooded Cobra lon-range combat Gear.

Heavy Laser Cannon

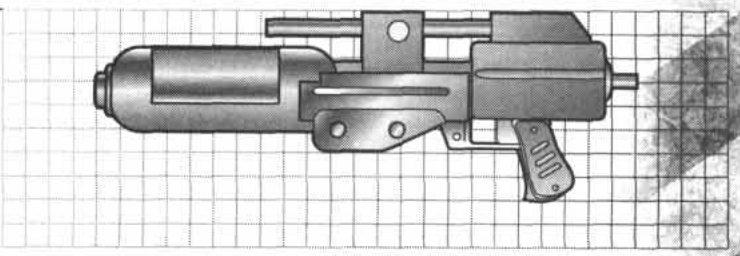
Purpose:	Anti-Vehicle
Effective Range:	2000 m
Penetration:	400 mm (up to 250 m range)
Accuracy:	good
Mode of Fire:	single
Usual Energy Charge:	10 shots



The largest vehicle-mounted battlefield laser, the Heavy Laser Cannon is popular for its high punch and lack of recoil. Although powerful, the HLC is nonetheless greatly limited by beam attenuation, which diminishes the damage over long distances.

Light Pulse Laser Cannon

Purpose:	Anti-Vehicle
Effective Range:	1200 m
Penetration:	400 mm (up to 150 m range)
Accuracy:	Average
Mode of Fire:	single
Usual Energy Charge:	15 shots

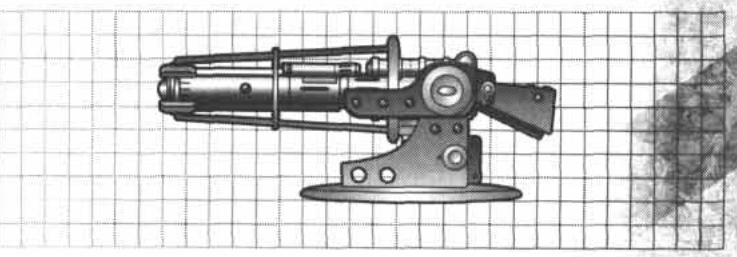


A weapon similar to the Light Laser Cannon, the Light Pulse Laser concentrates all its power in a single, highly concentrated pulse of energy. Although this reduces the range because of increased beam attenuation, it also causes a lot more damage to the target. Light Pulse Laser Cannons have an output of around 15 to 20 mW, depending on lasing efficiency.

The Sergon Optics A-20 Lightbearer is a 17.5 MW free-electron pulse laser mounted in the upper turret of the Aller Main Battle Tank. Sergon Optics is a division of Hyperion Works and is well known for its quality lasers.

Heavy Pulse Laser Cannon

Purpose:	Anti-Armor
Effective Range:	1200 m
Penetration:	575 mm (up to 150 m range)
Accuracy:	Average
Mode of Fire:	single
Usual Energy Charge:	10 shots



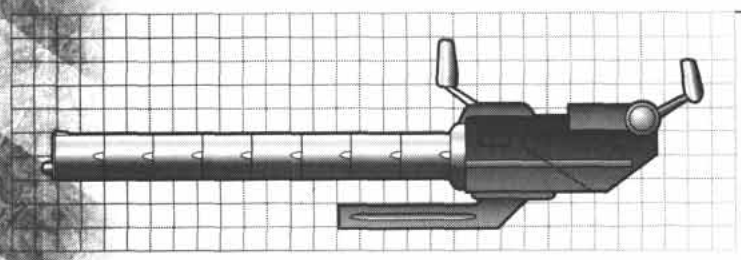
Like the lighter PLC, the Heavy Pulse Laser concentrates all its power in a single, highly concentrated pulse of energy. Although the beam rapidly loses coherence and power, the weapon is still very accurate for its large size and packs quite a punch. Heavy Pulse Laser Cannons have an output of around 25 to 35 mW and require large capacitor banks that take a long time to recharge.

The 35 MW HA Armorwerks PLC-35 is, without a doubt, the largest vehicular laser system currently in use. Pieced together from the remnants of crashed Earth ships' weapon arrays, the PLC-35 is a powerful battlefield laser capable of outperforming most projectile weapons at close range. Unfortunately, interaction with airborne particles greatly reduces its penetration depth over a longer range.

Bryce Hubbard (order #959915)

Magnetic Acceleration Cannons

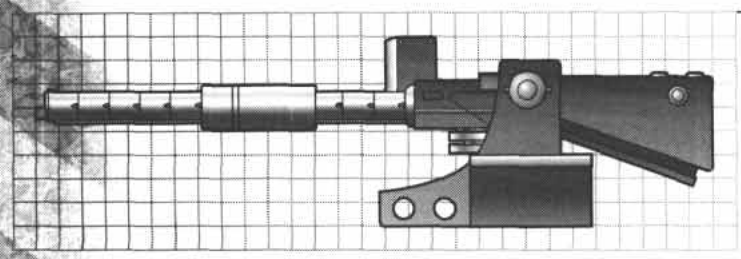
This class of weapon uses a system of electromagnets to launch projectiles at an extremely high velocity. This reduces lead time and flattens trajectories, improving accuracy. The shells are small chunks of shaped composite or plastic with a metal "skirt" to grip the magnetic field. Railguns and mass-drivers are power-hungry and include dedicated capacitor banks to feed them; even then, the number of shots is limited by the energy they contain. The actual ammunition is not a problem since the individual shells are so small.



Light Railgun

Purpose:	Anti-Tank
Effective Range:	2000 m
Penetration:	200 mm
Accuracy:	Average
Mode of Fire:	burst
Usual Energy Charge:	60 shots

The Light Railgun uses magnetic accelerator technology to propel one or more lightweight projectiles to fantastic speed, causing an awesome amount of damage to the target. The Light Railgun's open bore and rapid capacitor recycling allow a machinegun-like rate of fire.



Heavy Railgun

Purpose:	Anti-Armor
Effective Range:	4000 m
Penetration:	1225 mm
Accuracy:	Average
Mode of Fire:	single shot
Usual Energy Charge:	24 shots

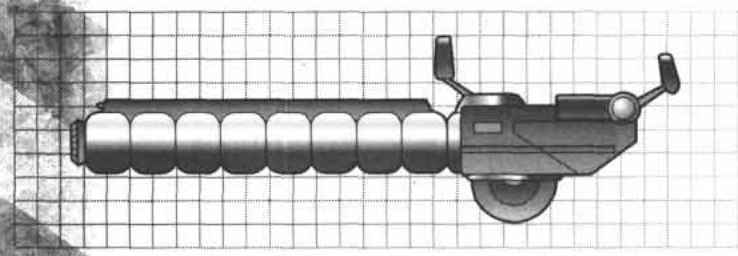
The Heavy Railgun is one of the most monstrous weapons available on the modern battlefield. Magnetic acceleration sends a hypersonic slug straight through any armored target, most often killing it. The large energy requirement of the gun limits its rate of fire as well as its ammunition capacity, ammunition in this case being the capacitor energy banks.

The 10mm Westfellow Technologies THOR is one of the rare advanced weapons seen on the battlefield. It is the main weapon of the Northern Lights Confederacy's Aller main battle tank. The gun has a separate engine to recharge its super-conducting capacitors.

Particle Accelerators

This class of weapon emits beams of atomic particles at velocities near the speed of light. Particle accelerators require large amounts of energy in order to function and are not very efficient in an atmosphere. Particle accelerators cause damage through both impact and electronic disruption. Most are equipped with an integral "leading" laser system to "burn" an ionized path to the target, but they still lose energy and hitting power over long distances through beam diffusion and atmospheric interactions.

Particle accelerators have become infamous on Terra Nova as the weapons of choice of the Colonial Expeditionary Force. The CEF's deadly hovertanks used these weapons as their main armament with devastating effect in the early days of the war. It was only Terranovan tenacity and the sheer number of defending troops that bogged down the relentless invasion before it was too late.



Light Particle Accelerator

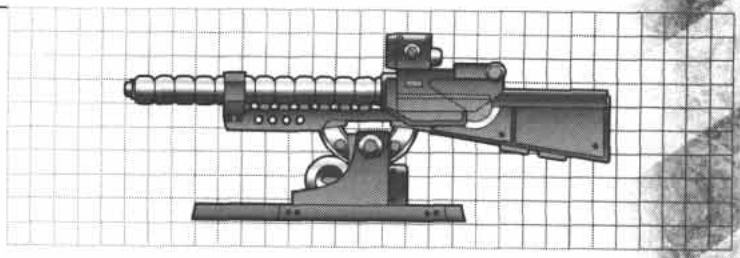
Purpose:	Anti-Vehicle
Effective Range:	400 m
Penetration:	100 mm (+ electrical damage)
Accuracy:	good
Mode of Fire:	single shot
Usual Energy Charge:	20 shots

The Light Particle Accelerator is small enough to be carried by the largest Gear models. It is thus the most common weapon of this type seen on the battlefield. Although the weapon itself is heavy and cumbersome and does not cause much damage when compared to a conventional weapon, its electronic disruption effects are a boon to salvage-minded commanders.

Bryce Hubbard (order #959915)

Heavy Particle Accelerator

Purpose:	Anti-Vehicle
Effective Range:	800 m
Penetration:	225 mm (+ electrical damage)
Accuracy:	good
Mode of Fire:	single shot
Usual Energy Charge:	15 shots



The Heavy Particle Accelerator is the largest particle weapon carried by land vehicles. It has a range comparable to many projectile weapons and its massive electrical discharge can sometimes burn out everything aboard an enemy vehicle in one shot — including the crew. Most current models of HPA are based upon the energy weapons salvaged from wrecked Earth hovertanks.

The particle accelerator carried by the CEF's HT-68 heavy assault hovertanks were frightening effective weapons and Terranovan engineers have yet to fully reproduce their capabilities. Only the Korps of Port Arthur have authentic CEF HPA technology, and even they are rumored to now be using downgraded models because of maintenance problems.

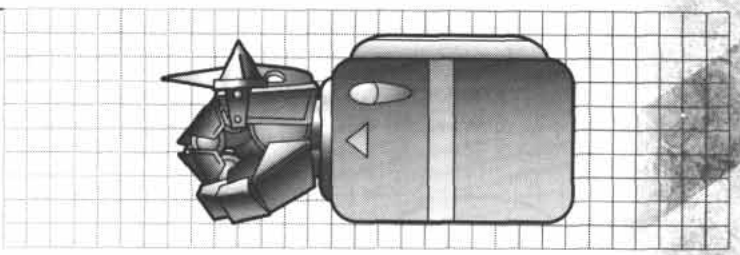
Close Combat Weapons

The development of humanoid fighting vehicles has led to the creation of several new weapons designed for use in close combat between vehicles. In most cases these are simple adaptations of infantry weapons to a larger scale, be it melee weapons like the vibroknife of hand-grenades. In-depth rules for most advanced melee weaponry is found in the **Duelist's Handbook**.

These weapons are almost entirely reserved for Gears because they depend on the presence of manipulator arms to handle and a humanoid structure to actually participate in close combat. Indeed, many are specialized weapons designed for Gear dueling. Some tanks and other vehicles do feature specially adapted versions of these weapons, however. A logging tractor might have a powerful vibroblade appendage to cut through foliage, although it would not resemble the large knife of a Gear vibroblade.

Chassis Reinforcement

Purpose:	Close-Combat Anti-Vehicle
Effective Range:	point blank
Penetration:	varies
Accuracy:	Average
Mode of Fire:	n/a
Usual Ammo Load:	n/a

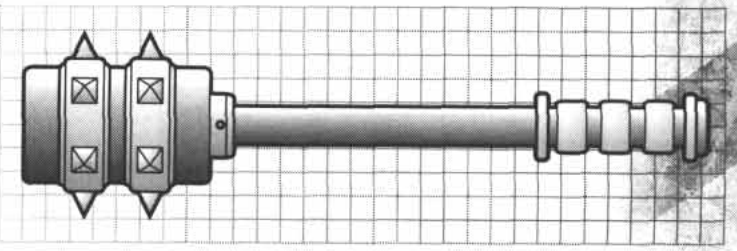


The Chassis Reinforcement is a simple welded plate of alloy designed to cause additional damage in physical combat. Gears are the vehicle type that use them the most, since their humanoid form enables them to deliver particularly effective physical blows, but other vehicles use them as well in the form of bumper plates and the like. They add +1 to the DM of a successful physical attack.

Most field technicians use a combination of forearm spikes and additional armor plating to increase a Gear's ability to punch or kick. This is a common modification made in the field, usually requested by pilots who got into close combat with enemy machines. Duelists and other hotshot pilots often have custom reinforcements, with characteristic spike arrangements.

Mace

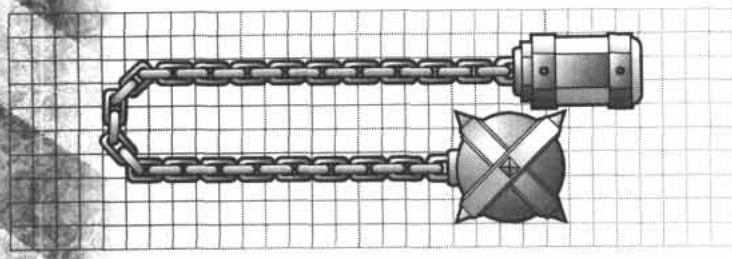
Purpose:	Dueling
Effective Range:	3 m
Penetration:	64 mm
Accuracy:	Poor
Mode of Fire:	N/A
Usual Ammo Magazine:	N/A



Heavy Gear maces are very simple close combat weapons used to pound an opponent into submission. They are usually of the short, one-handed variety, but larger two handed maces also exist. The most popular maces are studded balls of steel, but hammers and spiked maces are also widely used. These variations make very little difference against the armored skin of a Gear, but pilots often have a stylistic preference. One-handed weighted staffs are also used by some, often with one in each hand of the Gear.

Maces are extremely common and easy to manufacture, but Sage Industries in Smyrna produce the best known series of them. Hammers and maces are widely used in the Gear jousts of Smyrna as a secondary weapons for close-combat skirmishing.

Bryce Hubbard (order #959915)

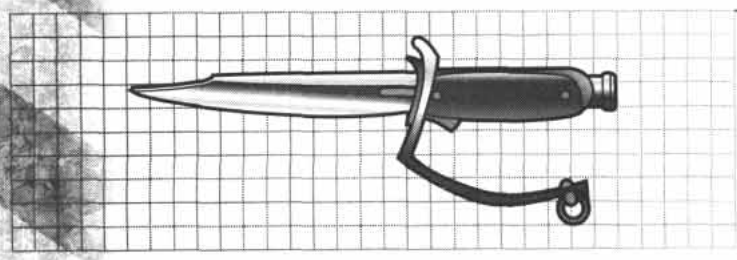


Morning Star

Purpose:	Dueling
Effective Range:	10 m
Penetration:	100 mm
Accuracy:	Bad
Mode of Fire:	N/A
Usual Ammo Magazine:	N/A

The big brother of the Gear mace, the morning star is a mace in which the weighted head is attached to a length of heavy cable or chain. The morning star does its damage by using its momentum to crack a Gear's armor, but can also be used to entangle. Most morning stars, like whips, are mounted into the Gear's forearm along with a winch. Others are simply modified maces and are incapable of reeling in opponents. Those who employ these simple devices do so because they find the emplacement of the standard weapon constricts the mobility of their manipulator hand.

The Sage Industries MLX-series sets the industry standard for Gear morning stars. These high-quality weapons feature the best of construction materials and are very popular in Smyrna. Sage also produces low-quality versions for the Badlands.

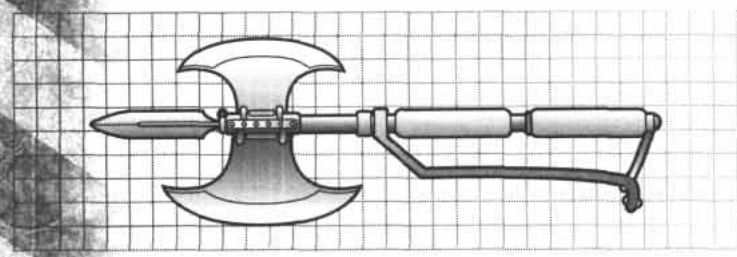


Vibroblade

Purpose:	Close-Combat Anti-Vehicle
Effective Range:	point blank
Penetration:	65 mm
Accuracy:	Average
Mode of Fire:	N/A
Usual Ammo Load:	N/A

The vibroblade is a hard alloy or ceramite Gear-sized knife equipped with a small sonic generator in the hilt. The high frequency vibrations cause the blade to vibrate at high speed for improved damage. The generator is switched on only about 5 seconds before use, increasing the endurance of the built-in power pack. Many Gears carry such weapons in a multitude of forms and styles.

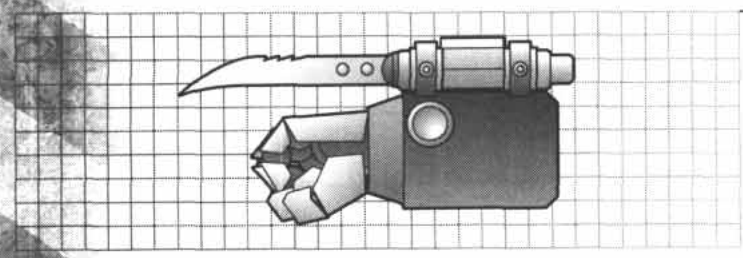
The Rucker Group VU-11 Vibromachete is the standard close-combat weapon for the Southern Black Mamba Gear. Its added length only comes into play when the Gear uses it to cut through dense jungle foliage, hence the machete appellation.



Vibroax

Purpose:	Dueling
Effective Range:	4 m
Penetration:	100 mm
Accuracy:	Poor
Mode of Fire:	N/A
Usual Ammo Magazine:	N/A

The massive vibroax is a distant cousin to the more versatile vibroblade. Usually consisting of two large vibroblades on a large staff, the ax is designed to terrify and destroy in close combat. Too cumbersome for use on the battlefield, the ax has found its home on the dueling field, often used to sheer off whole chunks of an opponent's weapon systems.



Vibroclaws

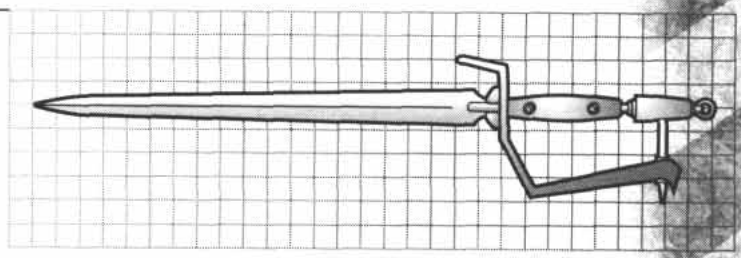
Purpose:	Dueling
Effective Range:	1 m
Penetration:	64 mm
Accuracy:	Good
Mode of Fire:	N/A
Usual Ammo Magazine:	N/A

Among the most characteristic weapons on the underground dueling circuits of Terra Nova are vibroclaws. Essentially modified vibroblades mounted on the forearm of the Gear, vibroclaws serve the same purpose as the more common forearm spike chassis reinforcement. The claws are more precise than handheld vibroblades but do limit the versatility of the Gear. Indeed, they slope over the manipulator hand, making it difficult to carry handheld weaponry.

Bryce Hubbard (order #959915)

Vibrorapier

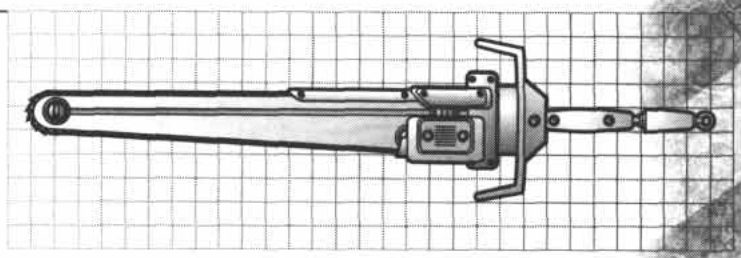
Purpose:	Dueling
Effective Range:	2 m
Penetration:	144 mm
Accuracy:	Good
Mode of Fire:	N/A
Usual Ammo Magazine:	N/A



Almost the opposite of the vibroax, the rapier is a highly accurate melee weapon which inflicts relatively little damage. Developed in the Southern Republic as a weapon of honor, it has maintained this role in its league of origin and is produced exclusively for the military market. In other areas, the use of rapiers has spread to gladiatorial combat, a practice severely frowned upon by Republican military officers.

Chain Sword

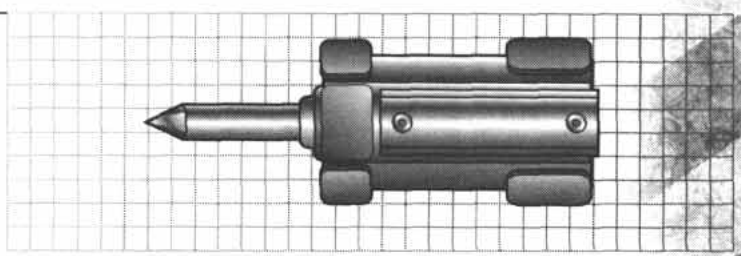
Purpose:	Dueling
Effective Range:	3 m
Penetration:	81 mm
Accuracy:	Average
Mode of Fire:	N/A
Usual Ammo Magazine:	N/A



Derived from the common engineering chain saws featured on Gears employed in forestry and other industries, chain swords have become a visceral favorite in the arenas of the underground. The sound of durasheet being torn asunder by the sword is often greeted by cheers. Chain swords are widely considered by military Duelists as a prime example of the debasement of gladiators. They see these weapons as simple crowd-pleasing monstrosities.

Spike Gun

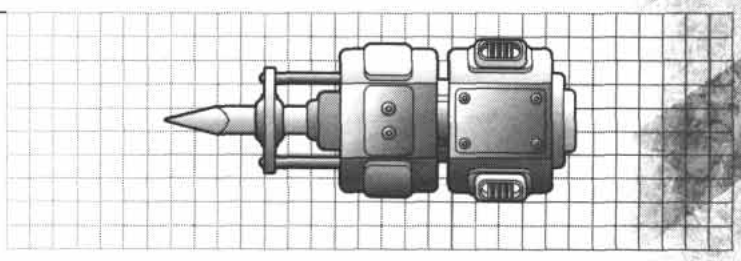
Purpose:	Hand-to-Hand Anti-Armor/Tool
Effective Range:	1 m
Penetration:	144 mm
Accuracy:	poor
Mode of Fire:	single
Usual Ammo Magazine:	5 charges



The Spike Gun is an unusual weapon/tool that is sometimes carried by vehicles, but is usually used by humanoid walkers such as Heavy Gears. The Spike Gun is a chemically powered, armor-piercing ram that is mounted on an arm. A tiny explosion propels a hardened alloy spear forward with enough force to punch through armor with no sound other than the dull thunk of ruptured armor plating (the detonation itself is muffled by a complex system of baffles). The spear can alwso be replaced with a chisel-like device for use in engineering work.

Heavy Spike Gun

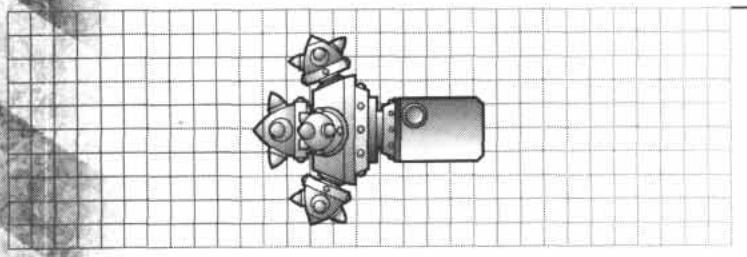
Purpose:	Close Combat
Effective Range:	1 m
Penetration:	196 mm
Accuracy:	Poor
Mode of Fire:	Single fire
Usual Ammo Magazine:	6 charges



A heavier version of the spike gun found on the Hunter Commando Heavy Gear, the heavy spike gun uses a stronger explosive charge and a reinforced shaft. The tip of the spike is also further sharpened to allow for increased armor penetration, although this entails reduced structural damage to the armor itself. Some heavy spike guns feature barbs and hooks to cause additional damage to the target's armor and internal systems.

The heavy spike gun is used by some military personnel, especially in commando and paratrooper units, but the standard military version is often seen as sufficient for their purposes. The more powerful version has found its home in underground arenas.

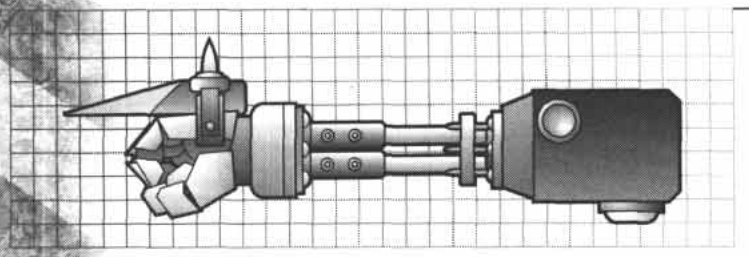
Bryce Hubbard (order #959915)



Mauler Fist

Purpose:	**Dueling**
Effective Range:	**1 m**
Penetration:	**81 mm**
Accuracy:	**Good**
Mode of Fire:	**N/A**
Usual Ammo Magazine:	**N/A**

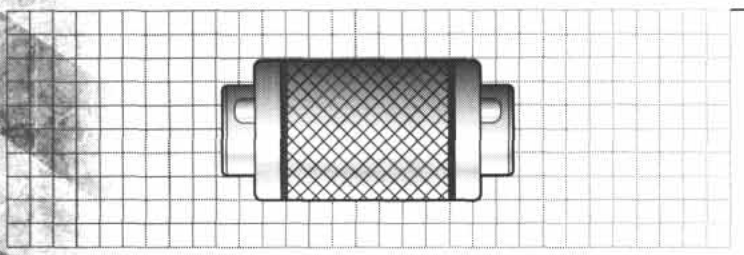
A frightening grinding device, the so-called mauler fist replaces the manipulator hand on a dueling Gear. The first is made up of two or more grinding heads, all of which rotate around the fist's central axis. The mauler first is a devastating close combat weapons because of its tendency to shred the opposing Gear's armor. Internal systems fare little better. Some Duelists complain that it is too easy for a reinforced armor plate to jam the fist, however.



Piston Punch

Purpose:	**Dueling**
Effective Range:	**3 m**
Penetration:	**100 mm**
Accuracy:	**Poor**
Mode of Fire:	**N/A**
Usual Ammo Magazine:	**N/A**

A massive close combat weapon, the so-called piston punch is a dedicated battle arm for a dueling Heavy Gear. The arm serves as the support for a large piston that can be slammed into an opponent's Gear. This weapon creates a powerful close combat machine, but sacrifices one of the major weapon platforms for the Gear. Indeed, the piston punch cannot be used to support most other weapons. Shoulder mounted weapons are possible, but they tend to be difficult to place because of the support frame of the piston.

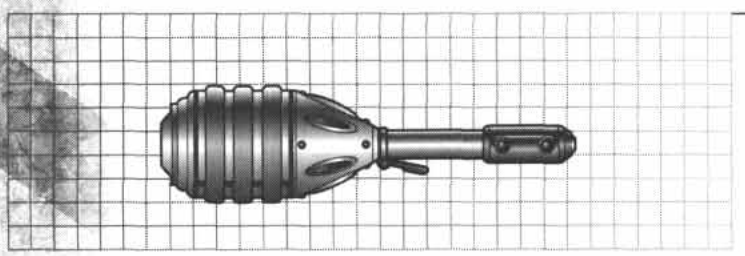


Hand Grenade

Purpose:	**Demolition, Anti-Infantry**
Effective Range:	**20 to 50 m**
Penetration:	**225 mm**
Accuracy:	**poor**
Mode of Fire:	**single shot**
Usual Ammo Load:	**1 grenade (often carried in 3- or 6-packs)**

This is quite simply a Gear-sized hand grenade. Many Gears carry a few of them in case they run into unexpected trouble or to use as flexible demolition charges. The warhead is powerful enough to actually damage armored targets, and can be useful in a variety of combat situations. Some grenades are fin stabilized for additional throwing accuracy.

The Paxton M-2A hand grenade is a standard-issue weapon for most Northern Gears. Like most Gear grenades, the M-2A consists of a shaped charge designed to punch through an armored target, surrounded by shrapnel to take out infantry in the immediate area.



Heavy Grenade

Purpose:	**Anti-Vehicle**
Effective Range:	**20 to 50 m**
Penetration:	**625 mm**
Accuracy:	**poor**
Mode of Fire:	**single**
Usual Ammo Magazine:	**1 grenade (often carried in 3- or 6-packs)**

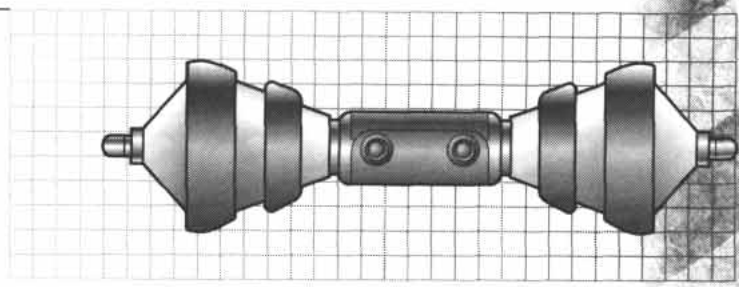
This is a heavier version of the standard Gear-sized Hand Grenade. The explosive charge is made more powerful at the expense of the pre-fragmented ceramic shrapnel load that made the smaller grenade such a deadly anti-infantry weapon. Nonetheless, the Heavy Grenade is still a very versatile tool, usable not only in battle, but also for engineering and demolition tasks (Heavy Grenades generally have a simple timer or fuse of some sort). Some rare Heavy Grenade designs are fin-stabilized for additional throwing accuracy.

The H-6 Heavy Grenade features an unorthodox design with an elliptical warhead and a throwing handle. Like other Heavy Grenade designs, a simple fuse allows the grenade to be used as a demolition charge.

Bryce Hubbard (order #959915)

Self-Destruct Grenade

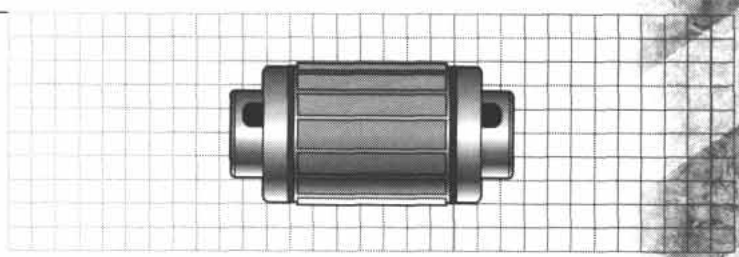
Purpose:	Last-Ditch Weapon/Demolition
Effective Range:	20 to 50 m
Penetration:	900 mm
Area Effect:	50 m
Accuracy:	poor
Mode of Fire:	single
Usual Ammo Magazine:	1 grenade



The Self-Destruct Grenade is so named because of its extremely powerful warhead and large area effect. It was originally developed as an engineering demolition charge for Badlands prospecting and mining operations, but was quickly turned into a weapon by settlers desperate to defend their homes against the Earth Forces. During the war, many fanatical Gear pilots carried these into combat in the hope of bringing some of their foes down with them as their own Gears were destroyed. All Self-Destruct Grenades are equipped with a timer allowing them to be activated and then left behind. The timer, once set, fuses in place and cannot be deactivated.

Haywire Grenade

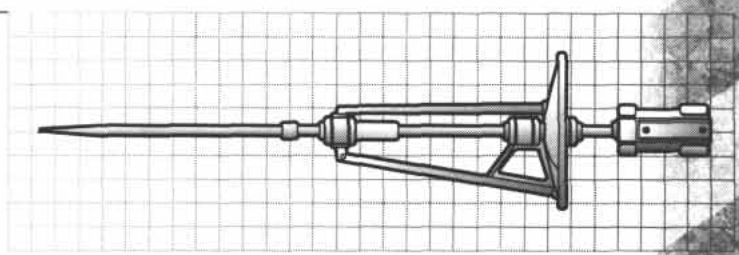
Purpose:	Anti-Vehicle
Effective Range:	20 to 50 m
Penetration:	100 mm + electrical damage
Accuracy:	poor
Mode of Fire:	single
Usual Ammo Magazine:	1 grenade (often carried in 3- or 6-packs)



The Haywire grenade is a rather specialized weapon designed to disable enemy units rather than destroy them. The core of the grenade is a fast-discharge energy capacitor. When activated, the grenade emits a high-voltage burst to cause cascading electrical failure in its target, hopefully taking it out by destroying critical circuitry or electrocuting crewmembers. Because the capacitor fractures and melts when activated, haywire grenades may only be used once and are not rechargeable.

Lance

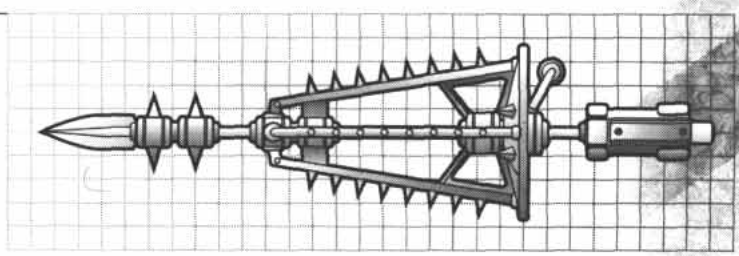
Purpose:	Gear jousting
Effective Range:	5 m
Penetration:	169 mm
Accuracy:	Poor
Mode of Fire:	N/A
Usual Ammo Magazine:	N/A



The simple Smyrna Gear lance is essentially a five-meter long steel alloy pole with a slightly sharpened tip. These are not weapons of finesse; they are designed to smash into the opposing jousting Gear with a maximum of force and entertainment value. Lances are usually made of simple steel, but some have been produced using military grade alloy, including durasheet and armoplast. These lances are only available to Duelists benefiting from wealthy patrons.

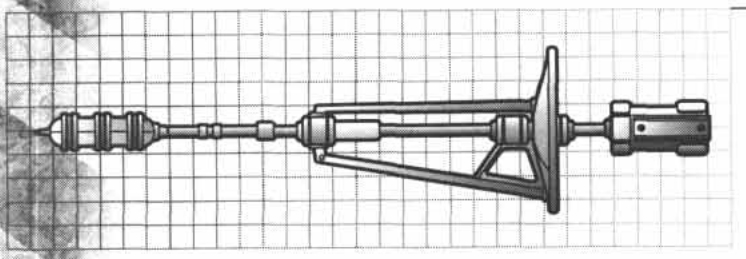
Heavy Lance

Purpose:	Gear jousting
Effective Range:	6 m
Penetration:	225 mm
Accuracy:	Poor
Mode of Fire:	N/A
Usual Ammo Magazine:	N/A



A massively heavy version of the standard Gear lance, the heavy lance is strapped onto Heavy Gears with a huge harness that limits their maneuverability. Heavy lances also feature prongs and barbs designed to inflict great damage on the structure of an opponent. A sleeker version of the heavy lance is mounted on the forearm of the Gear and supported by a secondary handle for the other hand. These are becoming the standard configuration in Smyrna. Heavy lances are more complex than standard Gear lances and so most are produced by Sage Industries. The Sage LX series is the current standard.

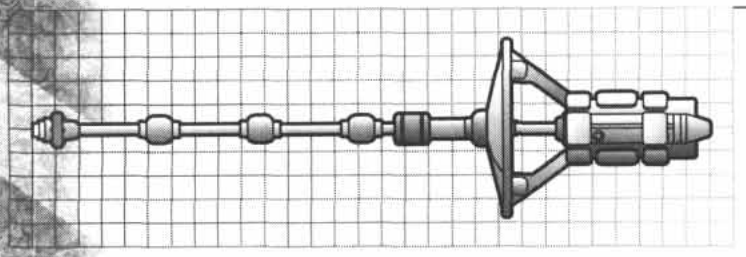
Bryce Hubbard (order #959915)



Explosive Lance

Purpose:	Gear jousting
Effective Range:	5 m
Penetration:	196 mm
Accuracy:	Poor
Mode of Fire:	Single fire
Usual Ammo Magazine:	one explosive charge

A variation on the simple Gear lance, the explosive lance features a shaped charge chamber mounted on the lance's tip. When contact is made during a charge, the explosive's force is added to the momentum of the Gear to cause additional damage. Explosive lances are seen as inferior weapons by several of the top competitors in Smyrna. They claim that it eliminates the factor of skill involved in well-placing a blow.

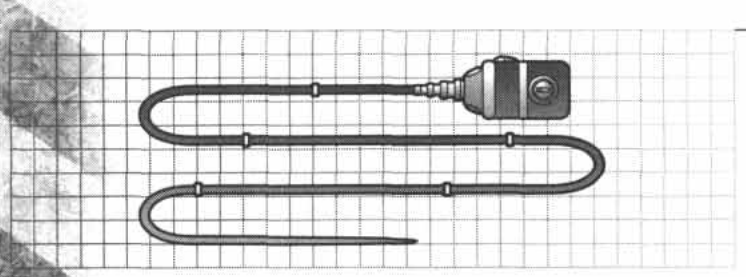


Haywire Lance

Purpose:	Gear jousting
Effective Range:	6 m
Penetration:	81 mm
Accuracy:	Good
Mode of Fire:	Single fire
Usual Ammo Magazine:	6 charges per battery

A much lighter and more flexible lance than is standard, the haywire lance relies of a powerful electro-magnetic charge sent along its length to inflict damage. As such, Gear joust participants need not hit their opponents squarely to inflict damage and often slash at each other with the thin charged lances. Jousts that involve haywire lances are often fought not in the straight track that is standard, but in oblong arenas. This helps compensate for the increased accuracy of the lance.

The Sage LL-39 elctrolance was the company's response to the success of Garidan's explosive lances and remains the jousting standard.

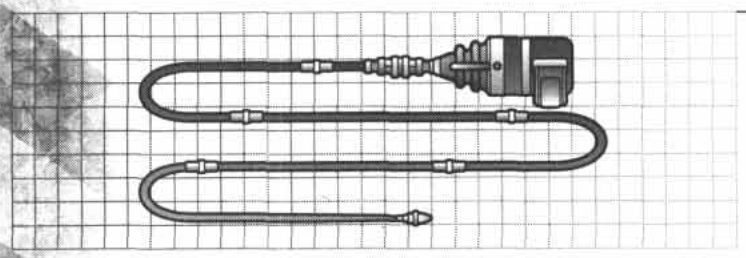


Whip

Purpose:	Dueling
Effective Range:	25 m
Penetration:	49 mm
Accuracy:	Good
Mode of Fire:	N/A
Usual Ammo Magazine:	N/A

Essentially a heavy weighted cable, the Gear-sized whip is used to lash or entangle an opposing vehicle. Practically useless on the battlefield, whips are extremely popular in dueling arenas. Most whips are mounted on a Gear's forearm and linked to a powerful winch which allows them to be reeled in when not in use. Others are carried in coiled whips on a Gear's hip plate.

Paxton Arms introduced the dueling whip to an entertainment-starved Badlands audience with it PD991 whip in TN 1865. The PD991 and its successors have all essentially been clones of the makeshift whips used in underground arenas for decades.



Haywire Whip

Purpose:	Dueling
Effective Range:	25 m
Penetration:	49 mm
Accuracy:	Good
Mode of Fire:	N/A
Usual Ammo Magazine:	5 charges for batteries

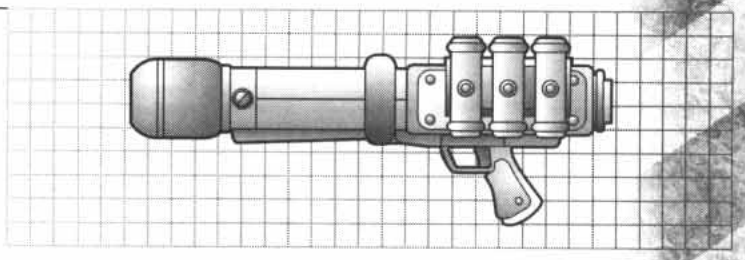
A high-tech version of the simple Gear whip, haywire whips can be used to send a powerful electrical charge from insulated batteries to the entangled opponent. On especially spectacular occasions this current can cause a massive overload of the neural net, the ammunition containment system or the engine.

Frontier Arms, a small Western weapons developer, created the Shocker Whip as a promotional weapon in TN 1903. While FA has remained only a small producer, the Shocker is still the dueling standard.

Bryce Hubbard (order #959915)

Net Gun

Purpose:	Dueling and animal hunting
Effective Range:	400 meters
Penetration:	25 mm
Accuracy:	Average
Mode of Fire:	Single fire
Usual Ammo Magazine:	3



Originally developed to be mounted on vehicles aimed at capturing giant wildlife such as barnabus iguanas or armadillo beasts, the net gun has found a second home in underground dueling arenas. Sometimes tied to a powerful winch, the net gun is used to paralyze an opponent at range. Dueling versions can be set so that the net does not expand, cauisng damage due to concussive force.

The Wildman net gun from Garan Wild Supplies is the model most commonly used in dueling.

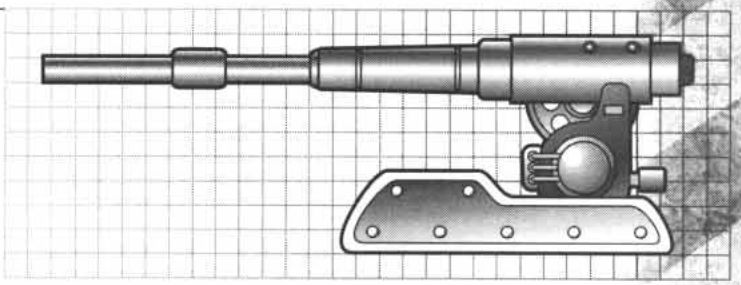
Tube Artillery

Tube Artillery is a blanket term that covers a variety of indirect fire support weapons. Although they might actually be howitzers, mortars, massdrivers or cannons, all of these weapons achieve similar game effects for simplicity and ease of bookkeeping. Tube artillery weapons have been divided into Light, Medium, Heavy and Very Heavy Artillery Guns.

All artillery pieces fire "salvos," a burst of projectiles bound for the same target point. Although a salvo consists of several shots, each firing of the weapon consumes only one salvo. The area effect of the weapon represents the arrival of the salvo's multiple shells/warheads. Firing just one shell is possible (see Ranging Shot, page 23), but the damage effect from its impact should only be worked out in a roleplaying campaign (each shell does half the regular damage, without a tactical AE).

Light Artillery Gun

Purpose:	Artillery/Fire Support
Effective Range:	10 km
Average Penetration:	145 mm
Area Effect:	15 m radius
Accuracy:	Average
Mode of Fire:	single
Usual Ammo Magazine:	40 salvos

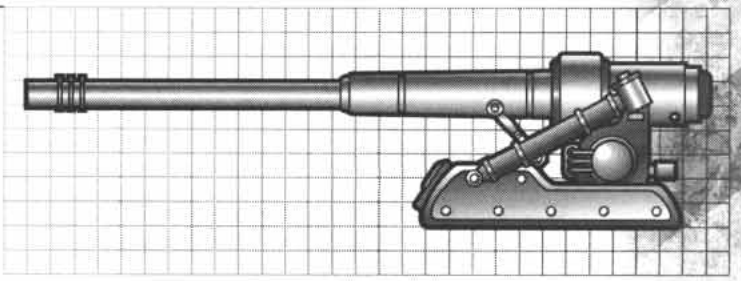


The Light Artillery Gun is a large cannon or howitzer. The usual caliber is around 100 mm, though some units use a smaller caliber and advanced binary propellants or electrothermal technologies to achieve a similar performance. A few rare designs have been based on massdriver technology, but their power requirement and technological complexity have made them unpopular.

The AMD-7 is a Southern massdriver artillery gun. Its drive coils can accelerate packets of kinetic penetration ordinance for normal fire or can load special ammunition canisters for special effects such as smoke. Its high maintenance requirement has prevented its wide distribution to front line units, however.

Medium Artillery Gun

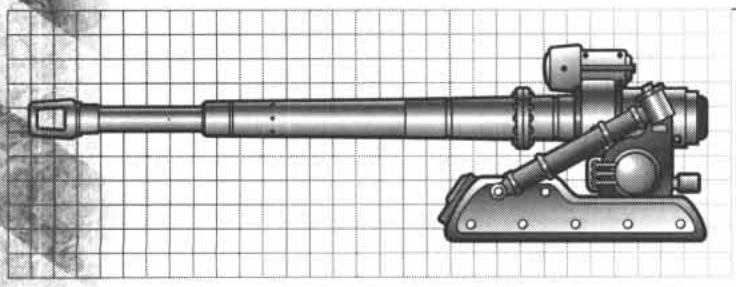
Purpose:	Artillery/Fire Support
Effective Range:	12 km
Average Penetration:	325 mm
Area Effect:	25 m radius
Accuracy:	Average
Mode of Fire:	single
Usual Ammo Magazine:	30 salvos



The Medium Artillery Gun is very similar to its smaller brethren, but uses shells in the 130 to 160 mm range. Some Medium Artillery Guns are actually built around a massdriver, delivering dozens of smaller shells at a time. Medium Artillery Guns are a popular choice for emplacement defenses, but few vehicles have been designed with these weapons so far.

The D7 howitzer is part of the highly successful "D" series manufactured by Dressen, a distinguished Humanist Alliance design and production team. The D-series weapons are renowned for their accuracy and reliability. Dressen is currently under close Republican scrutiny because of rumors that they are holding back their next, more advanced, design.

Bryce Hubbard (order #959915)

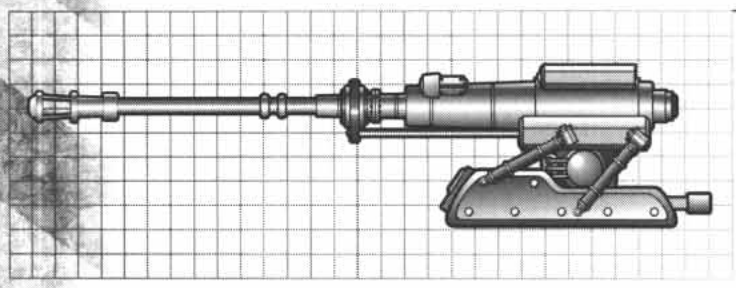


Heavy Artillery Gun

Purpose:	Artillery/Fire Support
Effective Range:	16 km
Average Penetration:	485 mm
Area Effect:	50 m radius
Accuracy:	average
Mode of Fire:	single
Usual Ammo Magazine:	15 salvos

The Heavy Artillery Gun is even larger than the MAG and uses shells in the 170 to 200 mm range. To get excellent performance without unnecessarily reinforcing the gun, many HAG designs use electrothermal cannon technology, or ETC. ETC is relatively old and well understood, but still costly to built into a weapon. ETC weapons inject an electrically ionized gas behind the shell as it travels the barrel, eliminating the loss of performances caused by the normal gas expansion. ETC is often coupled with an autoloader.

The M576 is a close cousin to the 200 mm cannon mounted on the Verder heavy self-propelled gun. Its carriage has been designed for installation in fortification or landship turrets.



Very Heavy Artillery Gun

Purpose:	Artillery/Fire Support
Effective Range:	24 km
Average Penetration:	900 mm
Area Effect:	125 m radius
Accuracy:	average
Mode of Fire:	single
Usual Ammo Magazine:	10 salvos

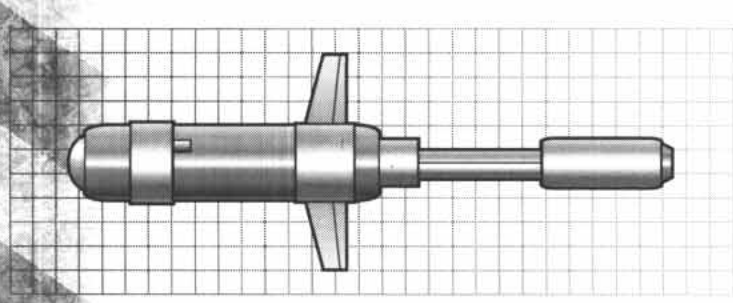
The monstrous Very Heavy Artillery Gun looks like it belongs more on a landship (on which VHAGs are commonly mounted) than on a battlefield vehicle. It can accurately place shells up to 24 km away in battlefield conditions, and special tests have sent rocket-assisted shells to nearly 120 km away. Although many have argued that missiles may prove a better (and less expensive) solution to the problem of long range support, the military is quick to point out the relative impunity of the VHAG's hypersonic shells to enemy counter-measures, electronic or physical.

The Defender Mk IV is the largest electrothermal weapon on Terra Nova. It is commonly mounted in fortification turrets to provide long range punch to city-states and other fortifications. Each shell is almost as tall as a man and must be loaded by a small crane.

Artillery Missiles

Light, Medium, Heavy and Very Heavy Artillery Missiles are long-range battlefield bombardment weapons. They can carry large payloads and are often salvo or ripple-fired to produce maximum area saturation. Most of the launcher designs use high velocity missiles that sprint to the battlefield in one minute or less, even though the battle may be taking place 50 or 60 km away, and dodge all but the most accurate anti-missile fire. This explains the high price of these weapons, especially when compared to the slower cruise missiles.

Unlike Artillery Units, one shot represents one projectile with a single high explosive warhead or multiple scattering submunitions. Artillery Missiles use the rocket and missile ROF ammunition expenditure rule and can be attacked by anti-missile systems.



Light Artillery Missile

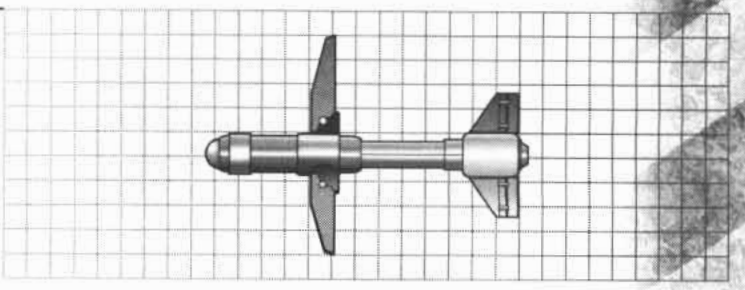
Purpose:	Artillery/Fire Support
Effective Range:	20 km
Average Penetration:	145 mm
Area Effect:	15 m radius
Accuracy:	poor unless guided
Mode of Fire:	burst
Usual Ammo Magazine:	16 missiles

The Light Artillery Missile lies just above the Heavy Rocket in the military arsenal. It carries a heavier fragmentation warhead, but can also be fitted with a variety of ammunition depending on the mission requirements. LAMs are steerable and can receive course corrections in mid-flight from an allied target designator.

Bryce Hubbard (order #959915)

Medium Artillery Missile

Purpose:	Artillery/Fire Support
Effective Range:	24 km
Average Penetration:	325 mm
Area Effect:	25 m radius
Accuracy:	poor unless guided
Mode of Fire:	burst
Usual Ammo Magazine:	8 missiles

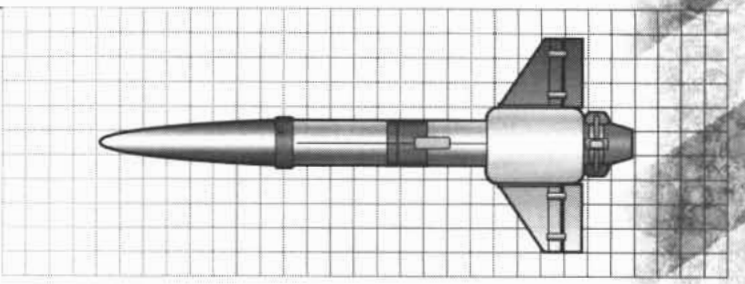


The Medium Artillery Missile is rarely seen on the battlefield. The launcher is usually mounted on a tracked or legged platform and placed far from the action, ready to rain sub-munitions on the field. MAMs are capable of limited steering while in flight and are equipped to use the data provided by allied target designators.

The Hellbringer tactical artillery missile makes the Northern Vandal artillery platform a deadly combatant indeed. Its two huge Hellbringers dominate its chassis, based on the Aller MBT.

Heavy Artillery Missile

Purpose:	Artillery/Fire Support
Effective Range:	36 km
Average Penetration:	485 mm
Area Effect:	50 m radius
Accuracy:	poor unless guided
Mode of Fire:	burst
Usual Ammo Magazine:	4 missiles

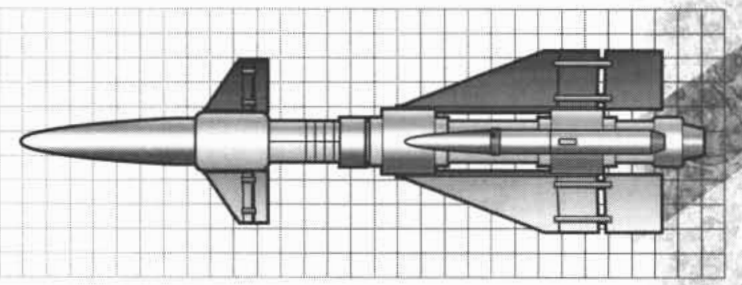


The Heavy Artillery Missile can hit a mobile target from nearly 36 kilometers away if provided with course correction data. Their long range and their large payload make them an extremely powerful form of battlefield artillery. The missiles are small enough to fit a mobile platform but are also often found in fixed defensive positions. Forward observer units deployed ahead of HAM positions can, with the use of a laser designator, destroy the largest of battlefield units.

Paxton Arms manufactures the PAM series of artillery missiles and its main seller is the larged PAM-17, nicknamed the Godhammer by PRDF artillery men. Godhammers are becoming popular in the South and Patriarchal Masao has dropped several on his rebel territories, most especially Basal.

Very Heavy Artillery Missile

Purpose:	Artillery/Fire Support
Effective Range:	60 km
Average Penetration:	900 mm
Area Effect:	125 m radius
Accuracy:	poor unless guided
Mode of Fire:	burst
Usual Ammo Magazine:	2 missiles



Unlike its smaller brethren, the Very Heavy Artillery Missile is so large and powerful it is often fired singly rather than as part of a salvo. The multiple warheads contained in its nose cone cover the attack zone very efficiently. Like the other artillery missiles, the VHAM can carry a large variety of specialized ammunition.

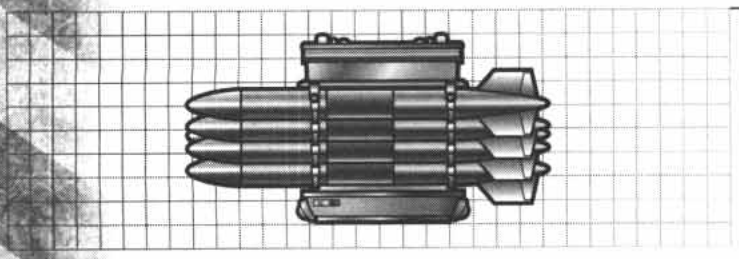
The Riley AR-75 Guided Artillery Missile is among the most widely deployed VHACs in the northern hemisphere. Riley has made significant progress in entering the Badlands market by lauding the AR-75 as a deterence weapon system for small desert communities. With growing global tensions, this sales tactic has worked like a charm.

Bryce Hubbard (order #959915)

Bomb Racks

Bomb racks are specialized hardware designed to hold freefall explosive charges. They are attached to hardpoints on the underside of an aircraft or inside a bomber's weapons bay. All types of bomb racks fit on similar universal mounting points and can be quickly exchanged. Bombs are usually laser-guided and have small fins to control their trajectory for precise, pin-point targeting.

Bomb racks can only be used by flying vehicles.

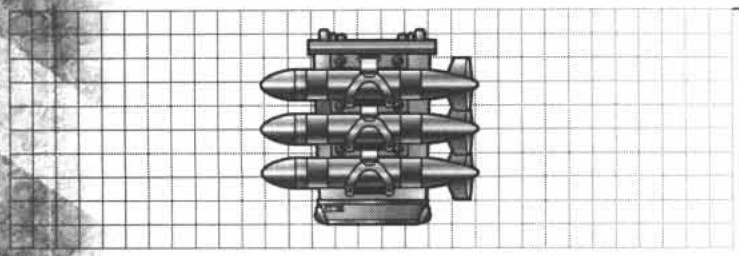


Light Bomb Rack

Purpose:	Area Saturation
Effective Range:	depends on initial speed
Penetration:	100 mm
Accuracy:	average (if guided)
Mode of Fire:	single or saturation
Standard Rack:	9 bombs

The Light Bomb Rack is a mounting frame and integrated guidance system for carrying dead-fall ordinance to the target, almost always in the form of guided bombs. The bombs themselves have no propulsion system, but do have some maneuvering ability to "home in" on their target.

The Light Bomb Rack shown above is a Mark 3 rack holding M36 laser guided bombs. The HF-12 fighter-bomber sometimes carries two such racks with nine bombs apiece on its outer wing hardpoints for ground attack operations.

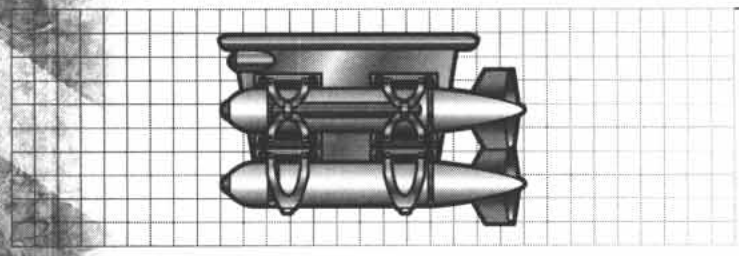


Medium Bomb Rack

Purpose:	Area Saturation
Effective Range:	depends on initial speed
Penetration:	225 mm
Accuracy:	average (if guided)
Mode of Fire:	single or saturation
Standard Rack:	6 bombs

Like the Light Bomb Rack, the Medium Rack is a mounting frame and integrated guidance system for carrying guided bombs. The rack is heavier and sturdier and can support more powerful bombs, although the reinforced frame causes more delay when dropping them and reduces the overall rate of release.

This Medium Bomb Rack is mounted in the main fuselage bay of the Republican RL-5A Quetzal fighter-bomber. Its Mark 78 bombs can shatter most ground targets to a radius of nearly 30 meters from the impact point. The Northern B-3 Buzzard heavy bomber also uses a imilar rack, this time dropping M62 bombs.



Heavy Bomb Rack

Purpose:	Area Saturation
Effective Range:	depends on initial speed
Penetration:	400 mm
Accuracy:	average (if guided)
Mode of Fire:	single or saturation
Standard Rack:	3 bombs

The Heavy Bomb Rack is a highly potent weapon: the bombs it carries can vaporize even the toughest armored target if it is guided to a direct hit. A laser sensor in the nose of the bomb controls small fins that can modify the trajectory of the projectile. The bomb's heavy warhead has an effective kill radius of more than 75 meters from the impact point, and even if it should miss, the concussion effects alone will take out most unprotected targets.

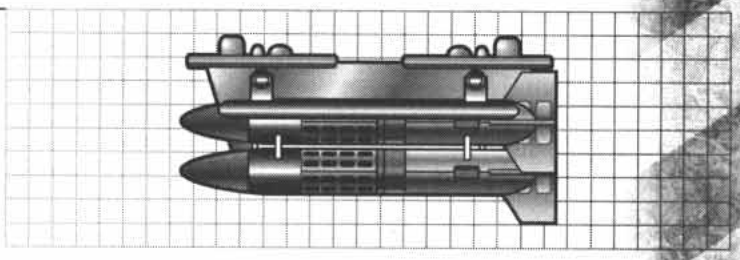
Some racks can be modified to carry heavy bombs equipped with nuclear warheads, although international treaties ban mass-destruction weapons. It is a commonly known, but rarely voiced fact that all major powers have these weapons nevertheless. Indeed, the UMF's armed forces have made use of them on several occasions, most notably to repel the CEF during the War of the Alliance

The Mark 108 bombs carried in the inner wing bays of the Azrael bomber are typical examples of Heavy Bombs. Each rack holds 3 bombs apiece, more than enough for a bombing run.

Bryce Hubbard (order #959915)

Fuel-Air Explosive Bomb Rack

Purpose:	Large-scale destruction
Effective Range:	depends on initial speed
Penetration:	1225 mm
Accuracy:	poor
Mode of Fire:	single or saturation
Standard Rack:	1 or 2 bombs



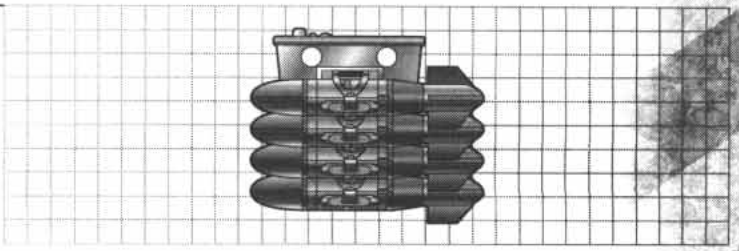
The Fuel-Air Explosive (FAE) Bomb Rack is very powerful, although its explosive radius has been intentionally limited in order to reduce collateral damage. The Fuel-Air Bomb contains a highly volatile gas mixture that is dispersed over a large target area and then ignited. The force of the explosion is followed by additional damage wrought by the intense heat of the detonation, igniting all combustibles at the impact point.

There are some even bigger FAE designs in existence that have an area effect comparable to a small nuclear explosion, but they are generally not seen on the tactical battlefield because they represent too great a danger to both sides.

The FAE-90 bomb carried in the ventral armament bay of the Azrael bomber is its main weapon, capable of a devastating attack against large and powerful targets. Because of the bomb's size and cost, only two are carried per plane. This, however, is considered more than enough, give their devastating power.

Cluster Bomb Rack

Purpose:	Area Saturation
Effective Range:	depends on initial speed
Penetration:	65 mm
Accuracy:	Average
Mode of Fire:	single or saturation
Standard Rack:	10 bombs



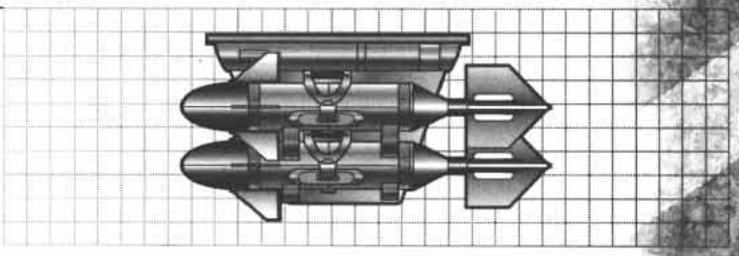
The Cluster Bomb consists of a large aerodynamic container that splits open when above the target area and releases hundreds of small explosive bomblets. The bomb is guided to the target via information downloaded from the launcher's fire control and, just before impact, by a sensor placed in the bomb's nose. The rack itself can release up to two bombs at once and holds up to ten. A trained crew can time the sub-munitions' release to completely saturate a large area in only a few seconds.

The MC-675 bomb contains 120 bomblets which are scattered by an ejection device over a zone nearly 150 meters across. The high bomblet density is very dangerous for any target in the dead zone.

Cluster bomb racks are not part of the standard armament of the major polar bomber designs (the Azrael and Buzzard), but several models have been fitted with these racks in wartime. Indeed, the modification is relatively easy and many militray airfields contain standard kits for refitting the bombers stationed there.

Heavy Cluster Bomb Rack

Purpose:	Area Saturation
Effective Range:	depends on initial speed
Penetration:	144 mm
Accuracy:	Average
Mode of Fire:	single or saturation
Standard Rack:	5 bombs



The Heavy Cluster Bomb is very similar in shape and function to its smaller brother, but it contains even more sub-munitions. These are designed to hit a large, but well defined area, yielding a higher saturation of the target zone. Each bomb contains hundreds of small bomblets equipped with a specialized warhead and a timer.

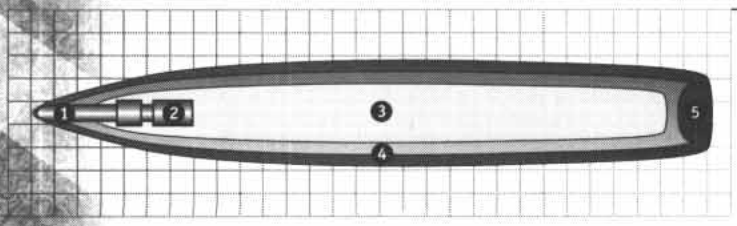
The bomblets are generally a mix of anti-personnel fragmentation warheads, high-armor piercing warheads, incendiary devices and area cratering shells (note that for playability purposes, the actual effects of the bomblets' many types of warheads have been averaged into the cluster bomb's damage multiplier and Area Effect).

The Territorial Arms's Air Division CB-500 "super" cluster bomb is in fact a large profiled container slung under the belly of the plane. It contains 500 high explosive canisters that are ejected over the target to ensure maximum saturation effects.

Bryce Hubbard (order #959915)

Artillery Ammunition

Artillery guns can fire a large variety of ammunition to achieve diverse battlefield objectives. Likewise, artillery missiles can carry different warheads to fit specific needs. When a fire mission is called in, the Forward Observer (FO) will always request the type of round which will compose the mission (whether these rounds are available or not is another matter completely). The following text lists the most common types of shells and warheads used by artillery units, and their game equivalents.

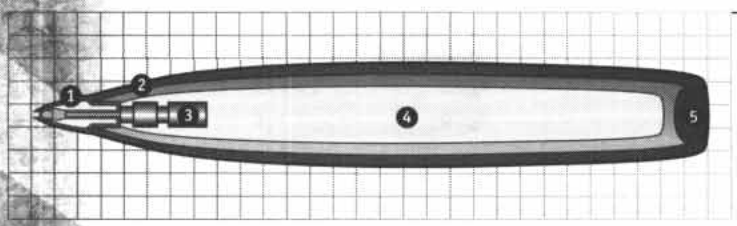


High Explosive

1	Fuse
2	Booster Charge
3	Explosive Charge
4	Fragmentation Liner
5	Base Plug

This is the standard artillery projectile. It carries a large explosive charge housed within a fragmenting body for increased damage. A pre-programmable fuse located in the nose of the shell can be set to detonate the shell on contact, with a delay or above the target. The gunner will normally select the most appropriate fuse setting for the job at hand; it is then automatically downloaded to the shell prior to firing or manually set by the loader on less high-tech weapons.

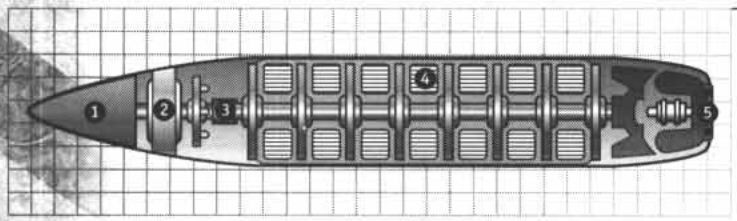
High Explosive is the default ammunition type used by all artillery weapons (cannons and missiles alike). Unless another type of ammunition is requested by the Forward Observer, the battery will always use HE.



Cratering

1	Reinforced Piercing Fuse
2	Standard Shell Body
3	Booster Charge
4	Explosive Charge
5	Base Plug

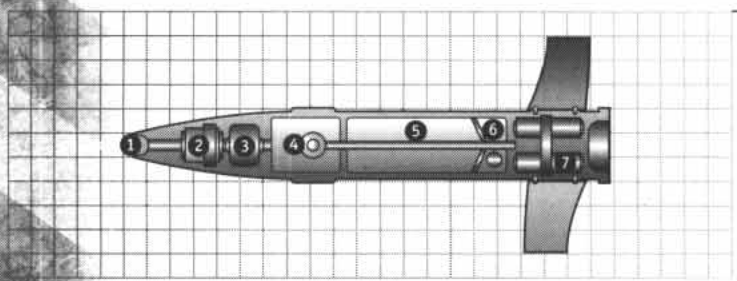
This type of shell is equipped with a special concrete-piercing fuse designed to damage or destroy buildings and other man-made structures such as roads, bridges and bunkers. The heavy piercing fuse enables the shell to burrow within the target before exploding, thus blowing out large chunks of material and weakening the overall structure. The concrete-piercing fuse fares less well against armored or soft targets, since it does not have the right penetration profile.



Flechette

1	Time Fuse
2	Detonator Charge
3	Explosive Charge
4	Flechette Block
5	Base Plug

Also called a beehive, this warhead has been specially designed to harm infantry units and other soft targets. It explodes just above the target point and showers it with thousands of pre-fragmented ceramic shards.



Seeking

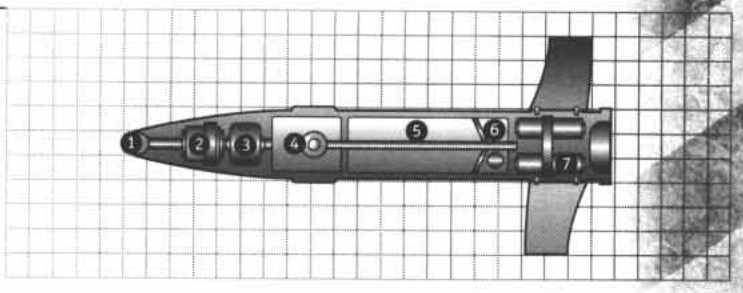
1	Sensor
2	Laser Guidance System
3	Forward Warhead
4	Fuse
5	Main Explosive Charge
6	Flight Gyroscopes
7	Battery

Seeking warheads are a rare type of missiles. The laser sensor array in the nose of the shell allows it to seek a target. The projectile can eve correct its trajectory in flight to try a second time, should it miss on the first pass.

Bryce Hubbard (order #959915)

Guided

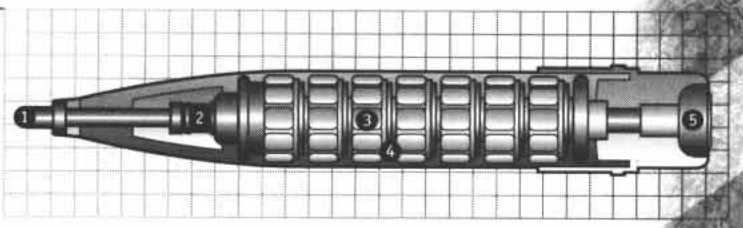
1	Sensor
2	Laser Guidance System
3	Forward Warhead
4	Fuse
5	Main Explosive Charge
6	Flight Gyroscopes
7	Battery



For all intents and purposes, guided shells are cannon-launched missiles. The laser sensor array in the nose of the shell allows it to seek a target and correct its trajectory in flight. Guided shells gain accuracy versus targets that have been "tagged" by an allied target designator within communication range. Attacks versus targets marked by a target designators do not need forward observers.

Illumination

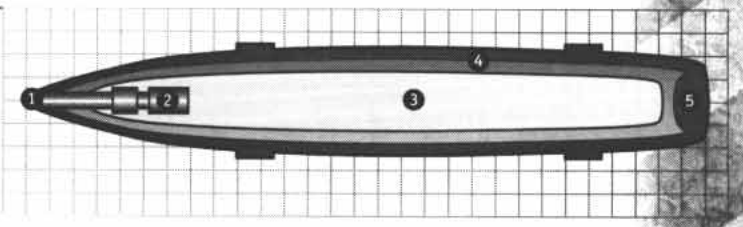
1	Delay Fuse
2	Ejection Charge
3	Flare Canisters
4	Folded Parachutes
5	Ejectable Base Plug



This type of shell carries a series of small parachute-equipped flares. When the shell bursts high above the battlefield, it releases and ignites the flares. These provide several thousand foot-candles each, making the area underneath as clear as day.

Incendiary

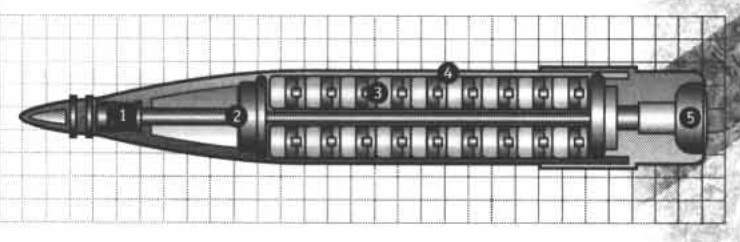
1	Fuse
2	Expulsion Charge
3	Incendiary Material
4	Combustible Liner
5	Base Plug



These shells are filled with an incendiary compound such as napalm or white phosphorus. The fuse is generally set to detonate the shell before impact so the burning agent will be spread out as widely as possible.

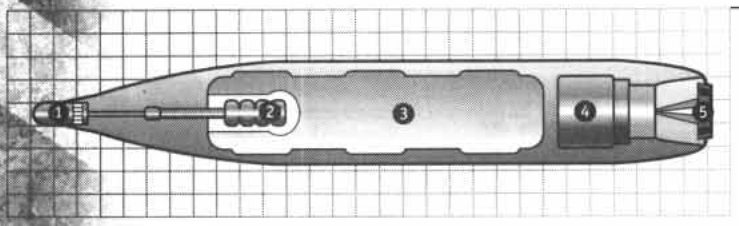
Minelayer

1	Delay Fuse
2	Separation Charge
3	Mines
4	Fragmentation Liner
5	Ejectable Base Plug



Also known as FASCAM (Field Artillery SCAtterable Mines) or ICM (Improved Conventional Munition) shells, Minelayer shells saturate an area with land mines. Although some shells carry anti-personnel mines and others only anti-vehicular mines, great success has been obtained with mixed loads fitted with variable timers. The mines are set to self-destruct over a certain period, usually between 24 to 48 hours after impact.

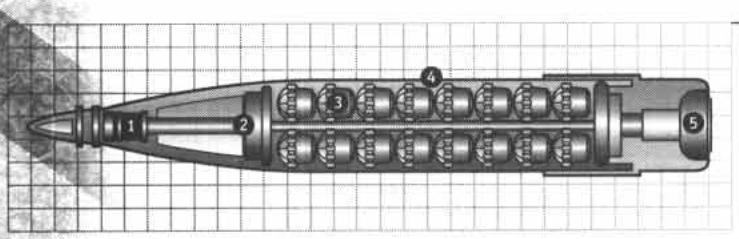
Bryce Hubbard (order #959915)



Rocket-Assisted Projectile (RAP)

1	Fuse
2	Booster Charge
3	Explosive Charge
4	Rocket Motor
5	Reinforced Nozzle

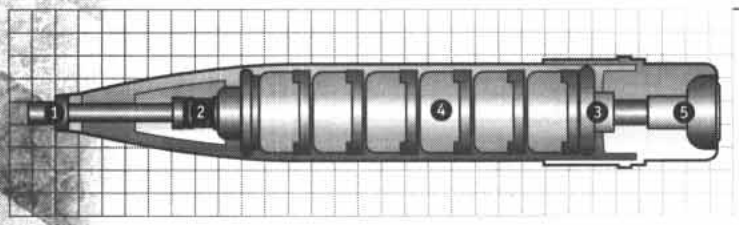
RAP shells are enhanced ammunition fitted with a small, fast-burning rocket motor. Some designs have low thrust/continuous acceleration motors or multi-stage propulsion units for more predictable flight characteristics. All RAP shells and rockets have greatly extended ranges. RAP shells are represented by Boosted Range ammunition (see p. XX).



Seeker

1	Delay Fuse
2	Separation Charge
3	Seeker Sub-munitions
4	Fragmentation Liner
5	Ejectable Base Plug

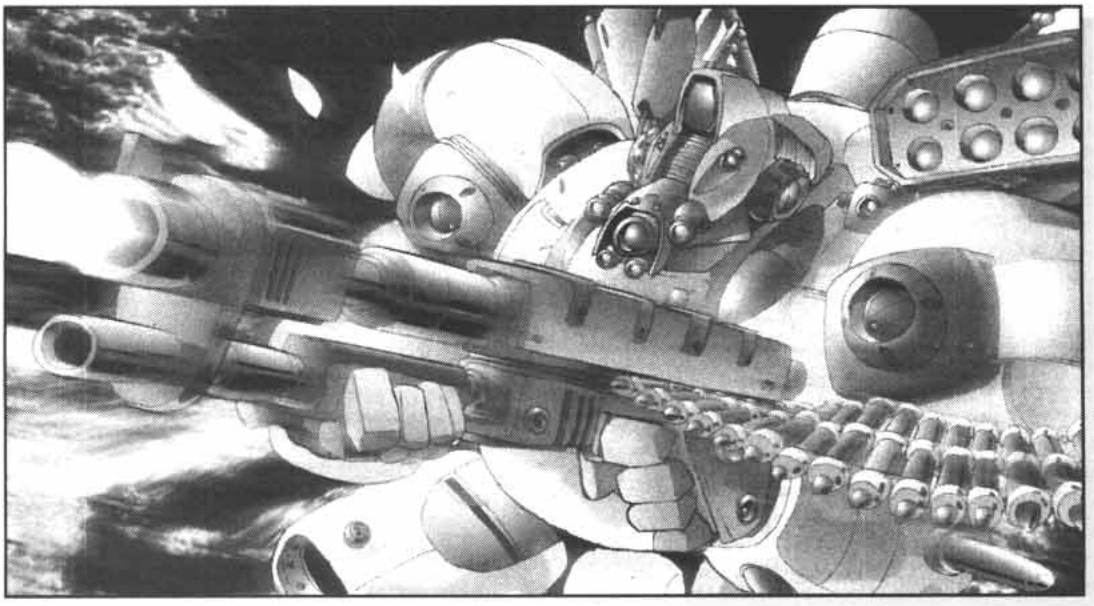
So-called seeker shells are a very specialized type of ammunition designed to attack armored vehicles. It is a "smart" weapon that can provide its own terminal guidance once released. Each shell contains several sub-munitions, each equipped with a miniaturized sensor array and a parachute. As the sub-munitions fall, they seek any large, dense mass nearby. Once a sub-munition finds a target, its explosive charge turns a plate of dense metal into a hypervelocity penetrator that strikes the armored target through its weakly protected top. Seeker shells are represented by Boosted Damage ammunition (see p. XX).



Smoke Shell

1	Fuse
2	Ejection Charge
3	Ejector Rail
4	Smoke Canisters
5	Ejectable Base Plug

Smoke shells contain several sub-munitions filled with a volatile gas mixture that vaporizes into thick smoke of whatever color was chosen. The artillery-fired Black Fog shells contain smoke but also chaff, flares and electronic dummies to interfere with the sensors of hostile forces. Smoke rounds are represented by Smoke and Black Fog ammunition (see p. XX).



Bryce Hubbard (order #959915)

1] OFFENSIVE SCORE

◆ Weapons with FF arc Weapon Threat Rating x 0.6	
◆ Weapons with T arc Weapon Threat Rating x 1.8	
◆ Punch Rating (Damage Multiplier of Arm x 0.5) squared	
Total Rating of All Weapons	
Punch Rating for all arms (if applicable)	
Ammunition	
Offensive Multiplier	

TARGETING SYSTEM MULTIPLIER	
Fire Control Score	Multiplier
5	700
4	120
3	24
2	6
1	2
0	1
-1	0.5
-2	0.333
-3	0.25
-4	0.2
-5	0.167

Offensive Score Targeting System Multiplier x Offensive Multiplier	

2] DEFENSIVE SCORE

◆ (Armor Rating) squared	
◆ (fastest movement speed in kph ÷ 25†) cubed	
◆ (sum of speeds of all other movement types in kph ÷ 6) squared	
† If only movement type is Ground, divide speed by 40 instead of 25	
Defense Multiplier	

MANEUVER MULTIPLIER	
Maneuver Score	Multiplier
7	7500
6	1000
5	180
4	36
3	9
2	3
1	1.5
0	1
-1	0.667
-2	0.5
-3	0.4
-4	0.333
-5	0.286
-6	0.25
-7	0.222
-8	0.2
-9	0.182
-10	0.167

Defensive Score Maneuver Multiplier x Defense Multiplier	

3] MISCELLANEOUS SCORE

(Total Actions granted by Crew) cubed	
(Communication Range in km ÷ 10) cubed	
(Sensor Range in km ÷ 2) cubed	
(Deployment Range in km ÷ 50) squared	
(Sensor Score Communications Score	
Perk/Flaw Point Total) squared	
Miscellaneous Score	

4] THREAT VALUE AND CHARACTERISTICS

Threat Value [Off Score Def Score Misc. Score) ÷ 3	
Default Size Cube Root (Final Threat Value)	

If the Default Size of the vehicle is calculated at less than one-fifth of the Armor Rating, raise the Default Size to one-fifth (round up) of the Armor Rating. The Default cannot be more than ten times the Armor Rating.

Default Cost 1000 x (final Threat Value)	
Actual Size (choose)	

The vehicle may be as large as twice the Default Size score or as small as one-fifth the Default Size score. The Size can be no greater than twice the vehicle's Armor Rating.

Pre-Production Cost Default Cost x (Default Size ÷ Actual Size)	
Production Type:	
Model Lemon Dice	
Individual Lemon Dice:	
Final Cost Pre-Production Cost x Production Cost	

SKETCH

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Bryce Hubbard (order #959915)

6.1.8 Fire Control

Fire Control modifies all of the vehicle's weapon attacks and represents the targeting computers and weapon mounts. Most combat vehicles have a standard military system (Fire Control Rating of zero), which includes rangefinders, gyro-stabilized mounts and recoil compensators for their weapons.

Very high tech vehicles have even sophisticated Fire Control systems, earning them a +1 or maybe even a +2. Simple, cheap or crudely built vehicles often have poor (in term of combat performance) Fire Control systems, rated at -1 or lower.

The minimum value for Fire Control is -5: a metal sight on a wobbly hinge, with pull-cord trigger. The table below shows the typical systems included for each Rating (which include all the systems listed before).

If the vehicle is a non-combat vehicle with no weapons, a Fire Control Rating should still be assigned to represent its potential for mounting them. Most non-combat vehicles have fire control Ratings of -3 or less — they don't have built-in dedicated targeting computers or gyro-stabilized mounts. Pintle-mounted weapons do not use the Fire Control system (see the *Pintle Mount* Perk, page 123).

Typical Fire Control Systems

Rating	System
-5	No HUD, Iron Sights
-4	Dampened Weapon Mount
-3	Horizontal Stabilization
-2	Vertical Stabilization
-1	Basic Targeting Radar; Basic HUD Reticle
0	Gyro Stabilization
+1	Improved Lead Tracking Software
+2	Full Leading Reticle
+3	Self-correcting Weapon Systems
+4	Advanced Radar*
+5	*Enemy Weakness Analysis**

*Hypothesized

Designer's Hint: Fire Control

Fire control systems can send the vehicle's cost through the roof, so moderation should be applied when selecting a Rating. If extremely accurate attacks are desired, individual weapons with high Accuracy may be a better choice. Taking a negative Fire Control instead of zero may sound suicidal, but is a good way to stuff more powerful weapons in the vehicle. Just remain stationary before firing.

Design Example

Kurt assigns his Gear an adequate but otherwise unremarkable mass-produced fire control system. He writes down "Fire Control: 0."

6.1.9 Sensors

The quality and the Range (in kilometers) of the vehicle's sensor array is chosen at this point. The Sensor Rating represents the resolution and processing speed of the vehicle's detection systems and is crucial for battles in obscured environments. The actual type of sensors carried is left to the designer's choice, and has little relevance to the rules.

A generic military sensor array has a Rating of 0. Poor or incomplete sensor systems are rated with negative values (the minimum value is -5), while high quality sensors have positive Ratings (up to +5). If the vehicle has no built-in sensors of any kind, "N/A" is written down in both entries and the No Sensor Flaw is added (see *Perks and Flaws*, page 112); both Rating and Range count as zero for calculation purposes. The table below shows the typical systems included for each Rating (which include all the systems listed before).

Battlefield vehicles normally have Sensor Ranges of at least 2 km. Sensor Ranges are rarely greater than 7 or 8 km — mainly because that is about how far the horizon is on an Earth-Sized planet when seen from a combat vehicle. This passive base Range can be extended by turning to Active mode and supplying power to the system (see page 17), but this makes the emitter quite visible to hostile sensors.

Sensors mounted on a flying vehicle benefit from a higher vantage point and much less background clutter, allowing them to reach further for the same power. When the aircraft is in the air, the Range of its sensor array is multiplied by ten *while in the air*. Thus, if a plane had a 2 km Sensor Range on the ground, it would be able to passively detect other objects up to 20 kilometers away in the air.

Spacecraft-mounted sensors have an even better environment to work in, since there is no atmosphere to distort the readings. The Range of a spacecraft's sensor array is multiplied by one hundred. Thus, if a spaceship had a base 2 km Sensor Range, it would be able to passively detect other objects up to 200 kilometers away *while in space*.

Typical Sensor Systems

Rating	System
-5	Hand-held Sensor Devices
-4	Basic Optical
-3	Basic Infrared or Ultraviolet
-2	Low-Light
-1	Basic Radar, Motion Detection
0	Ladar, Integrated Sensors
+1	Thermographic, Hi-rez Imaging
+2	Magnetic Resonance, Ultrasonics
+3	Broadband High Power Sensor Suite
+4*	Multiscanner
+5*	Sub-Atomic Resonance

*Hypothesized

Bryce Hubbard (order #959915)

◆ Designer's Hint: Sensors

The Sensor Range should be equal to or higher than the Extreme Range of the most powerful weapon system aboard the vehicle. If not, the crew will not be able to use the weapon to its maximum capability. The basic Sensor Range can be boosted (see page 135 of the rulebook), but doing so makes the emitter much more visible to the enemy.

◩ Design Example

Kurt wants his vehicle to have average quality sensors, so he writes down "Sensors: 0." He chooses to give his Gear only short ranged sensors to reduce costs, so he adds "Sensor Range: 2 km" beside his previous entry.

6.1.10 Communications

The quality and the Range (in kilometers) of the vehicle's communications array is chosen at this point. A generic military communications system has a score of 0. Poor systems are rated with negative values (minimum is -5), while high quality systems have positive Ratings (maximum +5). If the vehicle has no communication system, "N/A" is written down in both entries and the No Sensor Flaw is added (see *Perks and Flaws*, page 112); both Rating and Range count as zero for calculation purposes. A communication system can also play back standard data disks. The table below shows the typical systems included for each Rating (which include all the systems listed before).

Communication systems normally have a ground Range of at least 10 km. This can be extended by supplying more power to the system, but makes the emitter more visible on sensors (see page 17). Some Perks can affect the Rating and Range of the Communication system (see *Perks and Flaws*, page 112).

Because there are fewer obstacles to get in the way of radio waves, communication systems have a better range in the air and in space. Communication Range is automatically multiplied by ten at no cost, *while in the air*, for Flight-capable vehicles. Range is automatically multiplied by 100, *while in space*, for space-based communication system.

◫ Typical Communication Systems

Rating	System
-5	Signal Flags, Lights, Horns
-4	Short-range Hand-held Comm Devices
-3	Basic Radio
-2	Shortwave Radio w/basic scrambler, GPS
-1	Military Radio w/Scrambler
0	Laser Comm
+1	Advanced Descrambler
+2	Dedicated Comm Suite
+3	Broadband High Power Comm Suite
+4	Neutrino Comm Receiver
+5*	Sub-Atomic Wave Comm

*Hypothesized

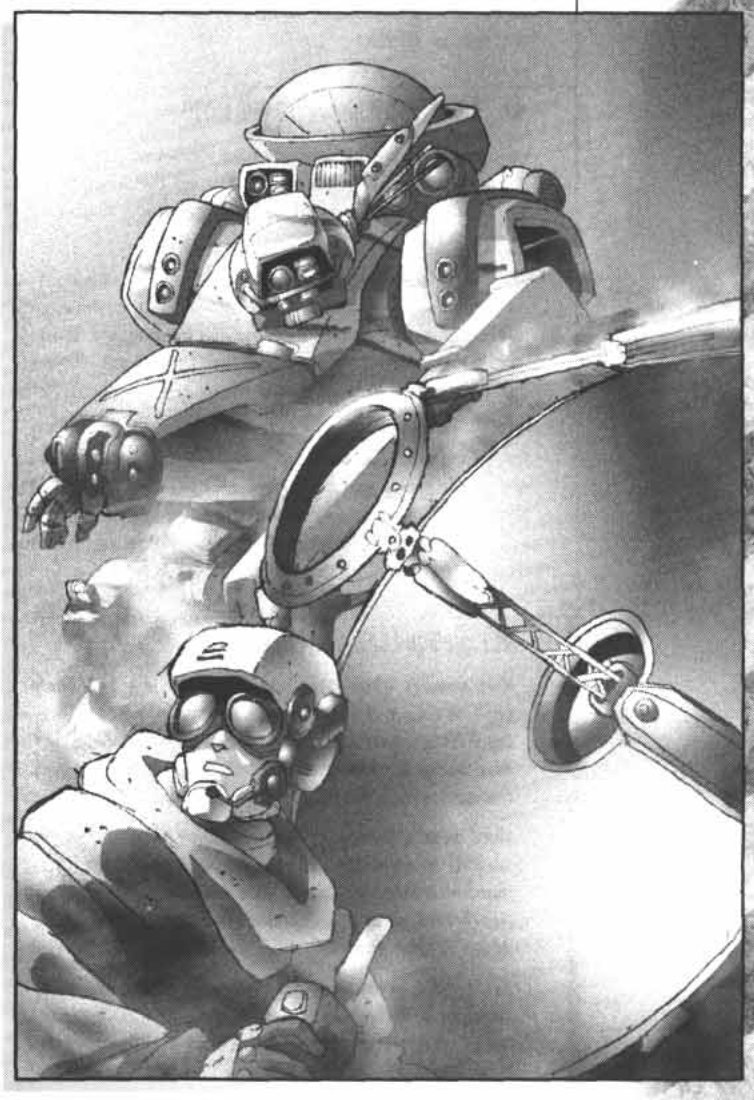
◆ Designer's Hint: Communications

A functional Communication system is more important than it seems. It allows the vehicle to receive coordinates for indirect fire, transmits the correct IFF signal to friendly defense installations such as minefields and automated turrets and can be used to control remote drones. A vehicle without a functional Communication system is cut off from its combat group and cannot receive Command Points.

Non-combat vehicles like transports often have poor communications systems, which doesn't mean they are cheap — they are just not designed to cut through the military electronic fog. They rate a -2 or -3 and have a base Range of less than 10 km.

◩ Design Example

Kurt wants his Gear to have a serviceable military communication system. 10 km seems like a good Range for his comm system. He writes down "Communications: 0, Communications Range: 10 km."



Bryce Hubbard (order #959915)

6.1.11 - Perks and Flaws

Many vehicles have special features, such as ejection systems and cargo bays, that are not covered by the vehicle's tactical statistics. These features are represented by characteristics called Perks and Flaws. Perks are systems or design features that give additional capabilities to the vehicle; numerous Perks can make a vehicle very complex. Flaws are design shortcomings or defective systems that impair the vehicle. Sometimes these defects are planned into the vehicle as a cost cutting measure, at other times they are the result of design errors.

A complete explanation of each Perk and Flaw follows. Those that apply should be noted along with their Rating (if applicable) and their point cost. All Flaws have a negative cost — they reduce the total Perk/Flaw cost of the vehicle. When calculating the Threat Value of the vehicle (see page 134), the minimum cost of the Perks and Flaws is 0.

Perks whose name is followed by AUX are defined as Auxiliary Systems for damage purposes. Perks whose name is followed by R have a Rating. The Rating of the Perk is listed after the name of the Perk on the design sheet. Many Perks are primarily intended for background and roleplaying purposes and do not have significant tactical effects.

◆ Designer's Hints: Perks and Flaws

Perks and Flaws are the greatest pitfall for new vehicle designers in Silhouette. Typically, a beginner's first vehicle design has dozens of Perks and relatively few Flaws (if any). There are two ways to control Perk costs.

The first is to cherry-pick the Perks that are most important to the design and leave out minor improvements that drive costs upwards without significantly improving performance. It is always assumed that basic equipment such as seatbelts and headlights are already included — there is no need to buy the Reinforced Crew Compartment or Searchlight Perks, for example.

The second method to control cost is to select appropriate Flaws to compensate for the chosen Perks. For example, the cost of a Satellite Uplink or other complex electronic systems could be reduced by adding the Vulnerable to Haywire Flaw, representing the vehicle's sensitivity to massive electrical attacks.

◩ Design Example

Kurt ponders what Perks and Flaws his Gear will have. First, as a Gear, it should have arms. Kurt selects two Rating 6 Manipulator Arms. He notices that these arms often have optional reinforcement to allow punching. He keeps this option in mind.

Since most of Terra Nova is covered with deserts, it seems sensible to make the Gear sand-proof with Hostile Environment Protection: Desert. As a final touch, the Easy to Modify Perk is added to represent the simple, no-nonsense design of the machine.

Kurt looks over the Flaws list in an attempt to lower costs, but since he intends to use his new Gear as a major building block of his army, he plays it safe and foregoes the Flaws entirely.

Perks

◆ Ablative Armor R

One (or more) facing of the vehicle is covered with a special armor plating which shatters under kinetic stress or vaporizes when hit. This absorbs incoming damage, but the ablative armor must invariably be replaced after each battle. The maximum amount of ablative armor that may be carried is equal to half the Armor Rating of the vehicle, rounded down. Each defensive arc (Front, Sides and Rear) must be protected separately.

When the vehicle is hit, the current Perk Rating is added to the Armor Rating of the vehicle. Ablative armor automatically loses 1 point from its Rating per ten points of damage every time it is hit. This is in addition to the normal Armor damage of the vehicle, if applicable. The Ablative Armor loses points on every hit of ten or more points of damage, whether the attack inflicts a system damage result to the vehicle or not.

Cost = Rating/2 (per defense arc)

◆ Acceleration Protection

Aircraft and spacecraft with this Perk have been modified to reduce the strain of acceleration on their crew, either through special cockpits, G-seats or advanced flight suits. Crew have a +1 bonus whenever they have to make a FIT roll due to sharp turns or other effects of acceleration. Only Flying and Space vehicles can take this Perk.

Cost = 1

● Acrobatic Handling AUX R

The maneuvering systems of battlefield Gears are designed with overall motion in mind. War machines must be able to move quickly and efficiently over varying terrain, but elaborate jumps are well beyond the needs of the military. All these factors are important in duels as well, but there is an added need for close-combat maneuverability. Being able to jump and flip the Gear through tight obstacle courses and to avoid multiple tackling opponents is not only useful but extremely crowd pleasing.

The Rating of Acrobatic Handling is added to the Gear's Maneuver score for close combat attacks and defenses and when defending against point-blank attacks. The Perk gives no advantage for any attack made from Short Range or further. Acrobatic Handling also modifies any rolls made for jumps, flips or kicks.

No Gear may take a Rating in Acrobatic Handling higher than one above their Maneuver Rating. Gears with negative modifier Ratings and vehicles without the Walker movement type may not take Acrobatic Handling.

Cost = Rating x 6

Bryce Hubbard (order #959915)

◆ Advanced Controls

The vehicle has a very advanced, user-friendly control interface. The great ease of its use allows the vehicle to have one extra action each combat round, regardless of the number of crew members aboard. This type of system is fairly complex to design, and as such very few vehicles feature it.

Cost = 10

◆ Advanced Neural Net

Advanced neural nets are the "smart" computers that form the core of the newest generation of Terranovan military vehicles. They were developed in part with technology recovered from destroyed or abandoned Earth vehicles and spaceships. Advanced neural nets are harder to manufacture and more expensive than regular NNets, but they give incredible response time to all of the vehicle's on-board electronic systems.

Advanced neural nets are highly responsive. If the crew spends one action at the beginning of the turn, it can add a +1 modifier to the vehicle's Maneuver Rating for the entire combat turn. Advanced neural nets also automatically get the learning ability (see *Neural Network*, page 11, for more detail).

Cost = 10

◆ Airdroppable

The vehicle is equipped with a parachute or an equivalent device that allows it to be dropped from high altitude onto a battlefield. The vehicle's suspension and drive train have been specifically designed to absorb the shock of landing without suffering any damage. For example, the vehicle can be built with high-impact actuators in its suspensions along with reinforced hardpoints along its upper hull to attach a parachute pack.

The Airdroppable Perk should be added to vehicles that will be parachuted in with airborne units. Note that the maximum mass of an airdroppable unit is 25 tons, as listed in the **Tactical Air Support** sourcebook (page 94). Machines with the Airdroppable Perk tend to be light armored vehicles or advanced Gear models. This Perk has limited tactical applications, unless the scenario specifically allows this type of deployment, but it could lead to some interesting (and potentially spectacular) roleplaying and tactical campaign opportunities.

Cost = 4

◆ Airlift Ready

Airlifting can be used to deploy a vehicle rapidly or to allow it to cross major obstacles. Vehicles with this Perk have been equipped with quick-connect hardpoints and are reinforced in a manner that makes them easy to airlift by VTOLs and rotary wing aircraft (the latter just have to lower slung load cables and wait for the vehicle's crew or techs to attach them).

A vehicle with the Airlift-ready Perk can be prepared for take-off in half the time normally required to do so for a vehicle of its Size. See *Airlifting*, page 23 of **Tactical Air Support**.

Cost = 1

◆ Airlift Winch AUX R

The aircraft is equipped with a rugged system which enables it to airlift troops and/or cargo without having to land. In most cases, this is a simple crane on a rugged swing arm that extends out of the aircraft's cargo bay.

The Perk's Rating gives the maximum number of troopers that can be airlifted in a single Air War or tactical round, or the maximum Size of any airlifted cargo. The Perk Rating cannot be higher than half the final Size of the aircraft.

This Perk is only useful to VTOLs, since the vehicle has to be airborne, stationary and at altitude level 0 or 1. Only Flying vehicles can take this Perk.

Cost = Rating

◆ Ammo/Fuel Containment System

The vehicle's ammunition and fuel bays are reinforced and equipped with additional blast-control panels. The system goes above and beyond the safety devices normally installed in a a vehicle of that type.

The system completely absorbs the first hit when an "Ammo/Fuel Hit" result is obtained on the Fire Control Damage Table — there is no further damage beyond the lost Armor points, but the Perk is destroyed. The Perk's effect can be restored by normal repair if a technician works on the vehicle after combat.

Cost = 4

◆ Ammo Storage

The vehicle is equipped to store some or all of its spare ammunition clips in an armored compartment to protect them against damage. If there is no Manipulator Arm or ammo-reloading Tool Arm mounted on the vehicle, the crew must reload the weapon manually, at a rate of one shot per action. The clips are not counted as AUX systems and can only be destroyed when actually in the weapon. The cost is one point per ten TV points of ammunition stored, regardless of how they are divided into clips.

Cost = 1 per 20 TV points of ammo stored (rounded up)

◆ Amphibious

The vehicle is adapted for occasional water travel such as river crossings and amphibious assaults. The lower hull is watertight, though it does not necessarily allow the vehicle to float, and a snorkel let the engine function normally. Often, wavebreakers and additional floatation skirts can be attached to the hull.

In the tactical game, the vehicle may travel across Water hexes, paying MP according to its normal movement type (*not* as a Naval vessel). In the roleplaying game, the vehicle is amphibious, but is not intended for extended aquatic activity. This Perk does not grant the vehicle Submarine movement.

Note that the amphibious Perk is only available to vehicles with either the Walker or Ground movement systems.

Cost = 5

Bryce Hubbard (order #959915)

◆ Anti-Missile System

Anti-missile systems (AMS) are designed to detect and destroy missiles before impact. They usually take the form of rapid-fire, small-caliber machine-guns, though small counter-missiles or shotgun-like devices are also used. All these missiles are mounted in small independent turrets on top of the hull to ensure both a rapid response time and complete coverage of the surrounding area. Anti-missile systems are most often used on slow and ponderous vehicles such as heavy tanks and landships, because their weight and clumsiness prevents them from dodging.

In game terms, each functional anti-missile system grants the vehicle an additional special defense roll versus projectiles such as missiles and rockets. Anti-missile systems can be activated or deactivated at the cost of one action (it is assumed they are "on" at the start of the battle). Active anti-missile systems do not use up actions and roll versus every incoming missile or missile cluster (burst attacks). If not currently in active mode, they can also be fired as normal weapons (x1 Damage Multiplier, ROF 3 with a Base Range of 1) at the cost of one action.

The anti-missile system has a Skill level of two, plus its Rating. It can attack any type of mortar shell, rocket, or missile, but not bazooka projectiles. If the result of the anti-missile system is greater than the attacker's roll, the anti-missile system shoots down the missile. The AMS completely destroys the missile when successfully used versus a single shot attack. When used to defend versus a missile cluster (ROF attack), the same technique is used, but each point of the MoS reduces the incoming cluster's ROF bonus by one. If the ROF bonus drops to zero or below zero, all of the incoming missiles have been effectively destroyed.

The amount of shots spent each time the system is fired is equal to five minus the MoS, with a minimum ammunition cost of 1. The maximum number of units of ammo that can be carried is equal to ten times the vehicle's final Size. There is no limit on the number of AMS carried per vehicle, but no AMS may have a Rating higher than 3.

Cost = (Rating x 5) + (0.1 x units of ammo)

◩ Example:

Gear Alpha fires an anti-tank missile at Tank Beta. Gear Alpha's final attack roll, after modifiers, is 5. Tank Beta's total defense roll is a 2. Fortunately, Tank Beta has two Rating 2 anti-missile systems, both currently active. The two systems roll 2 and 4, modified to 4 and 6 by their Rating. Since the second system's roll is better than Alpha's attack roll, the second anti-missile system shoots down the incoming missile (the first one just misses). The systems spend five and four units of ammunition, respectively (no MoS for the first one, MoS 1 for the second).

Seeing this, Gear Alpha's teammate, Gear Gamma, launches a ROF 3 rocket salvo toward the tank. Its total attack roll is 5. Tank Beta rolls another 2 for defense, so the anti-missile system activates again (it does not use actions and attacks every incoming missile attack). The first one rolls a 6, modified by 2, for a total of 8. The MoS is equal to 3, so the ROF bonus of the attack drops to zero. Of the salvo, only one rocket will strike the tank. If the second AMS hit as well, nothing will reach the tank.

◆ Anti-Personnel Charges AUX R

Anti-Personnel (AP) charges are directional fragmentation mines mounted on the hull of a vehicle as a deterrent to close assault by infantry units. When an infantry squad closes to within 25 meters of the vehicle, a small proximity sensor detonates one or more charges in the direction of the unit, slicing through their ranks and showering them with deadly shrapnel. Fortunately for infantrymen, the system is not fool-proof and sometimes either fails to function or does so too late, allowing the attackers to get to cover before the blast hits.

AP charges can be turned on or off at the cost of one action. They are either all on or all off — it is assumed they are "on" at the start of a battle. They have a Damage Multiplier of 3 and roll two dice for their attack roll, adding their Rating to the dice roll. No AP system may have a Rating lower than one (1) or higher than three (3).

Each firing of the system consumes one die's worth of charges. The range of the AP charges is 0 (Point Blank only — the infantry must be in the same hex as the vehicle) and they have a "T" firing arc. Firing AP charges does not use up actions — the system automatically attacks all infantry units (friend or foe) in the hex once per turn until the infantry unit is destroyed, leaves the hex, the system runs out of charge or is turned off.

The hull-mounted position of the charges makes them very vulnerable to enemy fire. Anti-personnel charges count as auxiliary systems, but damage is applied differently for them. On Light damage result, two dice's worth of charges are destroyed. On Heavy damage result, all charges are detonated and lost. It is not possible to armor or otherwise protect the AP charges, as this would reduce their performances below acceptable level.

Cost = (3 x Rating) + (0.02 x number of charges carried)

◆ Aquatic Sensors AUX

The vehicle is equipped with various underwater sensors such as sonars, magnetic anomaly detectors, and specialized cameras. These allow the vehicle to use its sensors effectively underwater. Vehicles with this Perk do not suffer obscurement effects from water terrain. A vehicle may be equipped with aquatic sensors in addition to its normal sensors, or it may be equipped exclusively with aquatic sensors. Vehicles with only aquatic sensors use the sensor range that would have been used by their "normal sensors," if they had any. Vehicles with both must specify the range of both types of sensors.

Aquatic sensors must normally be immersed in water to function. In tactical terms, this means that the vehicle only ignores the Obscurement effects of water while in water itself. Some vehicles, often aircraft, have aquatic sensors that do not need to be immersed in water to function. However, they must be within a minimum distance (often under a kilometer) from the body of water they wish to scan.

If aquatic sensors can be used out of water to detect targets in water, an additional +1 is added to the cost per 100m (2 tactical hexes) of distance this ability extends to.

Cost = 2 (if only aquatic sensors) or
2 + 1/2 of Range in km of aquatic sensor (if both)

Bryce Hubbard (order #959915)

Artificial Intelligence R

The vehicle is capable of independent action and decision making. The Perk counts as one crewmember. No live crew need be added. Additional "crewmembers" on an AI-controlled vehicle are often added using the Automation Perk.

The Rating of the AI is used as the Skill level of the "crew." AI are not true intelligences: they lack personality and flexibility. They also lack the rapid learning ability of more advanced neural nets, but are better at independent action because of their extensive data banks and expert systems.

Artificial Intelligence is not affected by "Crew" hits; any such damage is ignored, though Armor is lost as usual.

Cost = 25 + 25 x Rating

Audio System AUX

The vehicle has an audio system, similar in function to a 21th century car stereo. The audio system is fully digital and can serve as a radio receiver or play back standard datadisks. It also includes large speakers capable of high decibel output. This system has no tactical game effect, but offers roleplaying opportunities.

Cost = 0.5

Automation R

This Perk substitutes mechanical and electronic systems for real crew members. They can be anything from an autoloader for the main gun or additional computers for the sensor system — all that matter is the extra "manpower" they supply.

The Rating of the system is equal to the number of crew members the Perk simulates. The vehicle must have at least one live crew member or the Artificial Intelligence Perk, except if it is a remotly-controlled vehicles (see page 13).

Cost = 10 + Rating

Autopilot AUX

Autopilots are devices that can take over the piloting tasks. They can keep the vehicle going in a straight line, avoid large obstacles and steer the vehicle towards a prespecified location. In tactical terms, an autopilot is very limited. It can be used to keep a vehicle moving in a straight line or performing 60° (one hex-facing) turns. Autopilots cannot fire any weapons and dodge attacks as a level 1 pilot. They can, however, be used to ram large targets as a level 1 pilot without endangering the crew (who just exit the vehicle).

Cost = 5

Backup Communications System

The vehicle may ignore communication system damage effects of the first Auxiliary System Hit on the Systems Damage Table. All non-communication auxiliary systems take normal damage effects. The Perk's effect can be restored by a normal repair if a technician works on the vehicle after combat.

Cost = 2

Backup Fire Control

The vehicle may ignore the first "Fire Control Destroyed" result on the Fire Control Damage Table. The Perk's effect can be restored by a normal repair if a technician works on the vehicle after combat.

Cost = 5

Backup Life Support

The vehicle has backup life support systems that allow the vehicle to continue providing life support functions long after the primary system has been disabled. In game terms, the vehicle continues to have life support even if the vehicle has all of its auxiliary systems destroyed. The vehicle must already have a life support system (see *Life Support*) to take this Perk.

Cost = 2

Backup Sensors

The vehicle may ignore the sensor damage effects of the *first* Auxiliary System Hit on the Systems Damage Table. All non-sensor auxiliary systems take normal damage effects. The Perk's effect can be restored by a normal repair if a technician works on the vehicle after combat.

Cost = 5

Battle Arm R

The vehicle has a rudimentary arm to carry and orient weapons or other pieces of equipment. Battle Arms are merely flexible projections and are common only on striders.

While battle arms are not nimble at all, they can lift objects (provided these have been attached to the arm) whose Size score is equal to the arm's Rating. No matter the Rating of a battle arm, a vehicle cannot lift an item whose size is greater than twice its own size. If a vehicle has multiple arms, it can use these together to increase its lifting ability. Add one half the Ratings of the weaker arms to the full Rating of the strongest arm to determine the lifting strength of multiple arms.

Battle arms can be designed to punch opponents: they then end in a reinforced battering ram or other brawling weapon. This attack type has a damage score equal to the lifting capacity of the arm. This ability modifies the Offensive Score of the vehicle.

Cost = 0.2 x Rating for each arm

Camo Netting

The vehicle is covered with a heat-absorbent tarp which has a net attached to it. Leaves and other camouflage material can be attached to it, while heat is absorbed by the tarp. This gives a +1 to Concealment when in Woodland or Jungle hexes. The camouflage tarp is custom designed for each vehicle type, ensuring that it covers most of the hull and blurs the overall silhouette. Most tarps are made to be easily stored and installed. This Perk is only effective when the vehicle is stationary.

Cost = 1

Bryce Hubbard (order #959915)

◆ Cargo Bay

A cargo bay is a large hollow place within the vehicle to put miscellaneous material. Cargo bays can be designed for unusual cargo: some cargo bays are meant to carry only liquids, like the tank of a fuel truck. Others are compressed gas containers, like a tank of fire fighting foam. Of course, cargo bays can always be simple hollows intended to store boxes of goods. Although specialized cargo bays often cost more to design and build, their inherent lack of flexibility cancels this — thus no extra TV points are charged for them.

Cargo bays are rated in terms of their volume in cubic meters. The intended type of content of each cargo bay must be specified at the time of construction: solid, liquid or gaseous. Cargo bays are enclosed within the vehicle. Open-topped bays are also possible, but material carried in such a bay is counted as an AUX system for damage location purposes.

It is important to note that the cargo space bought represents only the actual space dedicated inside or on the hull of the vehicle, not an increase in the power of the engine. Thus, the cargo's weight counts as "towed" material for game purposes. Cargo bays have a minimum dimension of one meter, square or cubic. It is always preferable, when designing the vehicle, to state the actual dimensions and shape of the bay to see what can be fitted in it. Vehicles are assumed to occupy a volume roughly equal to (Size/2 + 1) cubed, rounded up.

Very small Cargo Bays (under one cubic meter) are not required to carry a crewman's personal effects, because every vehicle automatically has a small storage space for the crew's normal belongings. Only large amounts of personal gear might require a proper cargo bay.

FOR ENCLOSED CARGO BAY:
Cost = cube root (volume in cubic meters)

FOR OPEN CARGO BAY:
Cost = (cube root (surface area in square meters) ÷ 10)

◆ Catapult Hook AUX

This Perk enables any non-VTOL aircraft to take off from a carrier with the help of a catapult (which is included in the carrier's vehicle bay cost). This also enables any such aircraft to use the ship's short landing strip. Non-VTOL aircraft without this Perk can still take-off and land on a carrier ship, but must make a Piloting roll vs. 7 and 8, respectively, or crash in the attempt. A crash-landing is treated as a ramming attack against the carrier for damage purposes.

Cost = 2

◆ Chaff/Flare Dispenser AUX R

Chaff and Flare dispensers are used to confuse and defeat the radar and infrared guidance systems of incoming missiles. In game terms, each use of a Chaff/Flare Dispenser grants the aircraft a defense bonus versus missile and guided weapons. The dispenser's Rating is added to the pilot's defense roll. If the result of the vehicle's modified defense roll is greater than the attacker's roll, the countermeasures have successfully misled the missile(s) away from the target vehicle.

Use of a Chaff/Flare Dispenser does not cost an action in the Air War scale, but does cost one action per use in the Dogfighting scale. There is no limit, other than the dispenser's ammo load, to the number of chaffs or flares that can be used in one round, but only one shot is expended per defense roll.

Cost = (Rating x 5) +(Ammo/20)

◩ Example:

Infantryman Alpha launches a ground-air guided missile at fighter Beta. Alpha's attack roll is a 6. Beta's defense roll is a 4. Fortunately, fighter Beta has a Chaff/Flare Dispenser (Rating 2). The Rating is added to the defense roll, giving a final result of 6. Since the modified defense roll is equal to Alpha's attack roll, the chaffs and flares have misguided the missile.

◆ Climbing Apparatus

The Climbing Apparatus is a set of special footplate spikes, ropes and claws used by humanoid vehicles for climbing. Since the claws can hold the unit securely against the cliff face, weapon fire during climbing is now possible, albeit at a -2 modifier. The Climbing Apparatus also reduces the climbing Piloting test's Threshold by one. The climbing equipment is much too clumsy and cannot be used as a weapon.

A vehicle must have both the Walker movement mode and at least two Manipulator Arms capable of lifting it to make use of this Perk.

Cost = 2

◆ Counter-Battery Sensor AUX R

A Counter-Battery Sensor (CBS for short) is a set of specialized radar and sensors designed to locate an enemy artillery unit based on the trajectory and signature of its fire missions. When an indirect fire attack is incoming, an attempt can be made by any CBS-equipped unit within half sensor range of the target hex to locate the attack's origin, allowing effective counter-fire.

Activating the CBS costs one action. The operator "attacks" the enemy unit using Electronic Warfare as the Skill and the CBS as the weapon. The opponent must reveal in which range band the firing unit is located, relative to the CBS vehicle. The CBS's Base Range is equal to its Rating times the base Sensor range of the unit; it has +0 Accuracy and does no damage.

A successful roll locates the last known firing position of the firing unit. Obviously, if the enemy battery moved immediatly after firing, the information is much less valuable (though saturing the area with artillery strikes might just do the trick anyway). A failure does not yield any information. On a Fumble, the operator gets a phantom echo — any counterattack automatically deviates by a number of hexes equal to the result of three dice. Rather than read the dice normally, the results are added together.

Cost = 4 + Rating

Bryce Hubbard (order #959915)

Crew Accommodations

The vehicle has proper sleeping quarters for its crew. Two quality levels of crew accommodations are available. Military grade crew accommodations are spartan in design and provide little privacy or comfort. Luxury accommodations, on the other hand, include private sleeping quarters and personal hygienic facilities. A vehicle with numerous crew accommodations of either type also includes a few common rooms such as galleys and lounges. Luxury common rooms are obviously more numerous and more posh.

Cost = 10 + number of crew members (military) or 20 + number of crew members x 2 (luxury)

Diving Wings

Fixed wing aircraft with this Perk have their wings in a distinctive shape which enhances their ability to pull out of a dive. Any such plane gives a +1 bonus on Piloting Skill rolls for pulling out of Dives, Stalls or uncontrolled falls. Only Flying vehicles can take this Perk.

Cost = 2

Easy to Modify

When this Perk is selected, the designers are paid enough to break the golden rule of military contract engineering ("Make it as complicated as possible"). The vehicle is designed in such a manner as to be easy to modify (standardized parts, modular aspects). A +2 modifier is added to all technical Skill rolls to modify and repair the vehicle.

While this type of design is a joy to service or modify and often lasts longer in the field, it is generally more difficult to design. The materials used for Easy to Modify models are usually of higher quality, further adding to the basic cost. For this reason, Easy to Modify is a fairly rare Perk (to date, common only on the Hunter and its clones). Easy to Modify models rarely have many other innate features and are usually modified whenever new functions are needed. They also tend to be popular or common machines.

Cost = 10

Ejection System AUX

The vehicle is equipped with an ejection system to give the crew a chance to escape if the vehicle suffers an Overkill damage result (or before that, if desired). See *Ejection* (page 159 of the rulebook) for more details. This Perk also covers the various pieces of survival equipment such as life preservers and inflatable lifeboats on marine vehicles.

Every pilot would like to have an Ejection System in case of disaster. Despite this, very few ground vehicles have ejection seats. The reason is simple: if a ground vehicle crew is unable to crawl out of their vehicle, they are probably dead already. Aircraft crews, especially fighter pilots, are an entirely different matter. Aircraft are more easily destroyed than ground vehicles because even relatively minor movement damage can cause the vehicle to crash. Ejection Systems allow pilots in this predicament to eject and avoid death.

Cost = 1 + (number of bonus actions due to crew)

Electronic Countermeasures AUX R

Electronic CounterMeasures (ECM) are devices that are used to jam sensors and communication systems. Using ECM to jam requires one action per roll. Roll an Electronics Warfare Skill test, adding the ECM Rating as a modifier. Unless the roll fumbles, the result of this roll is the Threshold of all communications or sensor action tests (both use EW Skill) within the vehicle's ECM range. The jammed sensors and communications must pass this test each round just to be functional. ECM range is identical to the vehicle's base Sensor range.

Electronic warfare is a dirty game that should only be played by those who are competent enough to do it right. Everyday combat and civilian vehicles rarely carry either ECM or ECCM equipment. Scouts often carry a limited amount of ECM to help shield them and their allies during combat. Dedicated electronic warfare vehicles have full ECM and ECCM suites and are often capable of camouflaging their allies while picking out their enemies. ECM is especially useful to prevent Command Point distribution, forward observation and drone operations.

Cost = Rating x 2

Electronic Counter-Countermeasures AUX R

Electronic Counter-CounterMeasures (ECCM) are devices that are used to block jamming systems and/or punch through their effects. Using ECCM to prevent jamming requires one action. Roll an Electronics Warfare Skill test, adding the ECCM Rating as a modifier. Unless the roll fumbles, the result of this roll is the Threshold of ECM action tests (uses EW Skill) within the vehicle's ECCM range. The blocked jammers must pass this test each round just to be functional. ECCM range is identical to the vehicle's Sensor range.

Cost = Rating x 2

Emergency Medical

Emergency medical care is often a key to saving an injured pilot. A vehicle with this Perk includes features like instant casts for broken limbs and stimulant/pain-killer injections to prevent loss of consciousness. In tactical game terms, this Perk prevents one "Crew Stunned" result on the Systems Damage table. In roleplaying terms, the vehicle will prevent the character from losing consciousness due to injuries. In addition, the emergency medical features will prevent wound degeneration for up to one full day.

Emergency Medical is a Perk that was often viewed as a useless frill by most military designers. After all, if the pilot is injured seriously enough to need emergency medical treatment, then he is probably already dead or dying. However, the unplanned use of the emergency medical facilities as a source of stimulants quickly proved battle worthy, and the use of the package, while unpopular because of the additional cost, grew over time. No one can deny the advantage of being able to ignore a single "Crew Stunned" damage result, and the automated medical facility may often be the only thing that stands between a group of isolated Player Characters and a lonely, bleeding death on some far away, dusty battlefield.

Cost = 0.1 x number of crew and passengers (per use)

Bryce Hubbard (order #959915)

◆ Emergency Power Surge AUX R

Emergency Power Surges (EPSs) systems are a rare feature, mostly because they tend to damage the vehicle they are mounted on. A vehicle with this Perk can, for a short time, boost some of its statistics by unleashing emergency capacitors, nitro injections, etc. In game terms, the EPS system "spends" its Rating points to gain a set of benefits.

This Perk allows the vehicle to increase one of the following Attributes by one for a single combat round per Rating point spent: Maneuver, Top Speed MP, number of Actions, weapon Damage Multiplier or weapon Base Range. Each Attribute can be raised up by a maximum of three points (so the maximum EPS points usable during a single round is equal to 15). A vehicle could spend all of its Rating points in one round for one glorious burst of power, or conserve the points for emergencies.

It is also possible to "overburn" the EPS system, doubling the effects but damaging the vehicle. If this option is used, each EPS point counts as two, but the system affected drops by one point afterward. If actions drop below zero, the vehicle must "buy" back the penalty before applying the action. For example, a one-man vehicle at -2 actions would have to take extra actions (and associated penalties) to act.

EPSs burn themselves out during use. Therefore, they do not regenerate their Rating. EPS repairs usually require complete vehicle overhauls. EPS use must be declared during the declaration phase and does not require an action.

Cost = (Rating)²

◆ Fire Resistant

The vehicle is made of fire-resistant materials and provides adequate heat protection for the crew. In game terms, the Intensity of any flame attacks against the vehicle is halved before damage is calculated.

Cost = 8

◆ Fuel Efficient

The engine and systems of the vehicle are extremely efficient: a greater Deployment Range than normal is possible. As long as the vehicle remains at Combat Speed, each point of Deployment Range provides more kilometers of distance. One and a half, twice and three times the range are possible multipliers, depending on the option selected by the designers.

Cost = 2 for one and a half times the range
4 for twice the range
8 for three times the range

◆ Geological Sensor AUX

The vehicle's sensors are specially designed to perform geological surveys, such as analysing ground chemicals or performing magnetic analysis. This has no tactical application, but it is useful in roleplaying scenarios. Geological sensors are common features on many of the vehicles used in the Badlands.

Cost = 4

◆ Glider

Aircraft with this Perk possess the abilities of a thermal glider and only lose one altitude level or MP of speed when gliding. In addition, the pilot can ride hot air currents to actually *gain* altitude levels, by making a Piloting roll versus a Threshold of 5. Each point of Margin of Success allows the craft to gain one altitude level, without losing speed.

This Perk can only be taken by Flying vehicles.

Cost = 2

◆ Grapple Launchers AUX R

A compressed-gas or small gun unit mounted on the vehicle's hull can fire a special grapple attached to an ultra-resistant cable. The cable is attached to a winch which can be used to drag the vehicle forward or, if the target is lighter than the vehicle, drag it toward the winch.

Grapple launchers can be designed to send their projectile up to 250 m away. It is also possible to buy a simple winch with cable, without the launcher — the range is then considered to be 1 hex for calculation purposes, although the cable can be much longer than this (up to 250 meters long — designer's choice).

Cables (and by extension, the whole system) are rated according to the maximum Size capacity they can handle. For example, a Rating 3 cable can support a weight of 1.1 ton (the maximum mass of the Size 3 category). Several cables can be used together by adding the maximum weight they can support (e.g. two Rating 3 cables could drag up to 2.2 tons together).

Grapple launchers have an Accuracy of -2 and a Damage Multiplier of x2 if used as a weapon. If the Margin of Success of the attack is equal to or higher than 3, the grapple is now attached to the target in addition to any damage it might have caused. It can be detached and reeled in at the cost of one action.

The cable itself can take up to its Rating in damage points before being severed. Ranged weapons, however, have a -3 penalty to hit because the cable is so small. Point-blank melee weapons have no such penalty.

Cost = 0.2 x (range in 50 m hex) x (Rating)

◆ Gun Ports

The vehicle is equipped with gun ports from which the crew and passengers can fire small arms while retaining the protection of the vehicle's armor. The ports are often equipped with special "sealant" opening to preserve the atmosphere within the vehicle and prevent contamination.

Only small arms may be fired from gun ports, not heavy weapons. Because of the design of the gun ports, the weapon is restricted to a "Fixed" firing arc and has a -1 modifier to hit in addition to the vehicular movement modifiers.

Cost = 1 (gun ports for one-third of the crew and passengers)
2 (gun ports for half the crew and passengers)

Bryce Hubbard (order #959915)

◆ Haywire Resistant

The vehicle is specially designed to shrug off massive electrical charges through isolated circuitry and grounded structure. EMP sponges take care of the rest of the charge, sparing delicate systems from haywire damage.

This Perk allows the vehicle to reduce the effects of weapons with the "Haywire" effect (i.e. particle beams and haywire grenades). On Light Damage results, ignore the second damage roll produced by the haywire effect. On Heavy Damage results, the second damage roll is treated as a Light Damage roll.

Cost = 10

◆ Heat Resistant Armor R

Although all armored vehicles have some degree of heat resistance built directly into their armor plating, many front-line combat vehicles have an extra layer of ceramite/ablative plate on top of their basic armor to help them fend off Monroe-effect warheads and energy weapon beams.

Since the weapon of choice to hunt Gears is the autocannon, Gears do not normally sport this extra armor coat. Larger vehicles, like tanks, are usually better candidates for this Perk since they are often the target of energy-based weapons like bazooka shells, missile warheads or lasers.

The vehicle's armor is designed to deflect and dissipate the intense energy delivered by weapons like shaped-charge warheads or lasers. Select a Rating of Heat Resistance. The maximum Rating is equal to half of the vehicle's base Armor Rating (rounded down). This Rating is added to the vehicle's base Armor Rating when the vehicle is attacked by Heat-based weapons. This Perk has no effect versus weapons that are not heat-based.

◆ Heat Effect

Heat-based	Not Heat-based
Bazookas	Cannon
Mortars	Railgun
Rockets/Grenades	Rifles (infantry)
Missiles	Punch
Laser	Kick
Particle Beam	Ramming
Torpedo	Melee Weapons

Cost = Rating

● High Capacity Computer

The vehicle's computer system has additional processing power that is not consumed by its normal operations. In the tactical game, this has no noticeable effect.

In the roleplaying game, the computer can be used to run various programs that are unrelated to the vehicle's normal function. For instance, a high capacity computer might keep a series of code breaking programs or maybe the financial records of a company or a laboratory.

Cost = 0.5

◆ High Towing Capacity

The vehicle is equipped with a high torque, heavy duty powerplant and transmission. Its towing capacity is doubled or tripled. If the vehicle has the "Walker" movement type, this Perk provides heavier actuators and power systems to give more power to the lower limbs. This yields higher damage in combat from kicks and stomps — add one to the kicking Damage Multiplier for double towing capacity, and two for triple towing capacity.

Cost = 5 (double) or
15 (triple)

◆ Hostile Environment Protection

The vehicle is specially designed for prolonged exposure to some hostile environmental conditions. This Perk is noted "HEP: <chosen environment>" on the vehicle sheet. The following options are available.

The desert version of this Perk is a must for any vehicle that is expected to serve in the Badlands and as such is extremely common on Terra Nova. The other types of Hostile Environment Protection are very specialized and should only be added if the vehicle is expected to encounter such hazards.

● Desert

The vehicle can withstand extended exposure to desert conditions without needing special maintenance to avoid sand buildup. This Perk includes air filters, modified heat exchangers and cloth coverings on delicate mechanisms.

Cost = 1

● Extreme Heat

The vehicle is designed to withstand exposure to scorching temperatures, often well into the hundreds of degrees Celsius, without taking severe damage. If combined with the Fire Resistance Perk, the vehicle is effectively immune to incendiary attack.

Cost = 4

● Extreme Cold

The vehicle is designed to endure freezing cold temperatures, such as those found in Earth's Arctic and Antarctic regions, without freezing up or otherwise breaking down. Heaters, special lubricants and other modifications are part of this Perk.

Cost = 1

● High Pressure

The vehicle is designed to endure the great pressures of locations like ocean depths and the upper layers of gas giants. A variant of this Perk (Extreme Pressure) allows the vehicle to endure even the most extreme pressures, such as those found in the deepest of ocean depths or within the atmosphere of gas giants.

Cost = 4 (High Pressure)
10 (Extreme Pressure)

Bryce Hubbard (order #959915)

• Underwater

The vehicle can withstand full submersion in water and other fluids, up to a depth equal to five times the vehicle's Armor Rating in meters (multiplied by five when combined with High Pressure, multiplied by twenty with Extreme Pressure). Vehicles capable of Submarine movement automatically possess this Perk at no cost.

Cost = 2

• High Gravity

The vehicle is designed to withstand very high gravity environments (3 g+) for extended periods. This does not, however, guarantee that the crew can do the same.

Cost = 1

• Vacuum

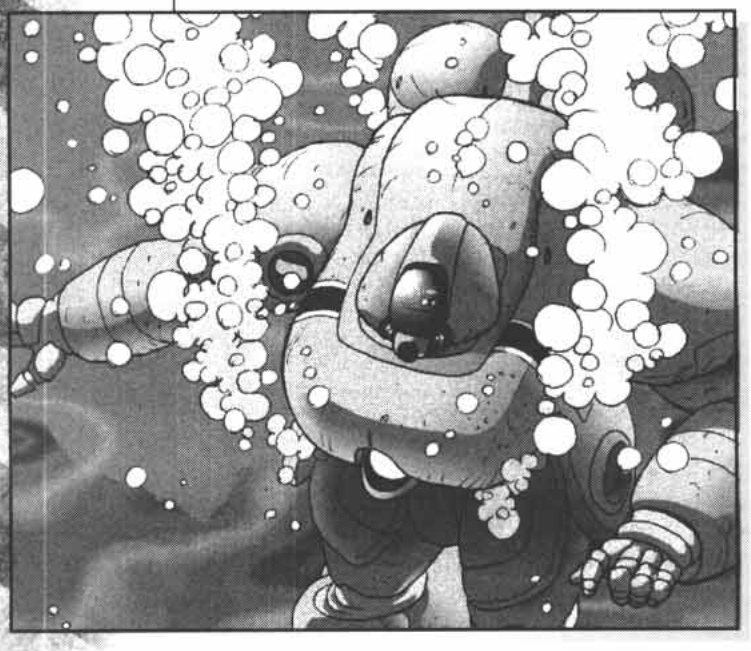
The vehicle is designed to withstand the lack of pressure found in vacuum environments. This means airlock hatches, pressurized hull, and so on (a life support system must still be bought separately). This Perk does not, however, grant a vehicle the ability to perform atmospheric re-entry.

Cost = 1

• Radiation R

The vehicle is designed to withstand high radiation levels. Foamed armor, rad-absorbing gel layers and additional shielding protect the vehicle's sensitive systems (especially the crew). The rad protection level, in rads/hour, is equal to ten to the power of the Rating (e.g., a Rating 3 system would give the equivalent of 10^3 rads/hour of protection).

Cost = Rating



• All

The vehicle is designed to withstand *anything* thrown at it. It is fully sealed and can go over land, underwater, in space, etc. It possesses all the above abilities at no additional point cost, except Radiation and Extreme Pressure protections (which must still be bought separately).

Cost = 12

◆ Improved Off-Road Ability

The vehicle is designed to handle rugged terrain even better than standard military craft. Its movement system is powerfully built with extra actuators and a reinforced structure. This Perk dramatically alter the appearance of any design that uses it.

Ground vehicles with this Perk have massive movement systems like 20th-century dune buggies and monster trucks. Hover vehicles with Improved Off-Road can vary how high they float off the ground, helping them avoid hazardous terrain; they also have improved hazard detection systems to help them avoid pitfalls and rough ground.

Walkers with Improved Off-Road ability have powerful legs and wide, high traction feet that allow them to run efficiently even when trudging over shifting sand or through swamps. Gears with this Perk normally do not have secondary movement systems like wheels and rely solely on their Walker movement mode.

In tactical game terms, the vehicle pays one less MP for any terrain type that requires more than one MP. For instance, a Ground vehicle with Improved Off-Road Ability would pay 3 MP instead of 4 MP when crossing Swamp hexes, but would still pay 1 MP per Clear or Sand hex. The Perk must be bought separately for each movement type.

Cost = 6

◆ Improved Rear Defense

The vehicle has a well-defended rear arc, either through a superior armor design or additional sensor systems. In game terms, this reduces the defense roll penalties from Rear and Rear Flank attack by 1. In other words, the Rear Flank arc of defense penalty is 0 and the Rear arc of defense penalty is -1.

It is normal for combat vehicles to have thick front plates and weaker rear plates, since most attacks come from the front (assuming that you are attacking the enemy and not being caught in an ambush...). Vehicles with this Perk get an equal distribution of their armor or sport additional plates to help protect their vulnerable rear arc. They also have additional sensors and automated monitors in the rear arc.

This Perk is best used on vehicles that are most likely to suffer rear attacks. For example, scouts must often expose their backs to return from a mission. Some fire support models have Improved Rear Defense to help them deal with swift, light vehicles that can overrun them and then circle around to get to their weak back or sides.

Cost = 10

Bryce Hubbard (order #959915)

◆ Jump Jets AUX R

The vehicle is equipped with short-burn jump rockets, often liquid-fuel thrusters or solid cartridge boosters bolted to its hull. These jets allow the vehicle to "leap" over a short distance, but they do not allow true flight.

The maximum distance of the jump must be specified. Jumping vehicles may clear obstacles whose elevation does not surpass one-half its jumping distance. For example, a jump-capable Gear with a jumping distance of 300 meters (6 hexes) may clear obstacles of elevation 3 or less.

Jumping requires one action but can be used in addition to the vehicle's normal movement, either at the beginning or the end of the normal move (note that this takes precedence over previous descriptions of the Perk). A vehicle may jump only in a straight line. Jumping occurs during the vehicle's movement phase, despite requiring an action.

Jump Jets are a somewhat bizarre Perk. They are bulky and expensive. Yet, this special ability is useful in three particular circumstances: city fighting, clearing obstacles and the Death From Above tactic. Jump Jets allow vehicles to launch uncanny surprise attacks in urban areas by hopping over obstructing terrain. Jump Jets are also useful for their ability to clear obstacles like walls, ravines, cliffs, and minefields.

Death From Above is a ramming technique which is only available to vehicle with Jump Jets. By leaping towards an enemy unit, a pilot can effectively execute a flying ram. Impact Speed is calculated as normal (see rulebook, page 140), with the ramming direction the same as it would have been for a ground-based ramming attack. Both attacker and defender are damaged by this maneuver. The attacking Gear's Size is multiplied by two for *this action only*.

Cost = maximum jumping distance in hexes x final Size

◆ Laboratories R

Some vehicles are equipped with "laboratories," systems that help the crew in specialized tasks. Each laboratory is dedicated towards one particular Skill or Skill specialization, with the exception of direct combat Skills (all Piloting/Driving, all Gunnery, Combat Sense). Laboratories are rated upon their quality (minimum of 0). This quality Rating is added as a modifier to any test performed using the laboratory's Skill.

Laboratories eliminate any penalty due to missing tools and proper equipment. They can be used to represent specialized rooms such as tactical command centers (Leadership), galleys (Cooking) or even theaters (Theatrics).

Cost = 10 + 10 x Rating (per lab)

◆ Large Doors

The vehicle's crew and passenger compartments are equipped with oversized doors that allow rapid egress and ingress. For each action spent, two crew members can exit the vehicle. A number of passengers equal to twice the Size of the vehicle may enter or exit each turn at no action cost.

Cost = 1

◆ Life Support AUX

Life support systems provide the vehicle's crew with a sealed and controlled milieu, protecting them from hostile environments such as vacuum, underwater, and poisonous atmosphere. If this system is destroyed while the vehicle is in a hostile environment, the entire crew immediately become casualties, eliminating the vehicle from combat.

The limited form of life support includes contingencies for breathing and limited nutritional and excretory needs and provides support for up to a week. The full version of life support includes complete air recycling, proper waste disposal, hygienic and nutritional facilities.

This Perk is best used on vehicles that are expected to travel in space, underwater or work in highly hazardous environmental conditions. Limited Life Support should be used on most of these vehicles. Full Life Support should be reserved for huge vessels like large spaceships and submarines, which require it for extended periods of time.

Cost = 2 (limited) or
5 (full)

◆ Lighter-Than-Air

Aircraft with this Perk use lighter-than-air gases to stay aloft. As this uses no Movement Points, Lighter-than-air craft do not fall when their movement systems are disabled or destroyed, though their horizontal movement will be determined by wind alone (see *Wind*, page 20 of **Tactical Air Support**). Lighter-than-air craft can gain or lose one level of altitude per round without using MPs (further altitude changes require MPs, however).

Light damage to the Structure will cause a lighter-than-air craft to lose one level of altitude per round, without the possibility to gain them back. Heavy Structural damage will cause a two-level drop per round. The envelope can be designed to be self-sealing; when taking Structural damage, airships with this option will suffer the loss of altitude effect only once instead of every round.

A lighter-than-air craft occupies three times as much space as its Size (for example, a Size 10 lighter-than-air will completely fill a tactical hex). Craft with this Perk are considered VTOL craft for determining admissible Perks and Flaws.

Only Flying vehicles can take this Perk.

Cost = 2 (standard envelope)
4 (self-sealing envelope)

◆ Low Profile

The vehicle has a very low profile which makes it easier to hide and conceal. Vehicles with this Perk tend to have sloped and compact hulls — for obvious reasons, bipedal walkers generally cannot be designed this way.

The vehicle gets +1 to Concealment while in cover (hexes with Obscurement of 2 or more). If the Hull-Down rules are used, it derives an extra 5 points of protection from its position.

Cost = 2

Bryce Hubbard (order #959915)

◆ Loudspeakers AUX

The vehicle is equipped with powerful external loudspeakers. These can be used for sirens, audio systems, communication gear, or other audio equipment. If turned on a night, they will allow the vehicle to be heard five times further away than usual (ten times for powerful loudspeakers!); see the rules for night-fighting on page 159 of the basic rulebook. This has little use but can be used to establish scenarios.

Loudspeakers are only really useful in the roleplaying game.

Cost = 1 for standard loudspeakers or 2 for really powerful speakers

◆ Manipulator Arm R

The vehicle has an arm-like structure that can pick up and manipulate objects. Manipulator Arms are part of the basic layout of many walker vehicles, but are truly common only on Gears. Smaller Manipulator Arms (Size 1-2) can be installed on virtually any vehicle to represent "micro-manipulators" used for delicate maneuvers or work outside the vehicle without having to expose the crew to danger.

A Manipulator Arm can lift an object whose Size is equal to or lower than its Rating. No matter the Rating of a Manipulator Arm, a vehicle cannot lift an item whose Size is greater than twice its own Size. Half the capacity of all weaker arms are added to the full capacity of the strongest arm to determine the lifting strength of multiple arms.

Optionally, Manipulator Arms can be reinforced to punch or crush opponents. These attacks have a Damage Multiplier equal to the Rating of the arm. This option adds nothing to the Perk's cost, but modifies the Offensive Score (see page 132). For roleplaying purposes, manipulators can apply pressure equal to half their Size Rating, rounded up. The highest weight value for that result on the Size to Mass chart is the pressure applied in tons per square meter.

Manipulator Arms can be used for fine manipulations and tasks which require dexterity. A standard Piloting Skill test is required, the Threshold varying according to the task. In addition, a negative modifier equal to half the difference between the object's Size and the hand's Rating (rounded toward zero) is applied to the roll. The Size to Mass table helps to evaluate the Size of the object being manipulated.

For example, a Gear with a Rating 6 Manipulator Arm is trying to pick up an egg (most definitely a Size 1 object). The pilot has to take a Piloting test with a modifier of (1-6, divided by half and rounded) -2 to make sure he does not break it.

Cost = 0.5 x Rating for each arm

◆ Micro-Labs

Microlabs are elaborate workbenches equipped with devices and sensors that are specialized for one task, such as toxin detection or electronic repairs. Microlabs have no tactical application, but they can be invaluable in RPGs.

Cost = 5 per micro-lab

◆ Mine Detectors AUX

Mine detectors are a set of highly specialized sensors designed to look for the telltale signs of the presence of minefields. These are very similar to the sensors supplied by the Geological Sensor Perk, but are specially calibrated to detect the mass and faint emissions of buried land mines.

Mine detectors allows the vehicle to detect mines in the same way as an infantry unit with the Mine Sensor equipment (see page 48 of **Tactical Field Support**): the vehicle's Sensor Rating is added to its Electronic Warfare roll.

Cost = 4

◆ Minelaying Equipment

The Minelaying Equipment Perk is a set of special machinery designed to dig a small trench or a series of holes along the path of the vehicle. The machinery then plants one or more land mines and buries them. The system can also "spray" the smaller anti-personnel mines behind the path of the moving unit for fast deployment (see the advanced mine field rules on page XX of **Tactical Field Support**).

The whole system is very efficient and can lay up to five points worth of mines every two minutes (four tactical rounds or twenty Skirmish rounds). The minefield becomes active one minute after the minelaying vehicle has left the hex, though this delay can be increased if desired. Minelaying Equipment may not be used to place Jumping Mines (see **Tactical Field Support**).

The mines are not included in the Perk's cost and must be bought separately at the normal cost. The equipment can place any type of mines, except Jumping mines.

Cost = 3 + 1 per ten TV points of mines (rounded up)

◆ Minesweeping Equipment R

Any vehicles can be equipped with mine-clearing devices, but these will work only in the primary environment for which the vehicle has been designed. For example, the mine plow of an engineering tank will be useless against naval mines, even if the vehicle has the Amphibious Perk. See page 31 of **Tactical Field Support** for more on minesweeping.

The exact nature of the minesweeping equipment depends on the designer, but most often consists of a mine plow or det-cord launcher on ground vehicles. A small distributor dropping chemiluminescent sticks to mark the cleared path is included at no point cost.

Minesweeping equipment may not be used to attack another unit, unless it has been specifically designed to do so. Attack-capable minesweeping systems, such as a det-cord launcher, must have their cost included in the Offensive Score. They have a Range of one hex, an Accuracy of -2, a Damage Multiplier of x15 and a TV cost of 10 points per shot.

Cost = 5 per Rating point

Bryce Hubbard (order #959915)

◆ Mining Equipment AUX

The vehicle is adapted to perform mining functions. Mining equipment must be specified as either light or heavy duty. Mining Equipment is a rather specialized Perk: in most cases, it is often cheaper to buy a simple tool arm equipped with an earth-moving scoop than buy this.

Light duty mining equipment generally consists of one or two sampler arms, a small earth-moving blade (or a more conventional bulldozer blade) and a simple winch with a cable strong enough to move the vehicle (not to be confused with the Grapple Launchers Perk, page 118). Heavy duty equipment is intended for commercial mining operations: in addition to the aforementioned equipment, it includes a large rock grinder, a shovel arm, one or two trenchers and a drill. Ore conveyors are also a fairly common addition to the package.

The mining equipment can be designed to attack opponents in melee combat. The Damage Multiplier equals half the cost of the mining equipment, rounded up. Light duty equipment has poor (-1) Accuracy and heavy duty equipment has very poor (-2) Accuracy. If selected, this ability modifies the Offensive Score of the vehicle like an arm.

Cost = 5 (light duty) or
20 (heavy duty)

◆ NOE Flyer

Aircraft with this Perk are equipped with very advanced radar-controlled flight systems, which allow the aircraft to effectively fly at altitude level zero ("Nap-of-Earth" flying). This enables the aircraft to avoid most long- and medium-range radars.

In game terms, the NOE flight system gives a -2 modifier to any roll on the Aircraft Control Loss Table (see page 10 of **Tactical Air Support**) if the aircraft is at altitude level zero. When flying at altitude zero, the vehicle benefits from the Obscurement of ground hexes against ground-based attacks (see page 21 of **TAS**). Only Flying vehicles can take this Perk.

Cost = 7

◆ No Fuel Required

The vehicle's main powerplant does not require regular fill-ups with fuel or reaction mass. It draws its energy from the environment around it (a solar-powered or sail vehicle, for example). The vehicle still has to undergo basic maintenance from time to time, though. This is what the Deployment Range Rating represents in this case.

Solar sail and magsail vehicles use this system. The sail itself is so thin (or insubstantial, in the case of the magsail) that it causes no damage to anything that comes into contact with it. Solar sails are damaged as normal during collisions. Sails damaged by any means will reduce the vehicle's thrust by 0.01 MP for each ten points of damage suffered. If the thrust falls under half its normal value, the sail collapses and is unusable. For game purposes, solar and magsails have a diameter equal to half the Size of the vehicle, in kilometers.

Cost = 10 (permanent power)
6 (if the power can be cut off)

◆ Passenger Accommodations

The vehicle is equipped to carry people for extended periods, with proper sleeping quarters for its crew and passengers. Military grade accommodations (intended for marines and other ship troops) are spartan in design and provide little privacy or comfort. Luxury accommodations include private sleeping quarters, a small lounge and personal hygienic facilities. A vehicle with numerous passenger accommodations of either type also includes a few common rooms. Luxury commons are obviously much more numerous and are often very posh.

This Perk can come in handy, if used properly. It is a necessity for long range vehicles that the crew remain fresh and alert. Passenger Accommodations are usually expensive because they take up a lot of room, but civilian vehicles can have military-grade accommodations to cut costs. A good example of this is the sleeping cab found just behind the driver on many long-haul trucks.

The Passenger Accommodations can also serve as a makeshift cargo bay. Military grade accommodations for one person are between two and six cubic meters in size (depending on the vehicle), while civilian accommodations can be as big as a thousand cubic meters on very large vehicles.

Cost = 10 + number of passengers (military) or
30 + number of passengers x 3 (luxury)

◆ Passenger Seating

The vehicle has extra seats for passengers. It is important to note that passengers, whether in seats or in accommodations, are not crewmen. The passengers do not confer any extra actions to the vehicle, nor can they control it. Passengers cannot use the vehicle crew's ejection system (if any); they must buy their own, as if they were normal crew.

Passengers do, however, count as crew for damage purposes, that is, they are hit on "Crew" results. Any damage taken should be randomized between crew and passengers using the usual method of damage resolution (page 146 of the rulebook).

Cost = 3 + number of passengers

◆ Pintle Mount

An infantry weapon installed on a swivel mount just outside a hatch is said to be pintle-mounted and must be operated by one of the vehicle's crewmen. That crewman can do nothing else and is exposed to enemy fire (count as Partially Exposed Crew, unless the vehicle is already open-topped). Pintle Mounts have a 180 degrees arc of fire, chosen at the time of design. The weapon is not protected by the vehicle's armor and counts as an Auxiliary system. Fire Control hits neither affect pintle mounted weapons nor does the Fire Control bonus apply to them. Firing penalties are equal to -1 for more than half and up to Combat Speed, and -2 for Top Speed, in addition to any other modifiers.

Pintle mounts are quite simple and add little to the cost of the vehicle. Any infantry weapon can be mounted on them. The cost of the weapon is equal to its DM plus its ROF in vehicle scale, and is added directly to the vehicle's final Offensive Score.

Cost = free (cost of weapon is added to OS)

Bryce Hubbard (order #959915)

◆ Ram Plate

Part of the chassis of the vehicle has been specially reinforced to withstand a high speed impact. Each ram plate must be assigned to a ramming arc (see page 140 of the rulebook). The vehicle takes only half the normal damage in a collision, provided the impact is in the same arc as the Ram Plate.

Cost = 4

◆ Reactive Armor AUX R

Reactive Armor is an advanced development of a millennia old concept. It is not composed of actual armor plates, but rather is a set of directional fragmentation mines mounted on the hull of the vehicle. A series of small dedicated sensor detonates one or more charges in the direction of an incoming attack, hopefully redirecting it or at least reducing its efficiency. The explosion counteracts HEAT-effect charges and sprays anti-laser aerosol to diffuse and refract laser beams.

Reactive Armor is always active. Because of balance problems, vehicles using the Walker movement system cannot have Reactive Armor at a Rating higher than 1. Each defense arc must be individually protected.

Reactive Armor reduces the Margin of Success of a HEAT attack by an amount equal to its Rating. If the Margin of Success of the attack drops below 1, no damage is done. If other units (friends or foes) are present in the hex when the reactive armor is activated, they automatically take a number of damage points equal to the Rating of the system times the Size of the vehicle, times the result of die.

Because the actual number of charges used to repel each assault is highly variable, Reactive Armor does not use ammunition but rolls against an Ammo Threshold. Every time the system is used, roll two dice: if the total is higher than the Ammo Threshold, the system has run out of charges. If the roll is equal or lower, the system works — lower the MoS and increase the Ammo Threshold by one. Fumbles are disregarded and count as a roll of one.

The Threshold starts at 0, so there is enough ammunition for at least two interceptions (Thresholds 0 and 1). Firing Reactive Armor charges does not use up actions and works until the system runs out of charges (the roll is above the Ammunition Threshold) or is destroyed in combat.

Reactive Armor is an AUX system, but damage is applied differently. On a Light damage result, add one to the Ammo Threshold. On a Heavy damage result, all charges on the facing hit are detonated and lost, effectively taking the system out of the fight. All charges must be replaced after a battle.

Cost = (half the Size of the vehicle x Rating)per facing

◆ Reduced G-effect

Aircraft with this Perk have been modified to reduce the strain of pulled Gs (acceleration) on its crew, either through special cockpits, seats or flight suits. The pilot has a +1 bonus whenever he has to make a FIT roll due to sharp turns or other quick accelerations.

Cost = 4

◆ Refueling Equipment

This Perk allows a vehicle to be refueled on the move. The refueling boom consists of enough equipment to refuel one vehicle at a time. The fuel is usually carried within a cargo bay, but the refueler can use its own Deployment Range or Reaction Mass instead.

Both pilots must roll their Piloting Skills vs. 4; if either fails, the refueled vehicle takes on only 1d6 x 10% of the intended load. A fumble means a collision occurred, and the refueling equipment on both vehicles is out of service.

A refueling attempt may be made every three minutes (6 rounds). Suggested time for total refueling is one round per point of Size of the target (plus the three minutes for hook-up).

Cost = 2 per refueling boom
1 for intake and receiving equipment

◆ Reinforced Armor R

The vehicle has one or more facings (arcs of attack) with better armor than the rest of the vehicle. When the vehicle is hit in an arc that is reinforced, add the Rating of this Perk to the base Armor Rating of the vehicle.

Four possible arcs can be reinforced: Front, Rear, Right Rear Flank and Left Rear Flank. Up to three of these arcs can be reinforced on a single vehicle.

Cost = Rating (per arc of attack)

◆ Reinforced Chassis

The frame of the vehicle is designed to absorb considerable punishment. The vehicle may ignore the first Structure hit on the Systems Damage Table, but then loses this Perk. The Perk's effect can be restored by a normal repair if a technician works on the vehicle after combat.

Cost = 6

◆ Reinforced Crew Compartment

The crew compartment is layered with additional armor and fitted with crash-absorbing material. The vehicle may ignore the first Crew hit on the Systems Damage Table, but then loses this Perk. The Perk's effect can be restored by a normal repair if a technician works on the vehicle after combat.

Cost = 4

◆ Reinforced Location Armor R

One of the vehicle's locations has better armor than the rest of the vehicle (by location, refer to the five entries on the System Damage table). When the vehicle is hit in a reinforced location, add the Rating of this Perk to the base Armor Rating of the vehicle before determining damage. This Perk cannot be taken more than twice per vehicle.

Cost = 0.5 x Rating, rounded up (per location)

Bryce Hubbard (order #959915)

◆ Rugged Movement Systems

The vehicle may ignore the first Movement hit on the Systems Damage Table, but then loses this Perk. This protection is due to the inherent strength of the drive system's design, or a built-in redundancy. This Perk's effect can be restored by a normal repair if a technician works on the vehicle after combat.

Cost = 5

◆ Satellite Uplink AUX

The vehicle has a specialized add-on to its communication system that greatly boosts its range. This allows it to patch into man-made satellites when the vehicle is on a planet, or transmit messages over great distances in space. The direct Communication range of a vehicle equipped with a Satellite Uplink is multiplied by one thousand (flight or space range factors still apply). The Satellite Uplink includes tracking and motion-correction equipment so the system can be used at up to half-Combat speed (or half-Thrust).

A vehicle with a Satellite Uplink is considered to have an unlimited communication range as long as there is a satellite or other relay in position (this will depend on the scenario being played). Another use for Satellite Uplinks is calling down orbital strikes (if available). While these are rarely used during peacetime, they are the most powerful form of wartime artillery available.

If the vehicle needs to stay in contact with distant groups on a regular basis, it needs a Satellite Uplink or, at least, to be partnered with a vehicle that has one. The best candidates for this Perk are command vehicles (to maintain communications with headquarters), communication vehicles (to allow them to serve as relays), and long-range scouts (to allow them to transmit reports).

Cost = 10

◆ Scoring Sensors AUX

Professional sport duelists often utilize a complex system of weapon simulations rather than actual arms (see Sporting Weapons). While these virtual arms can be used alone, they are more effective when opposing Gears are equipped with a special sensor net designed for this purpose. These sensors detect the emissions of sporting weapons and keep track of the amount of virtual damage received by the Gear.

Several settings are possible for the sensors (which are set before a match begins). In scoring mode, the sensor net divides the Gear into a series of locations, assigning points based on the precision and intensity of a hit. In shut-down mode, the net keeps track of virtual damage and shuts down the Gear when it is "destroyed." In virtual mode, the sensor relays information from each hit to various systems of the Gear, shutting them down based on calculated damage. In the latter mode, combat becomes frighteningly real as weapons "explode" and pilot compartments are "compromised."

When used in battle against Gears with Sporting Weapons, keep track of damage normally but only apply effects in virtual mode. Scoring Sensors add 5000 marks/dinars to the vehicle's price.

Cost = 0

◆ Searchlight AUX

The vehicle has a powerful front-mounted lighting system. At night, treat the vehicle's Fixed Forward firing arc as if it were in daylight. Some searchlights are mounted on a swivel plate: at night, the vehicle's Front (or Right, Left, or Rear, as selected) firing arc is treated as if it were in daylight. Any fire directed at the vehicle is also treated as if the vehicle were in daylight, regardless of the arc.

Cost = 1 per 50 m range (fixed)
2 per 50 m range (swivel)

◆ Shield R

Some vehicles, usually those with manipulator arms such as Heavy Gears, can carry a large piece of reinforced armor plating and use it as a shield. This shield can be moved in front (F defense arc) or to one side (L or Rt defense arc, chosen at the moment of design) of the vehicle to stop incoming attacks. A vehicle with a shield may expend one action to block an attack; the vehicle's pilot can then reroll his defense roll. If this second roll is successful, the vehicle is still hit, but the shield adds its Rating to the vehicle's base armor for damage purposes.

Vehicles may not carry shields whose Rating is greater than their base Armor Rating or their Size, whichever is smaller. The vehicle requires an arm of some type (Manipulator, Tool or Battle Arm) whose Rating is equal or higher than the shield's. When not actively blocking, the shield adds half its Rating (rounded down) to the vehicle's base Armor, either to the front or side defense arc (pilot's choice).

If a vehicle suffers Light Damage after having successfully blocked using its shield, the shield's Rating is automatically halved (rounded down). If a vehicle suffers Heavy Damage after having successfully blocked using its shield, the shield is automatically destroyed. In both cases, no further damage is applied to the vehicle or its Armor.

Cost = shield Rating x 3

◆ Shielded Weapons

The vehicle's weaponry is sheathed in plates of armor. The vehicle may ignore the first "-1 to a Single Weapon", *or* "-2 to a Single Weapon", *or* "-1 to All Weapons", *or* "Single Weapon Destroyed" result on the Fire Control Damage Table. The Perk is then destroyed. Its effect can be restored by a normal repair if a technician works on the vehicle after combat.

Cost = 5

◆ Sick Bay R

Some large vehicles, like landships, have an infirmary or sick bay. These facilities have no value in the tactical game but, in the roleplaying game, they are considered to be constant medical aide for healing purposes. Sick bays are rated by their maximum number of patients.

Cost = maximum number of patients x 2

Bryce Hubbard (order #959915)

◆ Smoke Launchers AUX

Smoke Launchers are small tubes fixed to the hull of the vehicle. Each tube contains a small smoke grenade which is launched using compressed gas to a position within 20 to 75 meters of the vehicle. The shell contains a volatile gas mixture which vaporizes into thick smoke of whatever color was chosen (usually black or gray, though practically any color can be ordered). Smoke Launcher charges are too slow and don't burn hot enough to be used as an offensive weapon. They never cause damage.

Smoke Launchers have a maximum range of one hex and can be fired at any time during the vehicle's Movement Phase at no action cost. The smoke covers the whole hex where the grenade lands. The dense smoke cloud has an Obscurement of 2 and will last until the end of the turn. Firing multiple charges in one hex will not add more Obscurement, nor will it increases the duration of the cloud cover.

The hull-mounted position of the smoke launchers makes them very vulnerable to damage. The launchers count as auxiliary systems, but damage is applied differently for them. On Light damage result, two dice's worth of charges are destroyed. On Heavy damage result, all charges are detonated and lost. It is not possible to armor or otherwise protect the launchers.

Cost = 0.1 per shot

◆ Sniper Systems

Sniper systems are additional targeting systems, such as long-range telesensors or dedicated millimeter-wave radars, that allow the weapons to which they are linked to have better accuracy at long range.

In game terms, sniper systems add a +1 modifier to the attack roll at Long and Extreme ranges, but only for the weapons that have been linked to the system.

Cost = 5 per weapon linked to the system

◆ Sporting Weapons

Usually paired with Scoring Sensors (see above), the Sporting Weapons Perk transforms a Gear's actual weapons into harmless virtual arms. This type of equipment is used for arena combat and for training purposes.

Rounds are replaced with blanks (to maintain recoil and ammunition) while arms are loaded with harmless laser pointers. Complex pointer rockets, grenades and mortar shells are created by combining a smoke round with a very mild haywire round. Vibroweapons can be converted by stopping the vibration and putting a targeting charge along the blade. A similar charge can be applied to Gear fists and ram plates, but in these cases true damage is not negated.

If used against Gears equipped with Scoring Sensors, combat functions as described in that Perk (see the previous page for the full rules).

Sporting Weapons add 100 marks/dinars per weapon modified to the price of the vehicle.

Cost = 0

◆ Stabilizer Mount

Stabilizer Mounts are special systems designed to handle the recoil generated by a large weapon, allowing even a light vehicle to use one. Stabilizer weapon mounts can take on a variety of forms, from giant rifle bipods (for Gears, obviously) to recoil compensators and hydraulic blades, but they almost always anchor the vehicle to the ground in some way.

The Stabilizer Mount Perk allows the vehicle to add +2 to its Size for weapon and ammunition purposes. Therefore, a Size 6 vehicle equipped with this system may carry weapons and ammunition as a Size 8 vehicle. Larger vehicles such as striders must often get into a "firing position" to use heavy weapons and this is also represented by the Stabilizer Mount Perk.

The Perk must be bought for each and every oversized weapon carried by the vehicle. Before firing that particular weapon, the vehicle must spend one action preparing its position (dropping down to the ground, activating the hydraulic jacks, etc.).

When preparing the firing position or using the weapon, the vehicle cannot move. As soon as it moves, the vehicle is not able to fire its oversized weapon(s) anymore and must spend another action regaining its firing posture.

Cost = 2 per oversized weapon

◆ Stealth AUX R

Stealth systems are features that make a vehicle difficult to detect with sensors: heat baffles, radar-absorbing skin, silent running systems, etc.

In tactical game terms, Stealth adds its Rating to the vehicle's Concealment value when opponents use Sensors to detect it (see page 136 of the rulebook for the full Stealth rules). Stealth systems have no effect upon visual detection.

Cost = Rating x 3

◆ Stratospheric Flight

An aircraft with this Perk can climb past the habitual ceiling of 12 km (altitude level 48 in Air War scale), in effect going into the stratosphere, up to an altitude of 50 km (altitude level 200 in Air War scale). It requires the Space movement mode and sufficient reaction mass in order for the vehicle to move into orbit, however. Flying vehicles in the stratosphere double their Flight MP at no cost because of the rarefied atmosphere.

Only Flying vehicles can take this Perk.

Cost = 8

◆ Streamlining

The vehicle is shaped to present minimal resistance to the medium through which it moves. It gets +1 MP when moving at Top Speed. Aircraft are already considered to be streamlined, but taking this option makes them even more so. Streamlining has no effect on space movement.

Cost = 2

Bryce Hubbard (order #959915)

◆ Target Designator AUX

Target designators are used to lock-on guided weapons (see *Guided Weapons*, page 199 of the rulebook). To lock on a designator, the vehicle simply "attacks" the target, using the designator as the weapon. Its Base Range is equal to its Rating; it has +0 Accuracy and does no damage. Any successful attack "paints" the target for incoming guided munitions. The target remains designated until the end of the round. Designators have a Forward arc and may not be used with a Sniper System.

Target Designators tend to raise a vehicle's cost quite dramatically and so are best kept for specialized vehicles. Scout and command vehicles are ideal choices for Target Designators since they frequently serve as artillery spotters. Occasionally, it will be more convenient to put the designator on the vehicle that carries the guided munitions. This is often the case with aircraft.

Cost = 5 + base range in hexes

◆ Tool Arm R

Tool Arms are, by far, the most diverse of the three Arm types. Tool Arms can represent forklift-like cargo loaders, a tow truck's winch arm, a crane's boom, an extendible blowtorch or any other useful tool that can be imagined. The only restrictions are that the Arm cannot handle objects with the finesse of a manipulator and may not serve as a weapon, unless otherwise specified. Its function should be clearly defined at the outset.

Tool arms can lift objects whose Size is equal to or lower than their Rating, provided it has been attached to or is contained by the arm. No matter what the Rating of a Tool Arm, a vehicle cannot lift an item whose Size is greater than twice its own Size. Half the capacity of weaker arms are added to the full capacity of the strongest arm to determine the lifting strength of multiple arms.

Optionally, Tool Arms can be reinforced to punch or crush opponents. These attacks have a Damage Multiplier equal to the lifting capacity of the arm. This option adds nothing to the Perk's cost but modifies the Offensive Score (see page 132).

Pincers, hands and other types of manipulators can apply pressure equal to half their Size Rating, rounded up. Look up the highest weight value for that result on the Size to Mass table: this is the pressure applied in metric tons per square meter. The manipulator can also be "locked" in position, in which case a pressure equal to its Size will be required to force them open. Arms forced open in that way are disabled as pressure lines rupture from the strain and joints pop open.

Cost = 0.3 x Rating for each arm

◆ Urban Friendly

This Perk is primarily a roleplaying convenience since it has little to no effect on tactical combat. Vehicles equipped with the Urban Friendly Perk have head lamps, brake lights and navigation lights. Their engine(s) are either non-polluting (hydrogen cells or electrical) or have emission-control systems and catalytic converters. Heavy military vehicles have rubber soles on the feet and/or treads to avoid damaging public roads.

Cost = 0.5

◆ Trideo Link-up AUX

All military sensor and communications systems can be used to relay simple video images to a remote location, but few Gears have the special equipment required for a full trideo feed. First developed for vehicles used by news reporters, the trideo link involves mounting twin stereoscopic cameras on the machine. The feed from these cameras is relayed through the vehicle's communications system (which is also slightly modified) enabling distant spectators to watch a duel or other encounter as if they were there. The trideo feed also includes a back-up recorder , allowing the storing of an hour of images in the vehicle proper.

On Gears, trideo cameras are usually mounted in special armored shoulder assemblies or on either side of the head. The cameras can also be mounted on thin tool arms, hence allowing greater visibility, but this exposes the sensitive equipment to a degree that makes such a mounting impractical in combat models.

A Trideo Link-up adds 15,000 marks/dinars to the vehicle's price, but otherwise has no effect on its Threat Value.

Cost = 0

◆ Vehicle Bay

The vehicle has a vehicle bay for storing another, smaller vehicle. There are also facilities to maintain and refuel such vehicles (the main difference between a cargo bay and a vehicle bay). Vehicles with vehicle bays are usually called carriers. Vehicle bays need not be for very large vehicles, as even Gears can transport small drones. Vehicle bays on a carrier may be purchased separately to reflect multiple storage areas. Carried vehicles spend one entire round disembarking from the carrier, during which time they may fire but not move.

Vehicle bays are rated in terms of the type of vehicle carried and the maximum weight they can hold. Each vehicle is considered as massing the maximum weight of its Size category. For example, a Size 10 bay holds up to 30 tons of vehicles: that can be 375 Size 1 vehicles, three Size 7 vehicles or one Size 9 and one Size 6 vehicles, and so on. The type of vehicle must be specified during construction, i.e. a bay designed to house assault boats cannot house tanks or jet fighters. Vehicle bays, however, can usually house different models of the same type (within size constraints).

Cost = (maximum carried weight in Size points)

◆ Weapon Link

A Weapon Link allows multiple weapons to be linked to a single fire control mechanism. One action is required to fire the weapon link. The link's Accuracy and Range are equal to the worst Ratings among the link's weapons. Each weapon attacks and is rolled for separately. As soon as one weapon misses, all the other weapons not yet fired automatically miss (but still use ammunition). When a link is fired, *all* of the weapons in the link fire. However, the individual weapons that make up the link may be fired individually. Weapons may be part of more than one link.

Cost = 1 per weapon in the link (per link)

Bryce Hubbard (order #959915)

Flaws

Annoyance

Any vehicle can have something infuriatingly annoying about it. The nature of this Annoyance depends heavily upon the type of vehicle. Small vehicles are typically cramped and uncomfortable, even putting limits on the crewmen's Build Attribute. Vehicles packed with electronics often have some minor subsystem on the blink now and then. Vehicles with powerful engines can have significant noise problems.

These type of Flaw are too insignificant to have an effect on the tactical game, but are interesting for roleplaying. Annoyances also serve to individualize the various designs, and they add significant "character" to vehicles. Each Annoyance must be clearly identified and described, and this Flaw cannot be taken more than five times (one or two is more likely). The gravity of the Annoyance is left entirely to the designer of the vehicle.

Cost = -0.2 per Annoyance

Sample Annoyances

Name	Game Effect
Cramped Crew Compartment	Limit on crew's BLD
False Alarm System	Gives false warning to crew
Instruments are hard to read	Crew has to concentrate harder
Loud Engine Noises	Engine makes worrisome noises
Small entry hatches	Takes one more turn to enter/exit
Stale Smell	Ventilation system creates strange odors
Uncomfortable Seats	*Reduce crew Skills after X hours*

Brittle Armor

The vehicle's armor and superstructure are either of poor quality of just badly attached/fitted. The vehicle loses twice the usual Armor points loss from damage, that is, two points at Light Damage and four at Heavy.

Cost = -10

Cannot Glide

The aircraft has little or no wing span, and cannot gain lift without thrust. Should the engines fail, or be cut off for any reason, the aircraft will automatically enter an uncontrollable fall (see page 157 of the rulebook). Only vehicles with the Flying movement can take this Flaw.

Cost = -4

Decreased Maneuverability R

When using one type of movement, the vehicle loses some of its natural agility. This Flaw only applies to vehicles with two or more Movement Types and must be linked with one Movement Type in particular. When this Movement Type is used, the Rating of this Flaw is applied to the vehicle's Maneuver value.

Cost = -(Rating x 2)

Defective Active Sensors R

The vehicle's active sensor system has a tendency to go on the blink in a random manner. Defective active sensors are rated from 1 to 5. In combat, roll one die each round just before attempting to obtain an active sensor line-of-sight. If the roll is equal to or less than the defective active sensor Rating, apply the Flaw's Rating as a negative modifier to the sensor test.

Cost = -Rating

Defective Fire Control R

The vehicle's fire control system has a tendency to go on the blink in a random manner. Defective fire controls are rated from 1 to 5. In combat, roll one die each round, just before firing. If the roll is equal to or less than the defective fire control's Rating, then apply the Flaw's Rating as a negative modifier to the attack.

Cost = -Rating x 2

Difficult to Modify

The vehicle's innards are a nightmare of intertwined machinery and cables. Pieces must be specially machined for it, bolts and nuts are not standard, the color coding is wrong, etc. A -1 modifier is applied to all repairs on the vehicle.

Cost = -5

Exposed Auxiliary Systems

If the vehicle has all sorts of external gizmos attached to its hull with little or no protection, then it is likely to have the Exposed Auxiliary Systems Flaw. This Flaw is particularly appropriate for vehicles with large sensors, satellite uplinks, or external ECM pods. Whenever an Auxiliary Systems effect is rolled on the Systems Damage Table, it is treated as if the damage was one stage worse (i.e. Light Damage is treated as Heavy and Heavy Damage as all Auxiliary Systems destroyed).

Cost = -5

Exposed Crew Compartment

This Flaw is used to represent the open tops of jeeps and convertible vehicles. If only part of the crew or passengers are exposed, use the "Partially Exposed Crew" Flaw instead (see page 130). Vehicles with Exposed Crew Compartments should not be front-line combat units under any circumstances. Whenever a Crew effect is rolled on the Systems Damage Table, it is treated as if the damage was one stage worse (i.e. Light Damage is treated as Heavy and Heavy Damage as all crew killed).

This is a particularly nasty Flaw, especially if Player Characters are aboard the vehicle. Vehicles with Exposed Crew Compartments should not be front-line combat units under any circumstances. Any armored vehicle crew knows that the armor has to be around you to afford any protection! This Flaw is used to represent the open tops of jeeps and convertible vehicles. If only part of the crew or passengers are exposed, use the "Partially Exposed Crew" Flaw instead.

Cost = -5

Bryce Hubbard (order #959915)

◆ Exposed Fire Control Systems

The vehicle's Fire Control mechanisms are inadequately protected. Firing sensors are exposed, barrel elevation mechanisms are unarmored, and so on. +1 is added to the die when rolling on the Fire Control Damage Table.

Cost = -4

◆ Exposed Movement System

Some movement systems are too large, project too far away from the chassis, or are completely unarmored. If the vehicle is a civilian or non-combat model, odds are that its movement system is poorly protected. Whenever a Movement system's effect is rolled on the Systems Damage Table, it is treated as if the damage was one stage worse (i.e. Light Damage is treated as Heavy and Heavy Damage as all movement systems destroyed).

Cost = -5

◆ External Power AUX

The vehicle does not have a powerplant and does not require regular fill-ups with fuel. It draws its energy from wired or beamed power; the Deployment Range represents the basic maintenance interval. External Power is not strictly a Flaw, but is a liability even though it reduces the vehicle's weight and cost.

External power can be beamed in, a collector receiving the energy and converting it for use by the vehicle's systems. The vehicle must remain in line-of-sight with the power supplier. If the collector is destroyed, the vehicle will suffer total power failure.

The energy may be wire-fed instead, the vehicle trailing a wire for power. A Piloting roll must be made every turn against the highest MP cost for the hexes traveled to avoid snagging the cable. Flying drones must test also and use the overflown ground's MP cost. Space drones are not affected. Failure means the cable is stuck and the drone must halt for the next round to free it. A fumble means the cable is severed. The cable has a Damage Point Capacity equal to the vehicle's Size, per hex.

Cost = -2

◆ Extreme Overheating

The vehicle is prone to overheating in a highly dangerous manner. The vehicle will automatically suffer a Light Damage effect if it does any of the following for two combat rounds in a row: move and fire a weapon, fire three or more weapons, or use jump jets. If it does any of those actions for three combat rounds in a row, the vehicle will suffer a Heavy Damage effect.

Cost = -10

◆ Fragile Chassis

Civilian vehicles and some non-combat vehicles use light, less expensive chassis to help cut costs. These chassis perform just fine under everyday, normal usage, but they are more vulnerable to weapons fire and physical damage. A +1 modifier is added to the die when rolling on the Structural Damage Table.

Cost = -5

◆ Fuel Inefficient R

The vehicle gulps down massive amounts of fuel. Each kilometer traveled adds the Rating of this Flaw for Deployment Range purposes. For example, a vehicle with this Flaw at a Rating of 2 will count each kilometer traveled at Top Speed as six for fuel purposes (1+2, times two for Top Speed consumption).

Cost = -Rating

◆ Hazardous Ammo/Fuel Storage

The vehicle's fuel tanks and/or ammunition bays are poorly designed. They are either placed in a prominent place, lightly armored, or even both.

A +1 modifier is added when rolling Light Damage on the Fire Control Damage Table, +2 when rolling Heavy Damage.

Cost = -5

◆ HEAT Vulnerable R

The armor of the vehicle cannot withstand high energy attacks such as those from lasers or shaped-charge warheads. Subtract the Rating of this Flaw from the Armor Rating of the vehicle when submitted to a HEAT attack.

Cost = -Rating

◆ Highly Flammable

The vehicle is built with flammable materials, or is extremely sensitive to excessive heat. All incendiary attacks have their Intensity doubled before damage is calculated. If the vehicle is destroyed, it will keep burning at Intensity 10 for an additional number of turns equal to its Size.

Cost = -7

◆ Inefficient Combat Computer

The vehicle's fire control computer is easily overtaxed and can only fire one weapon or set of linked weapons per turn without penalty. If more than one weapon or link is fired (or if a weapon is fired again at a different target), apply a -1 modifier to the attack rolls for each weapon or link fired after the first attack.

This Flaw can only be taken by vehicles equipped with two or more weapon systems.

Cost = -3

◆ Inefficient Controls

The vehicle's control mechanisms are poorly organized, causing the crew to waste precious time in high-stress situations as they interfere with one another to access controls. The number of crew actions is reduced by one. Note that this Flaw may only be taken for vehicles with two or more crew members.

Cost = -9

Bryce Hubbard (order #959915)

◆ Large Sensor Profile R

A design Flaw has made the vehicle more visible to sensors: a large structure, a high infrared signature, a poorly shielded, overly powerful electronic suite, or a significant radar trace. The Flaw's Rating is subtracted from the vehicle's Concealment value versus sensors (not for Obscurement). While this has a limited effect in tactical combat, a large sensor profile is hazardous when trying to ambush enemies or evade pursuit.

This Flaw is often underrated: while it has a limited effect in tactical combat, a Large Sensor Profile is hazardous when trying to ambush enemies or evade pursuit. If the vehicle is a large Gear, tank or a strider, this Flaw should be seriously considered. A Large Sensor Profile can also be caused by poor quality, overly powerful electronics suites whose emissions are easy to detect, or "hot" or noisy engines.

Cost = -Rating x 2

◆ Maximum Ceiling R

Aircraft with this very common Flaw cannot climb past a certain altitude. The Rating is subtracted, in kilometers, from a height of 12 km to give the aircraft's maximum ceiling. For example, an aircraft with a Maximum Ceiling Rating of 4 cannot climb past (12 - 4 =) 8 kilometers (an altitude level of 32 in Air War scale). Rotary wing craft rarely have ceilings higher than 4 km (Rating 8). Aircraft that can go higher than 12 km cannot take the Maximum Ceiling Flaw.

Only Flying vehicles can take this Flaw.

Cost = Rating x -1.5

◆ Maximum Climbing Angle R

Aircraft with this Flaw must advance a certain number of hexes before they can climb one altitude level; the Rating of the Flaw gives the number of hexes. VTOL craft cannot take this Flaw. Only Flying vehicles can take this Flaw.

Cost = Rating x -3

◆ No Communication

The vehicle is not equipped with any form of communication system. It cannot stay in contact with teammates and cannot act as spotter for indirect fire. It may not benefit from Command Points. Such a vehicle has both Communication Rating and Range equal to zero.

Cost = -5

◆ No Engine

This is not a Flaw *per se*: the vehicle has simply been designed without an engine or power transmission system and must be towed or catapulted. Vehicles with this Flaw usually have compensating Perks like Glider. If flying, the vehicle cannot have a Stall Speed lower than 1, unless it also has the Lighter-than-air Perk. Movement hits are ignored, though Armor is lost as usual.

Cost = -2

◆ No Sensors

The vehicle has no electronic sensors and may only detect opponents visually. The vehicle is likely to have a clear canopy or exposed crew compartment. Such a vehicle has both Sensors Rating and Range equal to zero.

Many small vehicles are guided using unassisted human senses. If the vehicle being designed is one of these, it probably has no sensors. Such a vehicle cannot perform Active Sensor checks and must rely entirely on the Passive Detection Rating of its crew to acquire its targets (see page 135 of the rulebook).

Cost = -6

◆ One Way Communication

The vehicle's communication system can either receive or emit, but not both. The comm system is either an emitter or a receiver. Only receiving Communication systems allow the unit to use Command Points, and only emitting systems allow forward observing.

Cost = -2

◆ Overheating

The vehicle is prone to overheating in a dangerous manner. The vehicle will automatically suffer a Light Damage effect if it does any of the following for three combat rounds in a row: move and fire a weapon, fire three or more weapons, or use jump jets.

Cost = -5

◆ Partially Exposed Crew

Only part of the crew is protected by the vehicle's mass; the rest is exposed to enemy fire. The vehicle is considered to have the "Exposed Crew Compartment" Flaw until all exposed crew members have been eliminated. For example, a vehicle which has three crewmen in an enclosed cockpit and four gunners on open mounts will have the Flaw until the four gunners are casualties. The cost would be (4 ÷ 7 =) 0.571 x -5, rounded off to -3.

Cost = -5 x (Crew Exposed ÷ Total Crew), rounded off

◆ Problem-prone

Tighten one bolt, and two come loose. For some unknown reason, problems seem to crop up everywhere on the new design. One die is added to the Lemon roll, regardless of the chosen production type.

Cost = -1 per additional Lemon die

◆ Poor Off-Road Ability

Since the game system assumes that typical vehicles are rugged military models, all vehicles are given a certain amount of innate off-road ability. Most civilian vehicles and some military transports lack the rugged suspensions and transmissions required for proper all-terrain performance. If the vehicle is one of these, this Flaw should be taken to represent its problems on broken ground.

Bryce Hubbard (order #959915)

Whenever entering terrain that costs two or more MP (not including elevation changes), the MP cost of the hex is increased by one. The vehicle may ignore this penalty and move counting the normal MP cost, but the crew must make a Piloting roll for each hex against a Threshold equal to 4 + the hex's MP cost. If failed, the vehicle suffers Light Movement damage or is stuck for 1d6 rounds. If fumbled, Heavy Movement damage or is stuck permanently and must be towed out.

Cost = -1

◆ Poor Towing Capacity

The vehicle's powerplant is too small, or its transmission system is not up to the task and overheats all the time. The vehicle's towing capacity is halved. Except for high performance fighters or civilian vehicles, very few designs have this Flaw.

Cost = -4

◆ Random Shutdown R

Whenever strained (each round of combat or every 15 minutes of moving at top speed), the vehicle must roll two dice to avoid shutting down (no movement or actions) for a number of combat rounds equal to the roll of one die. The Threshold is equal to one plus the Rating of this Flaw.

Cost = -0.5 x Rating

◆ Requires Airstrip

The aircraft cannot land on rough or even smooth non-asphalted ground. An airstrip is required for a safe landing — this is represented by a Road (see page 155 of the rulebook). In any other case, the pilot must make a Piloting Skill roll against a Threshold equal to 3 plus the Ground MP cost of the hex to avoid crashing. Only Flying vehicles can take this Flaw.

Cost = -5

◆ Sensor Dependent

The vehicle's cockpit does not allow the pilot a direct, clear visual image of his vehicle's surroundings. If the sensors are damaged or destroyed, the vehicle is running blind and is next to useless. It cannot attack, nor can it move. Any such attempt is automatically randomized on the board (i.e., direction and target are determined by the dice instead of the controlling player). If the environment permits, crew members may open a hatch, negating the penalty but acquiring the Partially Exposed Crew Flaw.

Cost = -6

◆ Traceable Emissions

The vehicle emits large amount of residual heat, smoke, radiation, etc., and is thus easily tracked down. Sensor rolls to spot the vehicle have a bonus equal to the Rating of this Flaw. Guided weapons automatically lock-on without need for a designator. AIs and computers (such as autopilots) may be instructed to track these emissions.

Cost = -Rating x 3

◆ Unstable

The vehicle is somewhat hard to control at high speed, either because it is badly designed or just top heavy. Apply a -1 modifier to all Piloting Skill rolls at Top Speed or in terrain with a MP cost greater than one. This is a more serious Flaw in an atmospheric flight vehicle, where a sudden turn can result in a lost of lift, intake, or any of a dozen other serious problems. A flying vehicle suffers a -1 to Maneuver any time it travels at a speed higher than Combat Speed.

Cost = -2, -5 for vehicles with Flight

◆ Vulnerable to Haywire Effects

The vehicle is vulnerable to electrical attacks. Fragile circuitry and ungrounded systems are prone to excessive damage. Haywire weapons get three damage rolls instead of their normal two.

If the vehicle has lots of nifty electronics packages, it is a great candidate for this Flaw. Vulnerable to Haywire Effects gives back lots of points and is rarely applied. Unfortunately, the vehicle is dead meat if it encounters enemies using particle beam guns and other electricity-based weapons.

Cost = -9

◆ Weak Facing

The vehicle has a weak facing (arc of defense). This may be due to incomplete armor coverage, shoddy design, or just plain bad material. When the vehicle is attacked on that side, halve its effective armor. This Flaw cannot be taken more than twice.

This Flaw is useful in order to help offset the cost of expensive Perks. However, both Weak Facings and Weak Points are very hazardous if the enemy knows of their existence. This is especially true of Weak Points, which are only hit on called shots. The vehicle should either rarely expose its weak area or have some means to defend it (a shield, for example). Note that even a side with some kind of specialized armor may have a Weak Point.

Cost = -(0.25 x base armor Rating) (per defensive arc)

◆ Weak Point R

The vehicle has a weak point in the armor covering one of its locations. This may be due to incomplete armor coverage, shoddy design, or plain bad material. When a specific system/location is targeted and successfully hit, reduce the base armor by the Rating of this Flaw before applying damage. This Flaw cannot be taken more than twice per vehicle.

Cost = 0.5 x Rating, rounded down

◆ Weak Underbelly

The underside of the vehicle is either unarmored or otherwise poorly protected. The vehicle's effective Armor is halved against all attacks coming in directly from below, such as minefields.

Cost = -0.2 x base Armor Rating

Bryce Hubbard (order #959915)

6.1.12 - Threat Value

The Threat Value and cost of a vehicle do not necessarily have to be figured out in order to use it in a given roleplaying campaign. Just plugging in the stats and playing is a perfectly valid option if a Gamemaster is present to balance the forces in presence. The Threat Value is useful only when hard numbers are required — for example, to help balance a one-shot tactical scenario, or to assign a price to a vehicle.

Threat Values enable the players to establish campaigns without the help of a Gamemaster. A single number is not the ultimate, perfect representation of a vehicle's worth, however. This is why a vehicle's Threat Value is further broken down into Offensive, Defensive and Miscellaneous Scores. These three "sub-values" point out the strengths and weaknesses of each vehicle design, making it much easier to balance out scenarios according to the mission at hand.

Calculating the Threat Value of a vehicle is a logical process involving separate, sequential steps. First, the Offensive Score, Defensive Score, and Miscellaneous Score values of the vehicle must be figured out. These three scores are then averaged together to determine the vehicle's total Threat Value, rounding up to the nearest whole number. This allows the player to change some equipment or values without having to recalculate the cost of the whole vehicle, only the affected sub-score.

THREAT VALUE FORMULA:

Threat Value =
(Offensive Score + Defensive Score + Misc Score)/3

◆ The Offensive Score

Vehicles with high Offensive Scores are especially good at dishing out damage. On open terrain and in face-to-face confrontations, they are very likely to come out on top. The base Offensive Score is based on the total of the Ratings of all the vehicle's weapons and their required ammunition.

If a weapon has either a Fixed Forward (FF) arc or is turret-mounted, its weapon Rating is altered. Weapons with "FF" arcs have a x0.6 multiplier applied to their Weapon Rating while weapons with "T" arcs have a x1.8 multiplier applied to their Rating (this includes the cost of the turret). The turret may be deemed "slow" (ST): the player must choose a 180 degrees fire arc for it each turn; the cost multiplier is x1.5 instead.

Only Weapon Cost, not ammo cost, is multiplied for these special arcs; ammunition is ammunition, regardless of the mounting of the weapon firing it.

Punching ability for all types of arms is entirely optional and must be paid for by squaring one-half of the punch's Damage Multiplier to calculate the weapon Rating of each punching arm. Note that it is possible to have a lower punch Damage Multiplier than the Rating of the arm — it just leads to more bookkeeping as a separate Rating must be recorded. Arms cannot cause more damage than their Size: if a higher DM is desired, a melee weapon should be bought.

Do not round numbers until the end of the OTV calculation; then round up to the nearest whole number.

◆ Calculating the Offensive Score

Weapon Arcs and Special Systems

Weapons with FF arc =	Weapon Threat Rating x 0.6
Weapons with T arc =	Weapon Threat Rating x 1.8
Weapons with ST arc =	Weapon Threat Rating x 1.5
Punch Rating =	(Damage Multiplier of arm x 0.5) squared

OFFENSIVE MULTIPLIER = the sum of the following:

Costs for all Weapons (modified for Fire Arcs)
Ammunition costs for all weapons
Punch Rating for each arm (if applicable)
Offensive Score = Targeting System Multiplier* x Offensive Multiplier

• *Do NOT use the Fire Control Rating. Instead, look up the Rating on the Targeting System Multiplier table and use the multiplier given by the table.*

Targeting System Multiplier

Fire Control	Multiplier	Fire Control	Multiplier
+5	700	-1	0.5
+4	120	-2	0.333
+3	24	-3	0.25
+2	6	-4	0.2
+1	2	-5	0.167
0	1		

◆ The Defensive Score

Vehicles with high Defensive Scores are especially good at avoiding or surviving damage. Their strong point is defending objectives and escaping enemy forces. The Armor Rating and all movement modes are included in the calculation. The second and subsequent slowest movement speeds are added together. For example, if a vehicle had the Flight (fastest), Ground and Naval movement types, the latter two would be added together for calculation purposes.

Ground and Rail vehicles with no other movement modes use a slightly modified Defense Score formula to reflect their simpler drive mechanisms. Their speed should be divided by 40 (for Ground only) or 60 (for Rail only) instead of the usual factor of 25 (see the formula on the next page).

The following formula produces the vehicle's Defense Score. Threat Values are calculated the same for flight-capable vehicles as for any other vehicle, with one little exception: a modified formula for the Defense Multiplier must be used. It takes into account the higher speeds of aircraft and also includes the Stall Speed of an aircraft, as this can have a significant effect in tactical games. Make sure to use the proper formula.

Do not round numbers until the end of the DTV calculation; then round up to the nearest whole number.

Bryce Hubbard (order #959915)

Calculating the Defensive Score

The Defense Multiplier is equal to the sum of the following:

(Armor Rating) squared
(fastest movement speed in kph ÷ 25†) cubed
(sum of speeds of all other movement types in kph ÷ 6) squared
(Space acceleration, in MP) squared

†Ground movement-only divide the speed by 40. Rail movement-only divide the speed by 60.

If the vehicle has the* Flight *movement system, the Defense Multiplier is equal to the sum of the following:

(Armor Rating) squared
((Flight Speed - Stall Speed) in kph ÷ 125) cubed
(sum of speeds of all other movement types in kph ÷ 6) squared
(Space acceleration, in MP) squared
Defensive Score = Maneuver Multiplier* x Defense Multiplier

* Do NOT use the actual Maneuver Rating. Instead, look up the Rating on the *Maneuver Multiplier* table and use the multiplier given by the table.

Maneuver Multiplier

Maneuver Score	Multiplier	Maneuver Score	Multiplier
+3	9	-4	0.333
+2	3	-5	0.286
+1	1.5	-6	0.25
0	1	-7	0.222
-1	0.667	-8	0.2
-2	0.5	-9	0.182
-3	0.4	-10	0.167

The Miscellaneous Score

Specialist vehicles such as scout exo-suits, communication AFVs and the like typically have high Miscellaneous Scores to reflect their unusual abilities. Depending on the scenario played, this can be useful or detrimental.

The following formula produces the vehicle's Miscellaneous Score. The vehicle's total actions are used in the formula, not just the bonus actions. The Communication, Sensor and Deployment Ranges should be divided by the correct factors before squaring or cubing them. If there are no Sensor or Comm system, use zero for both the Rating and Range; the proper Flaw (No Sensor, No Comm) should be added.

If the sum of the Sensor and Communication Ratings is negative, the square value will also become negative (for example, a total of -3 would be squared to 9, which would then become -9). The Perk/Flaw Point Totals referred to in the formula are the total cost points for all of the vehicle's Perks and Flaws, respectively; the costs are listed on pages 112 to 131.

Do not round numbers until the end of the MTV calculation; then round up to the nearest whole number.

Calculating the Miscellaneous Score

The Miscellaneous Score is equal to the sum of the following*:

(Total Actions) cubed
(Communication Range in km ÷ 10) cubed
(Sensor Range in km ÷ 2) cubed
(Deployment Range in km ÷ 50) squared
(Burn Points ÷ 100) squared
(Sensor Rating + Communication Rating) squared**
(Perk Point Total) squared - (Flaw Point Total) squared

*The Miscellaneous score has a minimum value of zero;

**If both values are negative, the resulting square becomes a negative value.

Design Example

Kurt pulls out his trusty calculator and starts to work out his Gear's Offensive Score. He adds the weapon Ratings of each of his Gear's weapons, carefully checking them in the weapon listing: 108 (for the Light Autocannon) + 226 (for the LRP/24) + (29 x 0.6) (for the fixed AP Grenade Launcher) + vibroknife (16 points) = 367.4.

He decides to add the punching option to both arms, at a cost of $(6 \times 0.5)^2 = 9$ points; one never knows when it might come in handy. He also buys ammunition for his various weapons: 60 shots for the autocannon (16.8 points), 24 rockets (13.9), 6 shots for the APGL (0.6 points), and 3 grenades (11 points each), bringing his Offensive score to 449.7. Since his Targeting System Multiplier is 1, his final Offensive score is 449.7 (which will later be rounded to 450 for simplicity).

He moves on to his Gear's Defensive Score. He enters his Gear's numbers in the Defense Multiplier formula: Armor 15, fastest speed 72 kph, and sum of all other speeds, 42 kph. His Defensive Score calculations look like this: $15^2 + (72/25)^3 + (42/6)^2 = 297.9$. Since his Maneuver Multiplier is 1 (because of his Maneuver 0), his final Defensive Score is 297.9 (which will later be rounded to 298 for simplicity).

Kurt now starts calculating his Miscellaneous Score. He's got just one guy supplying one Action, standard Sensors and Comm Ranges and Ratings, and a 500 km Deployment Range. He continues by calculating his total Perk/Flaw cost. He adds 3 + 3 (both arms) + 1 (HEP: Desert) + 10 (Easy to Modify) = 17. There are no Flaws. Kurt then uses this number to help him calculate his Miscellaneous Score as follows: $1^3 + (10/10)^3 + (2/2)^3 + (500/50)^2 + (0+0)^2+17^2 = 392$.

To find his vehicle's final Threat Value, he takes the average of the three numbers. His calculations look like this: (449.7+297.9+392)/3 = 379.86. Once rounded up to a whole number, the Threat Value of his Gear is 380.

Bryce Hubbard (order #959915)

6.1.13 - Default Size and Cost

The Default Size score of a vehicle is calculated using the following formula by using the Threat Value. Round the Default Size to the nearest whole number.

DEFAULT SIZE:

Default Size = Cube Root (Final Threat Value)
Default Cost = (Final Threat Value) x 1000

The Armor Rating of a vehicle places certain constraints upon its minimum Default Size. If the Default Size of the vehicle is calculated at less than one-fifth of the Armor Rating, raise the Default Size to one-fifth (round up) of the Armor Rating.

If the Default Size of the vehicle is more than ten times its Armor Rating, the designer has grossly underestimated the toughness of his vehicle and its structure is too flimsy to stay together. In this situation, return to Step Four, increase the vehicle's Armor Rating, and recalculate the vehicle's Threat Value and Size (Steps Eleven and Twelve).

The Default Cost in Mark/Dinar is equal to the final Threat Value times 1000. The final cost will be adjusted later to whatever monetary unit is appropriate to the place where the vehicle is assembled.

Design Example

The Default Size of Kurt's vehicle is equal to the cube root of 380, or 7.24, rounded down to Size 7. This is well above his minimum of (Armor 15/5) = 3 (one-fifth of his base Armor Rating).

The Default Cost of his Gear is (380 x 1000 =) 380,000 Marks/Dinars.

6.1.14 - Actual Size and Pre-Prod. Cost

The vehicle does not have to be the Size generated by these calculations. It may be as large as twice the Default Size score or as small as one-fifth the Default Size score. There is no cost involved in changing Sizes within these limits, because the advantages and disadvantages tend to cancel out. For example, a smaller vehicle will be easier to carry around, but a larger one will be cheaper to design (more room to work with!) and cause more damage in physical attacks.

If the Size of the vehicle is greater than twice its Armor Rating, the designer must reduce the vehicle's Size so that it is no greater than twice the vehicle's Armor Rating.

A vehicle must have at least one crew member per ten Size points or fraction thereof. The Automation and Artificial Intelligence Perks can be used to substitute for living crew members.

Most Gears are Size 6 or 7, although they could probably go as low as Size 5.

The pre-production cost of a vehicle is calculated using the following formula. It should not be rounded until the Final Cost stage, later on.

PRE-PRODUCTION:

Cost = Default Cost x (Default Size ÷ Actual Size)

Size To Mass Chart

Size	Mass in Tons	Size	Mass in Tons	Size	Mass in Tons
1	0-0.08	34	1001-1100	67	7901-8300
2	0.09-0.3	35	1101-1210	68	8301-8700
3	0.4-1.1	36	1201-1300	69	8701-9100
4	1.2-2.4	37	1301-1400	70	9101-9500
5	2.5-4.4	38	1401-1500	71	9501-9900
6	4.5-7.3	39	1501-1700	72	9901-10300
7	7.4-10	40	1701-1800	73	10301-10700
8	11-16	41	1801-1900	74	10701-11200
9	17-22	42	1901-2100	75	11201-11600
10	23-30	43	2101-2200	76	11601-12100
11	31-40	44	2201-2400	77	12101-12600
12	41-52	45	2401-2500	78	12601-13100
13	53-65	46	2501-2700	79	13101-13600
14	66-81	47	2701-2900	80	13601-14100
15	82-100	48	2901-3100	81	14101-14600
16	101-120	49	3101-3300	82	14601-15200
17	121-145	50	3301-3500	83	15201-15700
18	146-170	51	3501-3700	84	15701-16300
19	171-200	52	3701-3900	85	16301-16900
20	201-230	53	3901-4100	86	*16901-17500*
21	231-270	54	4101-4400	87	17501-18100
22	271-310	55	4401-4600	88	18101-18700
23	311-350	56	4601-4900	89	18701-19400
24	351-400	57	4901-5100	90	19401-20000
25	401-450	58	5101-5400	91	20001-20700
26	451-500	59	5401-5700	92	20701-21400
27	501-560	60	5701-6000	93	21401-22100
28	561-630	61	6001-6300	94	22101-22800
29	631-690	62	6301-6600	95	22801-23500
30	691-770	63	6601-6900	96	23501-24100
31	771-840	64	6901-7200	97	24101-25000
32	841-930	65	7201-7600	98	25001-25800
33	931-1000	66	7601-7900	99	25801-26600

Design Example

According to the calculations, the basic, unmodified design of the vehicle will be Size 7. Kurt looks up Size 7 on the Size to Mass Table and find that this represents between 7.4 and 10 tons.

He imagines his Gear being a little smaller and lighter than that (if only to stuff more of them in the cargo holds of his transports), so he decides to spend some additional cash on miniaturisation and make it a Size 6 vehicle.

Since his Actual Size is lower than his Default Size, his Pre-Production Cost will be greater than his Default Cost. He multiplies his Default Cost (380,000) by 7 (Default Size) and divides this by 6 (Actual Size), arriving at a PreProduction Cost of 443,333. Miniaturization does tend to raise the cost a little.

Bryce Hubbard (order #959915)

6.1.15 - Production Type and Lemons

Select the stage of production the vehicle is in. Prototypes are hand-crafted and often one-of-a-kind, making them outrageously expensive. Early production runs often still have a bug or two left in them that has yet to be worked out. Mass production runs produce cheap, reliable machines. Limited production runs improve product quality and increase cost. Scratchbuild designs are lovingly hand-crafted with little or no planning. The production type will also define how much care is put into each unit built and how many will be built on average (the "#" column).

Along with production type comes Lemon Rolls, the only random part of vehicle design (this is what the "Dice" entries in the table are for). Lemon Rolls are fully explained further. If the Gamemaster is designing a vehicle for use in a campaign, he should feel free to ignore Lemon Rolls or add Defects that he finds appropriate. If designing a vehicle that the Player Characters are building, the Lemon Rolls should be made and enforced.

Note that this table is designed for vehicles of Size 1 to about 15. Larger vehicles, such as the monstrous Landships, rarely go past what could be considered the Early Production stage because of their extremely large and complex construction. The same phenomenon applies to spacecraft as well.

Production Types

Model Type	Definition	#	M. Dice	Ind. Dice
Testbed Prototype	New Tech	1-3	12	2
Early Prototype	New Model	1-5	8	1
Late Prototype	New Model	1-10	4	1
Early Production	New Release	5-100	3	3
Limited Production	High End Model	5-500	1	2
Mass Production	Common Model	100+	2	3
Scratchbuild	Patchwork Mess	1	N/A	10

Lemon Rolls

Not every vehicle is made the same, even if they are the same make, model, and variant. Every once in a while, someone screws up and a lemon is produced. Just how many mistakes get made depends on what kind of model the vehicle is.

In addition to the base Model Lemon dice (see the table), one die is added for every full five Perks assigned to the vehicle (0-4, no extra dice, 5-9, one extra dice, and so on). The dice are rolled against a Threshold of 5: for each point above it, a Defect occurs. Fumbles are disregarded in this case. Due to the meticulous design and construction of Flight and Space vehicles, they tend to have fewer defects: one die is added for every ten (10) Perks the vehicle has, instead of the usual five.

When a new model is produced, its Model Dice are rolled and the Defects common to all vehicles of this model are determined. In addition, each individual vehicle gets a set number of Lemon Dice. Whenever a vehicle of this type is introduced into a game or campaign, its Individual Lemon Dice should be rolled to know what "quirks" it has.

Roll once on the Lemon Defect table per Defect. If multiple options are available, only one should be selected.

Lemon Defect Table

Die Roll	Defect
1	Structural Weakness (-1 Maneuver *or* -10% to Armor, rounding up)
2	Elec. Glitch (-1 Fire Control *or* -1 Sensors *or* -1 Communications)
3	Mov. Sys. Defect (-1 Maneuver *or* -10% Top Speed (min. 1 MP))
4	Vehicle has one Annoyance Flaw
5	Vehicle has additional Flaws totaling -2 or less
6	Vehicle has additional Flaws totaling between -2 and -4

Getting Rid of Defects

The Model Defects are basically errors that were made in either the conception or construction of the vehicle, and as such cannot be eliminated unless the unit is totally redesigned back at the factory. This often leads to the well-known parade of variants that merely correct the previous implementation's defects — sometimes adding new ones in the process.

Individual Defects are not so bad, however; they simply represent errors made on the assembly line. Unfortunately, repairing these Defects amounts to taking the vehicle apart and putting it back together — correctly, this time.

They are repaired like normal battle damage (see *Repairs*, page 154), but the repair time is doubled for each Defect repaired (fixing two defects will take four times as long as a normal repair), and the difficulty is also doubled. A failed repair roll means the vehicle is stuck with the Defect. A Fumbled roll means an automatic additional Defect!

The Curse Option

Optionally, if the Annoyance Flaw is rolled, it can be refused in favor of choosing to have a Curse. Effectively, the vehicle proves Murphy's Law whenever it is convenient to the Gamemaster. This can be used only in a roleplaying or integrated game, since it would be hard to apply the Curse evenly in a tactical game.

Here are a few examples of possible Curse effects: a certain tank model that gets struck by lightning ten times more often than other tank designs. A stealth submarine whose hull, for some unknown reason, picks up and resonates radio stations when near the shore. A destroyer which is just plain jinxed ("it's haunted... Yeah, that's it!").

Design Example

Kurt had already decided that his Gear is a mass production model. Consulting the Production Type table, he notes that he has to roll two dice for a new Mass Produced vehicle. His design has less than five Perks, so he does not have to add any more dice.

Kurt rolls his two Model dice, and obtains a result of 4. This is below the Threshold of five, and thus no Defect occur. All vehicles of this model will have to roll three dice for possible Individual Defects, but the base design is sound and has no defects. Kurt sighs with relief.

Bryce Hubbard (order #959915)

6.1.16 - Final Cost

The Pre-Production Cost of the vehicle is multiplied by the Production Cost Multiplier to obtain the Final Cost of the vehicle. It should be rounded up to the nearest whole number.

Vehicle Final Cost

Model Type	Prod. Cost Mult.
Testbed Prototype	x100
Limited Production	x2
Early Prototype	x20
Mass Production	x0.5
Late Prototype	x5
Scratch-Build	x0.2
Early Production	x1

Design Example

Since Kurt's Gear is a United Mercantile Federation mass production model, its final cost is 0.5 of the Pre-Production Cost. Half of 443,333 is 221,667, so the final cost of each Gear of this model is 221,667 Marks. Cheap!

6.1.17 Name the Design

Fill out a vehicle record sheet for the new creation. Christen it with a good sounding name or identification code and, optionally, write down its history and description. The new vehicle is ready to be taken out to battle.

Design Example

Kurt now has to name his new Gear. After pondering the name "Ranger," he decides to call it the "Hunter."

6.2 - Special Cases

The Mechanical Design System is very complete: it allows the creation of any type of vehicle or object, from a bicycle to a gun emplacement to a huge spaceship. However, since the scale of the system has to be somewhat large to accommodate all those vehicles' different sizes, the smaller ones tend to suffer from a certain lack of detail. Other more specialized items require additional explanations and special case rules. This section explain how to design small and oversized vehicles, and emplacements.

6.2.1 - Small Vehicles

Small scale vehicles (Size 5 and smaller) are easy to define using the normal rules. All that is required is a bit of ingenuity and a change of perspective. The Silhouette vehicle design system uses a set of mathematical formulas to compute the Size, cost and effectiveness of a given vehicle based on its chosen capabilities. By adding decimals to the statistics and using them in the design formulas, an accurate and more detailed pattern will emerge just like the other, larger, vehicle types.

Size

The main adjustment for small vehicles lies in the Final Size decided upon. Since the normal Size values cover quite a broad range of weights to choose from, they have been subdivided into smaller ranges for convenience. The Size value provided by that table is used in the Threat Value (TV) calculations as usual, complete with the decimals.

Small Scale Size-to-Mass Chart

Size	Mass in Kg	Size	Mass in Kg	Size	Mass in Kg
0.1	0-8	0.2	9-16	0.3	17-24
0.4	25-32	0.5	33-40	0.6	41-48
0.7	49-56	0.8	57-64	0.9	65-72
1.0	73-80	1.1	81-102	1.2	103-124
1.3	125-146	1.4	147-168	1.5	169-190
1.6	191-212	1.7	213-234	1.8	235-256
1.9	257-278	2.0	279-300	2.1	301-380
2.2	381-460	2.3	461-540	2.4	541-620
2.5	621-700	2.6	701-780	2.7	781-860
2.8	861-940	2.9	941-1020	3.0	1021-1100
3.1	1101-1230	3.2	1231-1360	3.3	1361-1490
3.4	1491-1620	3.5	1621-1750	3.6	1751-1880
3.7	1881-2010	3.8	2011-2140	3.9	2141-2270
4.0	2271-2400	4.1	2401-2600	4.2	2601-2800
4.3	2801-3000	4.4	3001-3200	4.5	3201-3400
4.6	3401-3600	4.7	3601-3800	4.8	3801-4000
4.9	4001-4200	5.0	4201-4400		

Movement and Maneuver

Small vehicles use the standard movement types with no modification to cost or capabilities. Speed is expressed in kilometers per hour, just like all other vehicles. To get the speed in meters per roleplaying turn (6 seconds), the speed in kilometers per hour is multiplied by 1.65, rounding to the nearest whole number.

Small vehicles are generally more nimble than larger ones and their Maneuver Attribute should reflect this. Generally, small vehicles will not have a Maneuver of less than -3.

Electronics

Small vehicles use the same Sensor, Communication and Fire Control Attributes as their larger brethren. Because of the limited internal space available, however, less equipment is generally carried. Sensor and Communication scores tend to be a bit lower (-1 or -2), but do not have to be.

Armor

Small vehicles may have Armor Ratings based on the Personal scale rather than the Vehicle scale. The Personal-scale Armor Rating is divided by ten for Threat Value (TV) calculation. In tactical battles, it is also divided by ten, but is rounded to the nearest whole number. For example, a truck could have an Armor Rating of 45 on the Personal scale. This would translate to an Armor Rating of 4.5 for TV purposes, and 5 for tactical battles.

Bryce Hubbard (order #959915)

◆ Weapons

Either the standard vehicular or infantry weapons can be used. Infantry weapons will need to be mounted on a Pintle Mount, or be carried with a human-sized Manipulator Arm (Size 1 or 2). Vehicular weaponry causes ten points of Personal-scale damage per point of Vehicle scale damage.

6.2.2 - Large Vehicles

Just like small vehicles, large vehicles can be built with specialized rules to better represent their capabilities and peculiarities. This section explains how to design large or oversized vehicles (anything above Size 30).

Large vehicles can be built as one large structure, but they are most often broken down into smaller parts to facilitate construction, reduce costs and increase their survivability. In Silhouette terms, this means that the vehicle is composed of a main hull, which may have the primary movement system(s), plus a number of superstructures and components that perform certain function and are "towed" by the main hull. Examples of this include weapon turrets, communication towers, drive units, etc. For the sake of simplicity, these are referred to as "sections" in the text.

◆ Size

The main adjustment for large vehicles lies in the Final Size. Movement systems are generally designed into the main hull, which is then used to "tow" the rest of the vehicle. The true Size of the overall vehicle (for collisions, physical attacks and transport) is thus the total of the mass of the main hull *plus* the mass of the sections added to it. This must be remembered if the vehicle is to tow or carry anything.

◆ Crew

Each section requires at least one crewmember, human or computer. Actions are determined separately for each part of the vehicle, including the main hull. Crew casualties are likewise applied to each separate section as damage is received.

Crew may be reassigned to other sections. A number of crewmembers equal to the Size of the smallest section involved in the exchange may be transferred each turn. Transferred crewmembers do not count for action purposes in the round during which they are transferring.

◆ Maneuver

Large vehicles are generally slower and more cumbersome than small ones, and their Maneuver Rating should reflect this. Generally, large vehicles will not have a Maneuver of more than -3. All sections must have the same Maneuver Rating as the main hull. They use the same movement modifiers in combat (e.g. if the main hull is moving at Combat speed, each section will be treated as moving at Combat speed).

Sections ignore any Maneuver-related damage result, but still lose Armor points as usual (1 for Light damage, 2 for Heavy damage). They are affected by any Maneuver damage suffered by the main hull.

◆ Movement

Only the main hull (and additional motive sections, if any are present) needs movement system(s). Other sections do not need movement systems but still have connections to the main hull to benefit from its movement — because of this, they may not take the "No Engine" Flaw or any other movement-related Perk or Flaw. Sections ignore any Movement-related damage result, but lose Armor points as usual.

The exception to this is additional motive sections. These contribute motive power by adding their total mass to define a common "towing capacity." This is then used to tow the rest of the vehicle (the main hull simply adds its own MPs, if applicable). Obviously, all motive sections must use the same movement type. If a motive section is Overkilled or can no longer supply *any* motive power, the speed drops; the new speed provided by the remaining motive sections is rechecked according to the towing rules. It is generally better to figure out these speed decreases as the vehicle is designed to save game time.

◆ Electronics

The electronic systems (Sensor, Communication, Fire Control) are distinct for each part of the vehicle. Thus, if the hull carries no weapons it can have a Fire Control Rating of -5, while the turrets have a standard Fire Control of 0. A communication tower could have a very high Communication Rating but not much else.

Some sections can dispense with Sensor, but they all need a Communication system to connect with the rest of the vehicle. Should it be destroyed, that section is cut off and may not receive orders from (or supply them to) the rest of the vehicle. It cannot benefit from Command points or transfer crew unless a messenger physically fetches them (that crewmember does not count for any actions while he is away from his post).

◆ Armor

Armor is placed as normal on the main hull and components. Each section has its own Armor Rating and takes damage separately. Should a section be Overkilled, any remaining damage is applied to the Armor of the main hull to see if additional damage is suffered. If the main hull is Overkilled, each section still has power for a number of turns equal to its Size, after which they lose all power and become inactive.

For example, a turret section with an Overkill value of 72 takes a glancing blow from a powerful laser beam and suffers 120 points of damage as a result. The Overkill result automatically destroys the entire turret, while the remaining 48 points of damage are applied to the main hull.

◆ Weapons

The weapon and ammunition carrying capacity of each section depends on its Size, as normal. Extra ammunition may be stored in other sections, but must be physically transferred. A section is considered fixed in place. If the design calls for a turret, the weapon(s) should be bought with the Turret fire arc as normal. Fixed arcs are also possible.

Bryce Hubbard (order #959915)

6.2.3 - Emplacements

Buildings and general structures such as roads and bridges are assigned Damage Point Capacities rather than an Armor Rating (see *Urban Terrain*, page 156 of the rulebook). These structures take damage by ablation rather than by Light or Heavy damage effects. It is possible to mount systems and weapons on these basic structures to give them additional capabilities: these are referred to as emplacements.

Emplacements are designed using the same system as vehicles, with a few limitations. They have a maximum Size Rating of 15 (25 when added to Dense Urban structures). Their movement is always equal to zero, and their Maneuver value is equal to -10 for calculation purposes. Their defense roll will always be equal to zero — a gun emplacement does not dodge. Emplacements always benefit from the Stationary attack modifier (+2). Gun emplacements ignore any Movement or Maneuver-related damage result, but still lose Armor points as usual (1 for Light Damage, 2 for Heavy Damage).

Emplacements don't have to make room for things such as an engine, transmission or control components, so they have more internal space to devote to weaponry and ammunition. They count as being five Size points larger than their actual Size for weapon and ammunition Size requirements. The Deployment Range shows how many hours of power is stored in their internal reserves.

◆ Anti-Aircraft Laser Platforms

Some defensive gun emplacements use megawatt lasers instead of ammunition-based weapons. AA Laser Platforms are built with the same rules as other gun emplacements, but are immobile. Because they are connected to a power grid, they never expend ammunition points. They can fire in burst or saturation mode if the chosen lasers have a ROF of one or more. Each weapon costs five times its normal value when figuring out the Offensive Score of the platform (for example, an emplaced, turreted Heavy Laser Cannon would cost 623 x 5 x 1.8 = 5607 points).

Because of their large power supply, laser turrets can be used for limited anti-missile fire. In game terms, firing in anti-missile mode costs one action per attempt and allows a single attack with a -6 modifier. One interception attempt may be made per Range band. Lasers with rapid-fire capacity can use ROF points on a one-for-one basis to reduce this penalty (for example, a Gatling Laser would suffer a penalty of only -5). Each functional anti-aircraft laser platform may roll versus every incoming missile or missile cluster (burst attacks), provided the crew (or the computer controlling it, if applicable) can spend the actions.

The anti-aircraft laser platform can attack any type of mortar shell, rocket, missile, or bazooka projectile. If the result of the anti-missile roll is greater than the attacker's roll, the system shoots down the missile. The laser completely destroys the missile when successfully used versus a single shot attack. When used to defend versus a missile cluster (ROF attack), each point of the MoS reduces the incoming cluster's ROF bonus by one. If the ROF bonus drops to zero, all of the incoming missile flight has been effectively destroyed.

6.3 - Weapon System Customization

There is an old military saying that goes "Remember, your weapon was made by the lowest bidder." While a soldier would never willingly fight with a barely functional weapon, sometimes they must make do with the quirks and limitations of the ones they are issued. From time to time, a few units will get lucky and get their hands on superior weapons.

The following rules explain how to customize the various weapon types that exists in the Heavy Gear universe to make them more individualized. Note that these rules require just a tad more bookkeeping than usual, and their use is entirely optional. Each option may be taken once; indicate which option was taken by placing an asterisk beside the modified weapon statistic. Only one option can be taken by weapon system.

Do not round numbers until the end of the calculations; then round up to the nearest whole number.

6.3.1 - Accuracy

Not all weapons shoot equally well. A short or warped barrel, a low quality guidance system or a poorly prepared charge can cause a shot to go wide of its intended mark. On the other hand, some weapons are more accurate than usual — needless to say, these are highly prized by soldiers.

If this option is chosen, add or remove one from the Accuracy Attribute. For example, a poorly made light autocannon will have an Accuracy of -1 instead of the usual 0. A great LAC, with a long barrel or gyro-stabilized mount, will have a +1 Accuracy.

ACCURATE WEAPON (+1 ACCURACY):
multiply weapon's Rating by 1.5

INNACURATE WEAPON (-1 ACCURACY):
multiply weapon's Rating by 0.6

6.3.2 - Damage

Some weapons are better designed and can cause more damage than other weapons of a similar type. This might be due to a more powerful charge, higher energy conversion ratio, larger warheads, etc. Underpowered weapons also exist, to the dismay of the soldiers using them.

If this option is chosen, add or remove one from the weapon's Damage Multiplier. For example, a poorly made light autocannon will have a Damage Multiplier of 7 instead of the usual (x8). A great LACwill have a x9 multiplier, almost as good as a standard Medium Autocannon!

POWERFUL WEAPON (+1 DAMAGE MULTIPLIER):
multiply weapon's Rating by 1.25

UNDERPOWERED WEAPON (-1 DAMAGE MULTIPLIER):
multiply weapon's Rating by 0.85

Bryce Hubbard (order #959915)

6.3.3 - Range

By putting more care into the crafting of the weapon, designers can sometimes manage to squeeze out a little more range than planned. Conversely, some weapons cannot match the range expected of a weapon of their type.

If this option is chosen, add or remove one from all Range bands. For example, a poorly made light autocannon will have Range bands equal to (1/3/7/15) instead of the usual (2/4/8/16). A great LAC will have (3/5/9/17).

LONG-RANGE WEAPON (+1 HEX):
multiply weapon's Rating by 1.1

SHORT-RANGE WEAPON (-1 HEX):
multiply weapon's Rating by 0.9

6.3.4 - Rate of Fire

By improving the cooling system and adding a faster auto-loader, some weapons can be designed with an improved rate of fire. However, the reverse is also possible: a badly-designed automatic weapon will jam if it is forced to fire too quickly!

This option can only be taken by weapons that already feature a ROF factor of one or more. For improved weapons, add one to the weapon's ROF. For badly designed weapons, the ROF remains as is, but count all Fumbles on shots using at least one point of ROF as a permanent weapon jam (weapon is out of action and must be repaired).

For example, a multi-barreled light autocannon could have a ROF of +3 instead of just +2. A shoddy LAC will jam on all Fumbled rolls.

HIGH ROF WEAPON (+1 ROF):
multiply weapon's Rating by 1.1

POOR ROF WEAPON (JAMS ON FUMBLES):
multiply weapon's Rating by 0.9

6.3.5 - Poor Workmanship

Some weapons are badly designed or built with low quality materials; others are experimental and not quite ready for field service. They overheat, jam, or otherwise fail, often with deadly consequences. Note that any type of weapon can suffer from this problem: for lasers, simply read "overheating safety override" instead of "jam."

Whenever the weapon is fired, the user must beat the weapon's Threshold with two dice to avoid weapon trouble. For example, a weapon with a Threshold of 3 will require a roll of 4 or more to avoid a problem. If a problem does occur, check the Margin of Failure on the Weapon Trouble table below.

An overheated weapon can be fired while overheated, but immediately roll against its Threshold with a -2 modifier. If the weapon jams, it cannot be fired until cleared. Clearing the weapon requires one action and another roll; if the new roll fails, the weapon remains jammed. A Fumble results in a permanently jammed weapon (a technician will be able to clear it after the battle, though). Obviously, a weapon that explodes is useless as well.

POOR WORKMANSHIP:
multiply weapon's Rating by 1 - (0.1 x Threshold)

Weapon Trouble

Margin of Failure	Problem
0	Weapon overheats for one Turn
1	Weapon overheats for two Turns
2	Weapon jams
3	Weapon jams
4	Weapon jams; lose 1d6 shots of ammunition in clearing it
5	Weapon damaged; -1 Accuracy OR add one to the Threshold
6 +	Weapon explodes; apply damage equal to weapon's DM times (MoF-5) vs. half the vehicle's Armor (rounded down)



Bryce Hubbard (order #959915)

6.4 - Ammunition Types

The usual warheads and shells used by the vehicles described in **Heavy Gear** are standard high explosive or armor-piercing rounds. However, many weapons can fire special ammunition types that are not in standard, everyday use. The list below offers over twenty ammunition types and their game effects, along with the names of the weapons that can fire them (note that lasers and particle cannons cannot use these new ammunition types, for obvious reasons).

Up to three ammunition types can be mixed in a single warhead, but the price gets atrociously high very fast. For example, ammunition designed for Boosted Range Area Effect (BRAE) will have a cost multiplier of (15 x 15 =) 225, making it extremely expensive per shot. Ammunition costs should keep up to two decimals after the point.

Some of the ammunition types cause no damage. This is obviously negated if another characteristic is taken that cancels this effect. For example, an Aerosol shell alone will cause no damage, but an Armor-Piercing Aerosol shell (while strange) certainly will. Weapons cannot use ammunition that duplicates their existing function(s). Likewise, effects are not cumulative — applying the same cost multiplier several times does not improve the ammunition more than once.

The following text replaces and expands the notes on page 133 of the **Heavy Gear Second Edition** rulebook.

6.4.1 - Common Ammunition

Many types of ammunition can be designed to fit a variety of operational roles, making weapons more flexible on the field. The types listed in this category are relatively easy to manufacture and do not require any change in the weapon or its targeting software. Ammunition designed for one weapon class will not fit another. A smoke round for a medium autocannon cannot be fired by a light autocannon or a field gun, for example.

A cost multiplier is listed under each ammunition type. This cost is applied to the cost of the ammunition, but not to the weapon.

◆ Anti-Laser Aerosol

The shell contains a volatile gas mixture with mirrored metallic particles in suspension. When it explodes, the contents vaporize into a thin mist that diffuses any laser beams attempting to penetrate it.

Any laser or particle beam weapon firing in or through an affected hex has its Damage Multiplier reduced by 1 for each hex crossed, including the target's hex but not the attacker's. Likewise, laser designator beams suffer a -1 penalty to their lock-on roll per hex crossed by the beam.

The mist is too thin to have an Obscurement value. It will dissipate at the end of the next turn. Anti-Laser Aerosol shells have no penetration power and thus no effect against armor.

Cost Multiplier: 5

◆ Anti-Structure

The warhead has been specially designed to damage buildings, roads, airstrips, bridges and bunkers. Whenever this type of ammunition is used against something with Structural Damage Points instead of Armor, the damage inflicted is doubled. If used as direct-fire ammunition, Anti-Structure ammo places a -1 modifier on the attack roll.

Anti-Structure ammunition is only manufactured for mortars, rockets, missiles and bombs.

Cost Multiplier: 15

◆ Area Effect

This type of ammo delivers a high concussion blast and/or scatters shrapnel around when it detonates. It gives the weapon an AE of 0 (if the weapon already has an Area Effect, add one to its radius). The damage in this additional zone is half the weapon's normal damage. All normal area effect rules otherwise apply.

Warheads can be designed for field guns, artillery weapons, mortars, grenade launchers, bazookas, rockets/missiles, torpedoes and bombs.

Cost Multiplier: 15

◆ Fire-Fighting Foam

The shells/warheads are filled with a stable polymer compound that expands into a fire-fighting foam once exposed to the atmosphere. The foam cancels one die worth's of Fire Intensity points per ten points (or part thereof) of "damage."

Foam shells have no penetration power and thus no effect against armor. The foam is non-toxic, harmless to people and property and dissolves in water.

Fire-fighting ammunition can be designed for flamers, field guns, mortars, grenade launchers, bazookas, medium and heavy rocket packs and hand grenades.

Cost Multiplier: 1

◆ Fragmentation

Fragmentation ammunition, often known as shotgun rounds, fires multiple small projectiles (most often flechettes) instead of a single large warhead. This makes them more efficient against soft targets and reduce the need for aiming, but it also reduces the damage caused by each attack.

In game terms, the attacker adds a +1 modifier to his attack roll, halves the Damage Multiplier, and adds +2 to the weapon's effective ROF. However, the weapon cannot walk its fire or saturate an area unless it has +1 or better ROF without the fragmentation ammunition.

All weapons, except energy weapons, can use this type of ammunition.

Cost Multiplier: 15

Bryce Hubbard (order #959915)

Illumination

The warhead contains a powerful flare and a parachute to keep it aloft while burning. The flare will illuminate an area equal to the weapon's Area Effect plus two (so a weapon with no AE would have an AE of 2, an AE of 2 would become 4, and so on). The flare will last one turn per ten points of the weapon's Damage Multiplier, rounded up. The illuminated area is counted as being in daylight.

Illumination ammunition can be manufactured for field guns, mortars, grenade launchers, bazookas, medium and heavy rocket packs and hand grenades.

Cost Multiplier: 1

Non-Lethal

Non-lethal ammunition is used for crowd-control or police operations, when it is important or desirable to keep the casualties to a minimum. Shells are built around either rubber bullets or low-velocity plastic projectiles that deploy "arms" to distribute the impact across a larger surface. Rockets, grenades, mortars and missiles can also be non-lethal, carrying a payload of choke or irritant gas. Non-lethal ammo has no penetration power and thus no effect against armor of any kind.

If non-lethal ammo is used in a roleplaying context, use the weapon's Damage Multiplier (vehicle scale) plus the MoS of the attack as a Threshold for a Health roll against unconsciousness. If it fails, the target is automatically unconscious for a number of rounds equal to the MoF of the Health test. In addition, if the roll fails by between 4 and 6, the subject gains a flesh wound; if by between 7 and 9, a deep wound. If the Build roll is failed by 10 or more, the target is dead. Once this period has passed, another Health test must be made every turn to regain consciousness. The Threshold is the same as before, but goes down by one after each failure to regain consciousness.

In the tactical game, non-lethal weapons have no penetration power and no effect of any kind against armored units. Only infantry squads (no matter the type of armor) and vehicles with the "Exposed Crew Compartment" Flaw are affected by this type of ammunition. The weapon's basic Damage Multiplier is halved, but the damage is otherwise applied as normal. Vehicles with exposed crew are only affected on "Crew" hits and disregard any other damage result (non-lethal gas attacks affect them automatically, however).

After the battle, casualties are dead on a roll of 6 instead of 4-6. On a roll of 1 or 2, the casualties are not harmed and are available for the next battle.

Only machineguns, light rifles, very light and light autocannons can fire non-lethal ammo; other direct-fire weapons are just too powerful. Pack guns can be manufactured with non-lethal ammunition, but they cannot fire anything else.

Rockets, grenades, mortars and missiles carry a payload of choke or irritant gas. The weapon's Damage Multiplier is halved, rounded down. The gas cloud's radius is assumed to cover only the target hex, unless the weapon or ammunition also has an Area Effect (in that case, one is added to the AE).

Cost Multiplier: 1

Paint

The weapon's shells are hollow and filled with a brightly colored paint (practically any color can be ordered, though day-glo tones are preferred). Paint shells cause no damage to vehicles and are used for training — although some have found some more ingenious combat uses for it. The paint is generally water-soluble.

Observers have a visual spotting bonus equal to the MoS of the painting attack when trying to visually spot a vehicle that has been hit by paint ammunition. Only the highest MoS is ever used — multiple hits are not cumulative.

Cost Multiplier: 2

Smoke

The shell contains a volatile gas mixture. When it explodes, the contents vaporize into thick smoke of whatever color was chosen (usually black or light gray). The smoke covers one hex both horizontally and vertically (unless the chosen ammunition also has an area effect, in which case add one to the weapon's normal AE) and has an Obscurement of 2. The mist will dissipate at the end of the next turn.

Smoke shells have no penetration power and thus no effect against armor. Only visual detection is affected by the Obscurement modifier. Active sensor sweeps are not affected at all.

Cost Multiplier: 1

Smoke (Artillery)

This heavier version of the standard smoke round can only be fired by Artillery-class weapons (see Tactical Field Support). The shell contains a volatile gas mixture, but also chaff, flares and electronic dummies ("noisemakers"). When the shell explodes, the contents covers one hex both horizontally and vertically (if an area effect already exist, add one to the weapon's normal AE), creating a zone with an Obscurement of 2. The effect will dissipate at the end of the turn after the next.

Artillery Smoke shells have no penetration power and thus no effect against armor. All types of detection are affected by the Obscurement modifier, even active sensor sweeps.

Cost Multiplier: 5

Tracer

Tracer shells have a tiny back-mounted flare that allows the gunner to follow them in flight to improve his aim. They are mostly used in automatic weapons to "lead" the burst to the target. Some flare types only show up on sensors, reducing the odds of detection by enemy infantry lurking nearby. Generally, about one in ten shells is a flare.

In game terms, the cost and aiming improvement are negligible — it is assumed that most automatic weapons use some form of tracer rounds already. When used at night, tracer ammunition gives a +1 bonus to both Walking Fire and Saturation Fire attempts. This, however, makes the firing unit plainly visible to all within LoS (-1 to all defense rolls, cannot hide).

Cost Multiplier: 1

Bryce Hubbard (order #959915)

6.4.2 - Uncommon Ammunition

Uncommon ammunition is a lot more specialized. In tactical games, the player may roll one die to determine if his vehicle was assigned its special ammunition. On a roll of 1 to 4, the special ammunition is not available and standard shells/warheads must be used. On a roll of 5 or 6, the vehicle may load the special ammunition if desired. In roleplaying or integrated games, the Gamemaster decides what ammunition loads are available to the Player Characters.

A cost multiplier is listed under each ammunition type. This cost is applied to the cost of the ammunition.

◆ Adhesive

Adhesive ammunition is designed to stick to the target before detonating. It places a -1 modifier on the attack roll, but, if successful, the warhead becomes attached to the target. It can be detonated later, counting as a MoS 1 attack at Point Blank Range. If desired, it can be detached at any time by the attacker at the cost of one action.

To detach an adhesive warhead, a Piloting Skill roll is made versus the attack's Margin of Success plus the DM of the weapon. If the defending vehicle has Manipulator Arms, a bonus equal to half the Rating of the largest arm (rounded up) is applied to the Piloting roll.

Adhesive ammunition is only manufactured for field guns, mortars, grenade launchers and missiles.

Ammo Cost Multiplier: 5

◆ Airborne Torpedo

Airborne torpedoes are actually a form of missile that is used to attack underwater targets like submarines. These missiles skim the surface of the water until the last possible moment when they suddenly dive in, striking the submerged target in the same manner as a torpedo. Airborne torpedoes allow missile launchers above water to attack underwater targets without penalty.

Airborne Torpedoes are only manufactured for mortars, rockets, missiles and bombs.

Cost Multiplier: 15

◆ Armor-piercing

The weapon is highly efficient when penetrating armor, concentrating all its energy on a single point to enhance its force. The vehicle's base Armor Rating is halved to determine damage. If the attack is successful, the target does not lose any Armor points (the entry hole is too small to affect the Armor Rating), but takes system damage as usual. Targets may not be Overkilled by Armor-Piercing weapons — any extra damage passes right through the target, possibly affecting something beyond.

Armor-piercing ammunition is available only for railguns and massdrivers.

Cost Multiplier: 5

◆ Biological

The weapon's shells are hollow and filled with a short-lived biological warfare agent. The most common payload is an airborne virus that has a very short incubation period. Whether or not the agent is lethal should be decided during design.

Lethal agent victims will die immediately after the battle, while semi-lethal agent victims can survive if provided with medical attention. The disease's infection sphere is assumed to cover only the target hex, unless the weapon or ammunition also has an Area Effect (in that case, add one to the AE).

Infantry units and vehicles with the "Exposed Crew Compartment" Flaw are affected if they are hit (although the vehicle itself suffers no damage, obviously). For every ten points of damage, a penalty of -1 will be applied to all actions attempted by the target. This represents the fact that the enemy unit is not feeling well — not feeling well at all... If the penalty goes down to -5 or worse, the affected unit becomes a casualty.

Biological shells have no penetration power and thus no effect against armor. Enclosed vehicles and infantry in sealed suits (Encumbrance -1, no cost) are not affected by bio rounds.

Bio ammunition can be manufactured for most weapons.

Cost Multiplier: 15 (semi-lethal) or 20 (lethal)

◆ Boosted Damage

Many weapons can fire ammunition that carry enhanced warheads for increased damage. These are generally more complex and costly and use technologies such as self-forging penetrators (for hyper-velocity missiles and rockets) or customized armor-defeating shells (for artillery or autocannons).

Such munitions are often small missile-like projectiles with terminal trajectory boosting. Many Boosted Damage weapons are semi-guided, attacking the target from above and targeting the thinner roof armor instead of carrying a larger warhead.

When used, these ammunitions add 2 to the base Damage Multiplier of the weapon. They do not otherwise increase or modify the Range, accuracy or rate of fire of the weapon.

Boosted Damage ammo is manufactured for all types of weapons.

Cost Multiplier: 15

◆ Boosted Range

The weapon can fire enhanced ammunition such as continuous acceleration rounds or multi-stage propulsion units. Such munitions are often small, self-guided missiles. These munitions increase the weapon's base Range by 50% (round down). Medium, Long and Extreme Ranges are equal to 2, 4 and 8 times the new base Range.

Boosted Range ammo is manufactured for all types of weapons.

Cost Multiplier: 15

Bryce Hubbard (order #959915)

Chemical

The weapon's shells are hollow and filled with a chemical agent such as combat gas. The most common payload is a deadly nerve gas. Halve the weapon's Damage Multiplier, rounded down. The gas cloud's radius is assumed to cover only the target hex, unless the weapon or ammunition also has an Area Effect (in that case, add one to the AE). Infantry units that are hit are considered to be casualties (cross out any remaining damage points). Vehicles with the "Exposed Crew Compartment" Flaw are also considered casualties if they are hit (although the vehicle itself suffers no damage).

Chemical shells have no penetration power and thus no effect against armor. Enclosed vehicles and infantry in sealed suits (Encumbrance -1, no cost) are not affected by chem rounds.

Cost Multiplier: 15

Haywire

The haywire warhead is a strange weapon designed to immobilize enemy vehicles without destroying them. Upon impact, a large rapid-discharge capacitor releases all its stored energy in one intense burst that fries circuitry, damages sensitive systems and shocks crewmembers into unconsciousness or death.

The weapon's Damage Multiplier is halved, but it gets two rolls on the Systems Damage Table when it scores Light or Heavy Damage on an opponent. In roleplaying terms (for example, if "Crew" is hit), treat the weapon's damage results as an electrical attack with an intensity equal to its Damage Multiplier plus its margin of success.

Haywire ammunition can be designed for field guns, mortars, grenade launchers, bazookas, chassis reinforcements, melee weapons, torpedoes and bombs.

Cost Multiplier: 15

Incendiary

The shells are filled with an incendiary compound such as napalm or white phosphorus. Halve the weapon's Damage Multiplier; the weapon gains the "Fast Burn" characteristic.

Incendiary ammunition can be designed for all weapons.

Cost Multiplier: 12

Minelayer

Formally known as FASCAM and other acronyms, Minelayer ammunition saturates an area with small multi-purpose land mines.

If used as direct-fire, normal munition, Minelayer ammunition places a -1 modifier on the gunner's attack roll. If used in saturation fire, it attacks normally. In addition, the attack's saturation effects remain in that hex until the end of the battle or until the hex is cleared (as per regular minefields).

Minelayer ammunition can be designed for field guns, mortars, grenade launchers, bazookas, heavy rocket packs, torpedoes and bombs.

Cost Multiplier: 15

Mass Destruction

Mass destruction ammunition includes special warheads like nuclear, thermonuclear, neutron and anti-matter. The Damage Multiplier of these devastating warheads is ten times normal. They have huge area effects, giving them an AE score equal to their Damage Multiplier plus one. In addition to their basic damage, these doomsday weapons automatically do their Damage Multiplier in damage points to anything within their blast radius, regardless of whether or not they "hit" their target.

Mass Destruction ammunition can be designed for heavy and very heavy field guns and all artillery weapons. It can also be used to represent space-based weapons: in that case, it can be used for any weapon type, even energy weapons.

This ammo type, because of its huge power, has a special cost. When using Threat Values to "purchase" vehicles for a tactical game, vehicles equipped with mass destruction ammunition are worth fifty times their normal Threat Value.

Cost Multiplier: special TV multiplier

Seeking

The weapon can try to hit a moving target more than once: the missile turn and twist to try and collide with an enemy vehicle. If the attack fails, the attacker may reroll it. If the target has already spent action(s) to either shoot down, parry, block or dodge the attack, it can defend itself again with the same method at no additional action cost (but normal ammo expenditure).

Seeking ammunition is only available for missiles (except rockets) and torpedoes.

Cost Multiplier: (10 + 20 per additional attack roll)

Sensor-Homing

The weapon uses the target's electronic emissions to lock-on and destroy it. It is most often used for missiles, but special computer/sensor systems can be adapted for shells. If the target made an Active Sensor roll, used Communication or has any kind of ECM or ECCM active during the combat round where the Energy-homing attack takes place, the weapon gains a +2 to hit.

Sensor-homing ammunition can be designed for heavy and very heavy field guns, mortars, all missiles (except rockets), torpedoes and all artillery weapons.

Cost Multiplier: 30

Subroc

Subrocs are missiles that have been specially modified to allow them to be launched from underwater firing platforms like submarines. They rapidly rise to the surface of the water and once airborne speed towards their targets. Submarine missiles allow submerged vehicles to attack surface, land, or aerial targets without surfacing. They cannot be used against submerged targets.

Subroc ammunition can be designed for all bazookas, rocket packs and missile types.

Cost Multiplier: 15

Bryce Hubbard (order #959915)

◆ Underwater

More than just an ammunition type, Underwater allows the weapon and its ammunition to be used in an aquatic environment. The weapon can be fired from an underwater vehicle at other underwater vehicles or at vessels floating on the surface. In general, Underwater is built into the weapon when it is designed and is very hard to retrofit unto existing weapon systems (Mechanics vs Threshold 8). Underwater can be applied to lasers, but not particle beam weapons.

Some underwater weapons, such as torpedoes (rockets and missiles with the Underwater ammo), can only be used underwater. These weapons are less costly to produce than weapons that can fire both above and underwater, which are both more complex and more expensive.

Cost Multiplier: 10 (underwater only) or 20 (both above and under)

◆ Ammunition Reference Table

Common Ammunition

Name	Cost Multiplier	Weapon Types
Anti-Laser Aerosol	1	all
Anti-structure	15	MOR, RP, MIS, B
Area Effect	15	FG, ART, MOR, GL, BZK, RP, MIS, TORP, B
Fire-Fighting Foam	1	all
Fragmentation	15	all
Illumination	1	all
Non-Lethal	1	all
Paint	2	all
Smoke	1	all
Smoke (Artillery)	5	all
Tracer	none	all

Uncommon Ammunition

Name	Cost Multiplier	Weapon Types
Adhesive	10	FG, MOR, GL, BZK, HRP, TORP, B
Airborne Torpedo	15	all
Biological	15 (semi-lethal) or 20 (lethal)	all
Boosted Damage	15	all
Boosted Range	15	all
Chemical	15	all
Haywire	15	FG, MOR, GL, BZK, CR/Melee, TORP, B
Incendiary	12	all
Minelayer	15	FG, MOR, GL, BZK, HRP, TORP, B
Mass Destruction	none, but vehicle's TV x 50	HFG, VHFG, ART
Sensor-homing	30	ART, FG, MOR, MIS, TORP
Subroc	15	BZK, RP, MIS
Underwater	10 (underwater) or 20 (both)	all

Abbreviations: chassis reinforcement (CR), pack guns (DPG), field guns (VHFG, HFG, FG), artillery weapons (ART), mortars (MOR), grenade launchers (GL), bazookas (BZK), rocket packs (HRP, RP), missiles (MIS), torpedoes (TORP), bombs (B).

6.4.3 Ammunition Feed

Weapons with ammunition can be fed in one of two ways: either through "clips" (actual ammo clips, removable battery packs, etc.) or by an ammunition "bay" (through internal belt-feeding, autoloader, etc.).

Each method has its own advantages and disadvantages. All weapons are considered "bay-fed" unless stated otherwise.

◆ Clip

The ammunition rounds stored in a clips, being external to the weapon, do not increase the Minimum Size required to mount it on a vehicle. Rather, the ammunition clips are stored on the exterior hull of the vehicle, generally on easy to access hardpoints (often located on the back for obvious reasons).

This, however, also makes clips very vulnerable to damage. Each additional clip counts as an AUX system — Light damage destroys one clip, Heavy damage destroys one die's worth. Destroyed clips explode, causing a number of damage points equal to the Damage Multiplier of the ammunition directly to the hull. It is possible to protect the clips, however, with the Ammo Storage perk (see below).

Clips can also be damaged while in the weapon. When rolling a Fire Control damage result (sub-table A), it is possible to read "Clip Destroyed" instead of the first two results of the table. Apply the usual damage resolution procedure (see 5.10.1 in the Heavy Gear rulebook) to decide which option is applied.

Changing clips requires one action and the presence of either a Manipulator Arm or a Tool Arm designed for ammo-loading. The number of shots stored in each clip is left entirely to the designer's discretion — large clips last longer, but more ammunition is lost if they are destroyed during battle.

Any type of ammunition can be stored within a single clip. If there are more than one type of ammunition rounds in a clip, the order in which the ammo types are loaded must be noted and then followed. For example, if ten Area Effect shots are followed by two fragmentation shots, the first ten AE rounds must be fired before the frags.

Some vehicles are equipped to store part or all of their spare ammunition clips in an armored compartment to protect them against damage. This is the Perk: Ammo Storage, which is explained at length on page 113.

◆ Internal magazine

An internal magazine is the default ammunition storage. Though it takes up internal space on the vehicle, the ammunition is protected from enemy fire without having to buy additional reinforced storage space.

Ammunition stored in bays is entirely internal to the vehicle and is fed to the weapon through the inside. Because of this, extra ammunition will increase the required Minimum Size of the weapon, as usual. Multiple ammunition types can be stored, but switching between types requires one action.

Bryce Hubbard (order #959915)

6.4.4 - Ammunition Prices and Availabilities

Ammunition is very expensive, often costing nearly as much as the weapon itself in the long run. Officially, ammunition is sold only to registered armed forces representatives, although several companies have proven themselves willing to deal with anyone coming up with the money.

Ammunition costs vary wildly depending on the type of weapon it is manufactured for. Ammunition for weapons with Damage Multiplier of 10 or less costs ten times its point cost (for example, APGL grenades are 10 x 0.1 = 1 marks/dinars each).

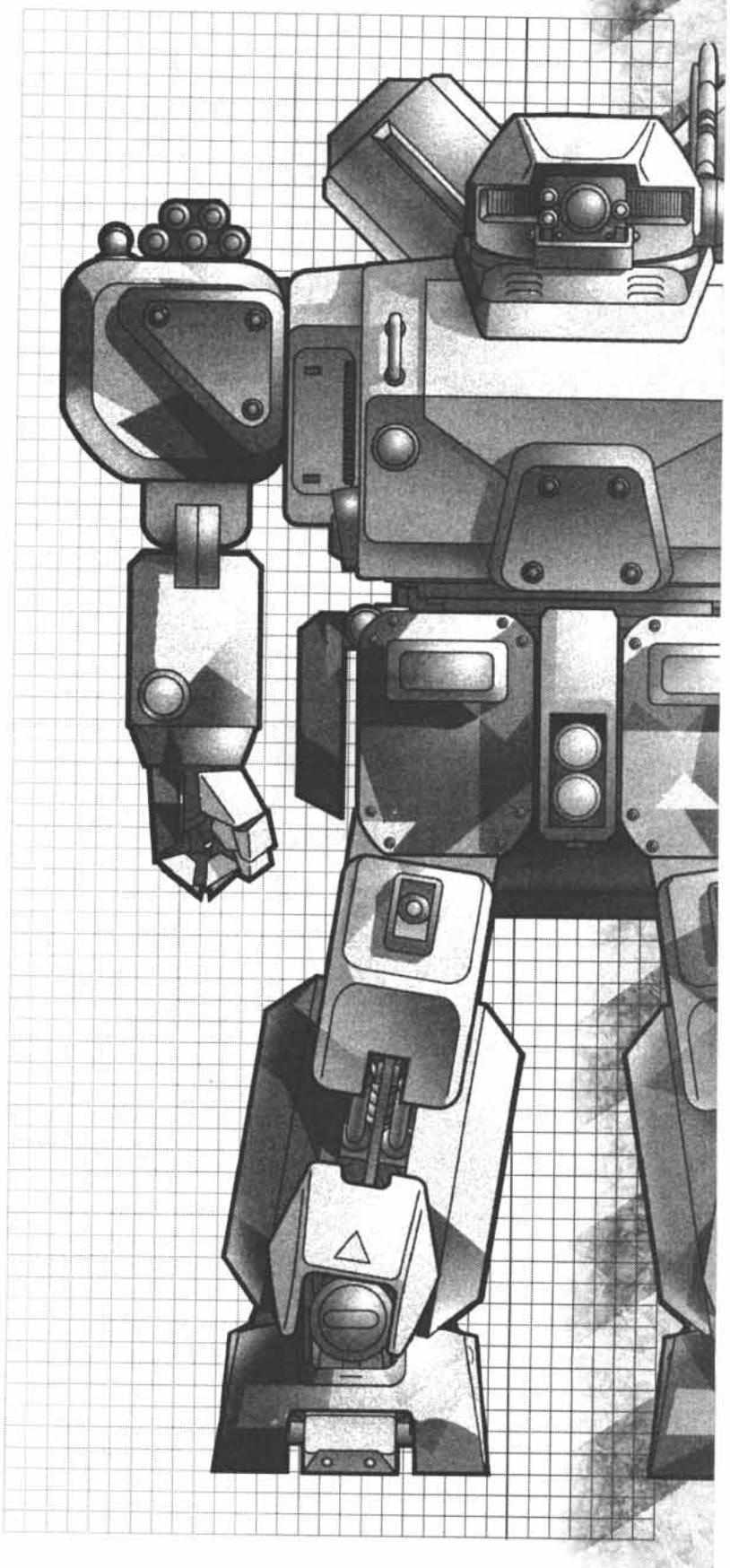
Ammunition for weapons with Damage Multiplier between 11 and 30 costs a hundred times its point cost (for example, HAC shells are 100 x 0.68 = 68 marks/dinars each).

Ammunition for weapons with Damage Multiplier above 31 costs a thousand times its point cost. Special type multipliers (see table above) are also applied to this price, though the multipliers must be divided by ten first (for example, Boosted Damage would multiply costs by 1.5) .

◆ Ammunition Availability

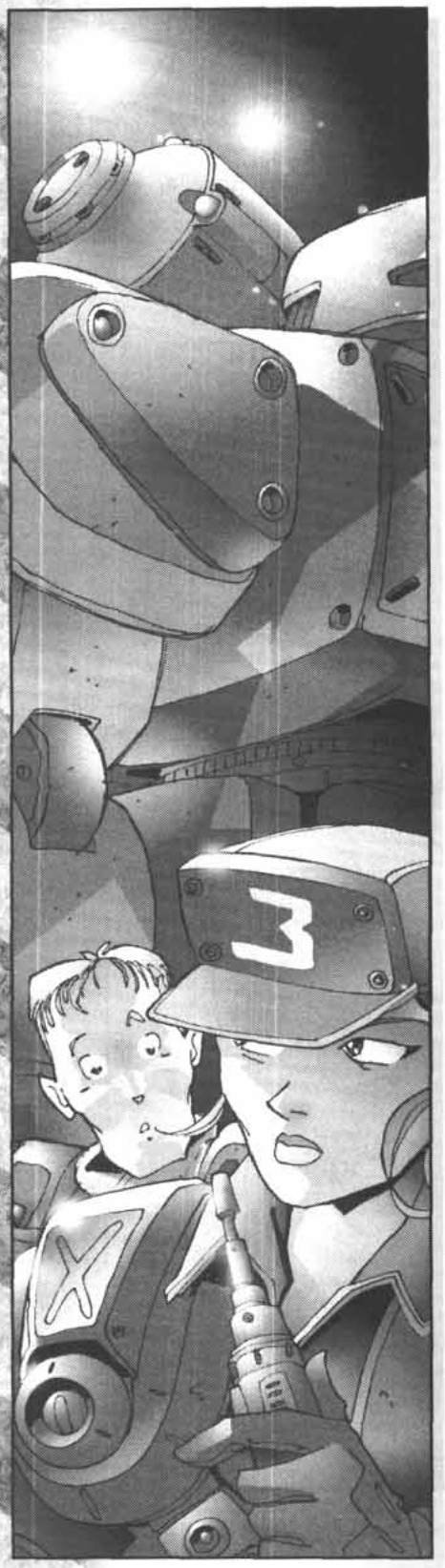
The simplest types, such as Non-Lethal or Foam, are available almost anywhere. These are often sold to fire and police departments and crowd control units for use in water or foam cannons (modified flamers).

Any other type is restricted to military use and can only be only found on the black market, at a cost 2 to 5 times higher than the listed price. The source can be a corrupt quartermaster, a band of rovers, or even a greedy company official, but regardless of the provenance, all governments consider the possession of military weapons and ammunition to be a grave offense.



Bryce Hubbard (order #959915)

Minds And Machines



On the floor of the shop lay a sitting Hunter, its battered armor showing the nicks and scars of long and distinguished service. Its rough appearance was broken only by the spotless right arm, which looked brand new.

The Gear's pilot was pacing up and down in the shop like a nervous father. Everybody thought pilots were so tough and rugged, but none of them could stand it when their machine wouldn't work right.

"Now, what's th'problem?" said the grumpy-looking technician. Sometimes she wondered whether a degree in psychiatry shouldn't be part of her job requirements. Talking to pilots was like being a doctor with terminal patients who had to speak to the parents. Either that or like being a shrink with codependent nut-cases. They didn't pay her enough for this.

"Well... I'm not too sure. The left leg's stiff as hell, and every time I try to make it run the computer signals a power loss. It's been gulping down pressure juice at double the normal rate lately, and the targeting display blinks out every once in a while," explained the dusty man. He sounded like a little kid, an annoying whine creeping into his otherwise strong voice. "And the main gun wobbles."

"Did ya check the feedback timing from the arm?" The tech had seen this a million times; a little bit of sand or dirt was slowing down the response time on the arm and the compensator was sent into a subtle movement loop. Either that or the NNet was just nervous, a habit it could easily have picked up from the pilot pacing back and forth in front of her. She pointed a greasy finger toward the mechanical elbow. "Might be the problem for that gun thing. For the rest, looks like pretty straight business to me. Why don'tcha leave it here for a couple'o days and I'll see what I can do."

"A couple of days?! I'm supposed to be escorting a caravan tomorrow!" All the strength was gone from his voice — pure whine, now. The tech wondered how a pilot who loved his machine so much could know so little about mechanics. He expected everything to be fixed immediately, not at all concerned about the hours of work she'd be putting into the machine. A little appreciation would have been nice.

"S'too bad. Can't fix everything in one night, ya know." The pilot looked crushed. His worried brow was starting to sweat and he was looking around even more nervously. The base commander wasn't known to be very understanding about "technical delays." She sat the pilot down and brought up a tech display on her dataglove. Poor little boy had to be reassured.

"I tell you what: I'll fix your feedback problem first. At least you'll be able to shoot straight. You can come back and see me later for the rest. Just be extra careful and warn your squadron that you ain't responding well. Deal?" As much as these pretty-boys annoyed her, she didn't want to see them get killed. She'd never admit it, but she kind of liked them.

"Deal. " Relief washed over his face like a wave. He got up again and adjusted his uniform, trying to recapture the air of the rugged pilot. He looked back at his machine with renewed pride and almost whispered something to it before catching himself. "I'll be back in the morning."

The tech got up and walked over to the Hunter's gun arm to begin working. She wasn't their therapist, she realized; she was their goddamn mother.

Bryce Hubbard (order #959915)

7.1 - Modern Tinkerers

Humankind has always depended on technology for its survival, and later, for its advancement. The laws of entropy being what they are, however, all mechanisms eventually break down, forcing the creation of a new job: the technician. He (or she) is the equivalent of a medical doctor for machines, monitoring their health and fixing any damage that might occur during their operation.

Technology has gotten so complex, most people do not know how it works anymore; those that do are thus always in great demand. The ever increasing complexity of the tools used by humans have forced the technicians, like the doctors, to specialize themselves and learn to repair and maintain one particular type of machine, be it a computer or a vehicle. They are assisted in their function by sophisticated self-diagnostic routines built directly into the items, but they must also learn to trust their own knowledge and instinct. After all, even diagnostic tools might break down.

7.1.1 - Education

Though some people have a natural affinity with machines, it takes more than raw talent to be able to understand and repair them. It requires skills and training, even more so if one desires to not only maintain but design. The basic knowledge might be gained within a season or two, but it takes many cycles to become truly proficient at it.

The usual way to get an education as a technician is to join a formal technical school right after the basic education is completed. Depedning on the status and funding of the school, teaching might vary from the classical instructor/class sessions to full virtual reality simulations of complex repair operations. Most schools use a bit of both, reserving the VR time for complex or costly training and teaching the basic techniques on actual (if often obsolete) equipment.

The armies of Terra Nova and their mechanized legions have a seemingly insatiable appetite for skilled technicians and will offer training to any recruit that meet their criterias. Many youths enter the armed forces of their city-states in order to get free training that they can later put to good use in the civilian market once their stint in the military is done.

In the Badlands and other remote communities, where resources might be more limited, technical schools are much more scarce. As a result, apprenticeship is still a common practice, especially in small communities were trades are handed down from parent to offspring. While the apprentice will be paid nothing beyond a bed and some food, he will gain a valuable education that will enable him to make a good living wherever his life leads him in the Badlands.

7.1.2 - Customs and Traditions

Like for most professions, technicians have their own slang, traditions and habits that stem from their work. Some traditions date back centuries or even millennias, their origin and exact meaning lost in the sea of time. For example, most techs have at least one good luck charm, whether a favorite tool, a trinket or even just a small mechanical part hung on a simple cord necklace.

Technicians have an internal pecking order that is not very noticeable but does exist nonetheless. A vehicle mechanic will often consider himself better than the village handyman, but will be looked down upon by the military tech. Regardless of their occupation, however, all technicians have great respect for the most daring of their own: the field technician. Those that can not only fix machines but fix them while under fire usually earn a reputation quite early.

The technicians are known by a variety of nicknames. Whether called grease monkees, slicks, handyman, or just techie, they take great pride in it. They are also known by less favorable names such as oilies, manglers or hammerloonies. Since it would not do to be openly at odds with the person that ensures the good functioning of your weapons (and thus your safety), the soldiers will most often keep their comments to themselves or to the walls of the barrack's outhouse.



Bryce Hubbard (order #959915)

7.2 - Vehicle Modifications

Because much of the modern technology is based on relatively standardized formats, modifications to already existing vehicles are fairly simple to accomplish even while in the field. Additional weapons can be bolted on and linked to an existing fire control system, a more powerful engine can be installed, an improved suspension can be retrofitted, or armor plates can simply be welded onto the hull for additional protection.

A vehicle that has been extensively modified will often look very little like the original design, unless extra care has been taken to conceal its new capabilities. Also, some modifications cannot be concealed, like the Improved Off-Road Perk.

Each vehicle is divided into separate sub-systems for enhancement purposes: Structure, Perks and Flaws, Weapons, Armor and Movement. Each system to be modified requires its own Skill roll(s), supplies/parts and adds its own Lemon Dice. The particulars of each modification are explained in the relevant paragraph.

7.2.1 - Structure

Structure here is defined as being the basic framework of the vehicle, the underlying element(s) around which the rest of the vehicle's systems are organized and mounted. Major modifications to the structure are possible using basic tools, but this tend to drastically change the characteristics of the vehicle.

In general, the basic frame of the vehicle is left mostly untouched as systems are swaped out for more powerful (or just different) ones. If modifications to the vehicle's structure are attempted (for example, to change its Size or shape), though, the vehicle effectively becomes a new vehicle built at the Scratchbuild production level (see page 135).

7.2.2 - Perks and Flaws

It is possible to modify a vehicle to add or remove specific characteristics. Not all Perks and Flaws may be retrofitted that way, but those that can, usually can be without much difficulty. The table on the following page lists the Perks and Flaws that can be added to a vehicle.

Perks or Flaws that are not listed are too deeply integrated into a vehicle's design to be retrofitted and incorporating (or removing) them may only be done at the factory — in effect, creating a new variant on the same basic chassis.

The table has four columns. The first one is pretty straighforward and lists the Perk or Flaw's name. The second column indicates whether or not the modification can be done in the field, i.e. without extensive lifting equipment and powered tools that are normally found only in a workshop.

The third column is the Threshold(s) required to install the system. "M" means a Mechanical Skill check is required, "E" an Electronics Skill check; the number is the actual Threshold. The last column is the cost of the parts; the number is multiplied by the Size of the vehicle ("S"), the Rating ("R"), the cost of the weapon ("W") or nothing at all.

Perk And Flaw Modifications

Perk/Flaw	Req. Workshop?	Threshold	Cost
Airdroppable	Y	M5	Sx1000
Amphibious	Y	M5	Sx500
Anti-missile System	N	M6, E6	Rx10,000
Anti-personnel Charges	N	M4	Rx1000
Aquatic Sensors	N	E6	100,000
Audio System	N	E3	5000
Autopilot	N	E5	10,000
Backup Comm System	N	E5	30,000
Backup Fire Control	N	E5	50,000
Backup Life Support	Y	M5	20,000
Backup Sensors	N	E5	30,000
Battle Arm	Y	M7	Rx10,000
Camo Netting	N	M2	Sx100
Cargo Bay	N	M5	2000/m^3
Chaff/Flare Dispenser	N	M3	Rx10,000
Crew Accommodations	N	M5	50,000/crew
Ejection System	Y	M7	50,000/crew
Electronic CounterMeasures	Y	E7	Rx20,000
Elect. Counter-CounterMeasures	Y	E7	Rx20,000
Emergency Medical	N	M7, E4	3000
Geological Sensor	N	E7	15,000
Grapple Launchers	N	M5	Rx5000
Hostile Environment Protection			
Desert	Y	M5	Sx1000
Extreme Cold	Y	M5	Sx2000
Improved Rear Defense	Y	M7, E5	Sx80,000
Laboratories	Y	M7, E5	Rx40,000
Loudspeakers	N	E3	2000
Manipulator Arm	Y	M7	Rx50,000
Micro-Lab	N	M5, E5	Rx15,000
Mining Equipment	Y	M6	Sx10,000
Passenger Accom.	N	M5	100,000/pas.
Passenger Seating	N	M5	4000/pas.
Pintle Mount	N	M3	1500
Ram Plate	N	M4	Sx1000
Reinforced Chassis	Y	M7	Sx60,000
Reinforced Crew Comp.	Y	M7	Sx40,000
Satellite Uplink	N	M5, E7	100,000
Searchlight	N	M4	3000
Shield	N	M5	Rx10,000
Shielded Weapon	N	M5	Wx1000
Smoke Launchers	N	M3	500/shot
Sniper Systems	Y	E7	10,000
Stabilizer Mount	Y	M7	Wx5000
Target Designator	Y	E7	Rx10,000
Tool Arm	Y	M7	Rx30,000
Urban Friendly	N	M4	5000
Weapon Link	N	E7	5000
Wide Angle Searchlight	N	M4	5000

Bryce Hubbard (order #959915)

7.2.3 - Weapon Systems

This is probably one of the most common modifications performed on a vehicle. Fire control computers can usually be reprogrammed to take extra weapons into account, even though a lag of a few micro-seconds might be perceptible when generating a firing solution. Weapons can be either hand carried (for vehicles with Manipulator Arms) or incorporated into the vehicle's structure. Rules for hand-carried weapons are covered on page 74.

Adding a projectile or missile weapon to the hull is a relatively straightforward task. Most of the gyro-stabilization and fire control equipment is already built into the weapon. Energy weapons cause more of a problem because they require additional power conduits and cooling equipment. In addition to the weapon itself, which must be bought or acquired separately, a certain number of miscellaneous parts are required (refer to the table below). Weapons, when bought new from the manufacturer, usually cost (Rating x 1000 marks/dinars). This does not include the cost of the ammunition, which must be bought separately.

Weapon Modifications

Operation	Threshold	Cost
Remove Weapon	4	None
Add Projectile Weapon	7	Rating x 10
Add Missile Weapon	7	Rating x 10
Add Energy Weapon	9	Rating x 100

Hardpoints

Many vehicles, especially aircraft, carry their offensive payload on hardpoints, which are reinforced locations where extra systems can be attached. When changing weapon system, even with modular devices, the OTV or MTV have to be recalculated. It is somewhat bothersome, but it accurately represents the difficulty of modifying a complex vehicle. Even with modular connectors, it is necessary to ensure that the software are loaded, the data buses connected, etc. Vehicles are assumed to be equipped with a number of hardpoints equal to their Size Rating (or less, if desired), each capable of carrying between one and three weapons (of the same type). If a weapon is ready to install, it takes a number of minute equal to its Min. Size to attach it in place.

The point cost for existing weaponry assume that it is fully integrated with the vehicle's frame and protected by its armor, even when attached to a hardpoint. It is possible, however, to carry weapon systems on unprotected external hardpoints to reduce their cost and augment the vehicle's versatility. The weapon is carried on an external hardpoint and cannot be protected by armor. Each One-shot Weapon counts as an AUX system — Light damage destroys one weapon, Heavy damage destroys one die's worth. Destroyed weapons explode, causing a number of damage points equal to the Damage Multiplier of the ammunition directly to the hull (wrecking the hardpoint in the process, of course).

Only missiles and bombs may be bought as such, at one-fifth the Rating (x0.2). Ammunition is not required — the weapon is completely destroyed when used. The weapon can use any of the acceptable ammunition type by dividing the listed cost multiplier by 10, with a minimum cost multiplier of x1.

7.2.4 - Armor Systems

Modifying the Armor Rating of a vehicle is one of the simplest tasks there is. Entire armor plates can be removed to make the vehicle lighter (and thus faster) or added to make it tougher. The latter solution is the one most often performed.

When removing Armor points, the lighter mass will help the engine push the vehicle faster. For each 10% (rounded up) of Armor removed, one MP is gained, up to a maximum of 20% of the original speed. Armor can also be beefed up, though it will slow down the vehicle.

There are two ways to increase the Armor Rating: reinforce the overall structure of the vehicle (adding Armor points) or bolt on additional armor plates (adding the armor-related Perks). For each 10% (rounded down) of armor added (regardless of their nature and compared to the unmodified base Armor), one MP is lost. In addition, for each 20% of extra armor (same as above), one point of Maneuver is lost.

Armor Modifications

Operation	Threshold	Cost
Remove one Armor point	4	None
Add one Armor point	6	100,000/base Armor point
Add HEAT Resistant Armor (1)	6	50,000/Size point
Add Reinforced Armor (1)	7	10,000/Size point
Add Ablative Armor (1)	5	5000/Size point
Add Reactive Armor (1)	5	8000/Size point

7.2.5 - Movement

Modifying a vehicle's movement system can involve dabbling with the engine(s), the transmission or even adding an entirely new movement type. The extent of the modification depends on the parts and facilities available as well as the Skill of the team performing the modification (use the Modifiers to Salvage Threshold table, page 151). The following table lists the changes that can be performed on a vehicle.

Adding speed is relatively simple. A vehicle's speed cannot be increased by more than 50% of the original speed, however. Installing a new movement system, or reinforcing an existing one, is a more challenging task. Only one additional movement type may be installed, and it automatically adds a Lemon die because of its complexity.

Movement Modifications

Operation	Threshold	Cost
Add one MP	6	10%*
Add Movement Type	7	50%
Add Improved Off-Road perk	7	30%
Add Rugged Movement Systems perk	7	10%
Add Double Towing Capacity perk	7	10%
Add Climbing Apparatus perk	6	10%

*When a percentage is indicated, use the vehicle's current cost as a base.

Bryce Hubbard (order #959915)

7.3 - Scratchbuilding Vehicles

Vehicular engineering in the 62nd century relies primarily on simple, modular assemblies that make construction and repair much easier. This also allows a vehicle to be cobbled together from the components of other, less fortunate machines. Field technicians are often called upon to do such a job, which goes beyond the usual simple repairs and modifications.

The first thing to determine is what kind of vehicle is being built and what are the resources available to do so. This will influence the results greatly: try as you might, building an entire Landship out of wrecked Hunters is not such a great idea... The concept behind the design should at least match the parts available.

7.3.1 - Making Plans

The Vehicle Construction Rules are used to create the statistics of the new vehicle. If one already know (roughly) what parts are available, it may be easier to work from that. For example, weapons cannot be built, they must be salvaged; planning to give the vehicle a fragmentation cannon is pointless if all available spare parts come from Hunters armed with autocannons.

The vehicle's production level is automatically "Scratchbuilt." Ten (10) Lemon Dice are rolled in addition to those caused by the Perks (one die per five Perks). Don't cheat — if five or six defects turn up, too bad: it is part of the game (they can still be fixed afterward, though). The final cost represents the overall value of the assembled vehicle.

◆ Roleplaying Repairs and Design

Obviously, the formulas and procedures detailed in this chapter are somewhat dry and lifeless. The actual scavenging and scratchbuilding of a new vehicle can prove to be a great adventure for the Player Characters as they wander in the Badlands seeking that elusive JKJ-4643F actuator controller or another square meter of undamaged durasheet armor plating. It will not do to just quantify the salvaging operation as a bunch of numbers — it should be explained what the parts are, how they are removed/installed, which tools are used, etc.

So, next time the characters stumble across a wrecked Hunter, they are not salvaging "30 points of Mechanical Parts," but rather "about two square feet of durasheet plates of various shapes, a knee's front actuator, six liters of uncontaminated hydraulic fluid and two fingers."

◆ Labor and Salvage Points

The vehicle repair system introduced in the Tactical Combat Boxed Set and on page 154 of this manual is a somewhat abstract system that ignores the requirements for spare parts. If the Players so prefer, the above system can be used to calculate the amount of parts that will be required for each repair.

First, the damaged vehicle must be evaluated for the number of Salvage parts it represents. Then, the points required to generate the vehicle in its prime, undamaged form are calculated. The difference is the number of points required for the repair.

7.3.2 - Getting Parts

Scratchbuilding a new vehicle requires a huge amount of spare parts and tools to do the job. Beside the (often) very specialized equipment necessary to assemble the mechanisms and handle components that may weight half a ton, a diversified spare part pool must be at hand. Some of the parts will not be usable while others will have to be reworked. Consequently, the technicians must stockpile a lot more than they will actually use.

The quantity and quality of the parts salvaged from other vehicles will depend on the vehicle they come from and the skill of the person salvaging them. To simplify the whole process, the parts are abstracted into Salvage Points that are then used to build the machine. There are two kinds of Salvage Points: Mechanical and Electronic.

Mechanical Salvage points represent all the purely mechanical and physical aspect of the vehicle. For example, structural members, hydraulic actuators and armor plates are all in this category, even though they vary greatly in size, shape and function. Electronic Salvage points represents the wiring, sensors and communication equipment of the vehicle, again regardless of their actual nature: wire, scanner plate, camera or anything else.

Both types of points lump all these systems together for ease of play, though enterprising Gamemasters may want to identify the system that each point represents individually (a procedure generally not encouraged because of the enormous amount of bookkeeping it entails).

The maximum number of resource points available from a given vehicle, in each category, is equal to the formulas listed on top of the next page. Size is the vehicle's current Size; Current Armor Rating is the vehicle's base Armor Rating, counting any damage received but not points gained or lost through Perks and Flaws. The Electronic Multiplier is based on the vehicle's current electronic equipment: refer to the table on next page for the exact numbers.

To know how much material the technician(s) actually recovered, two Skill tests are required: one with the Mechanics Skill (for structural and physical parts) and one with the Electronics Skill (for sensors and other electronic components). The Thresholds to beat are detailed in the Salvage Threshold Table (found on the next page) and are directly proportional to the condition of the original vehicle. Add any applicable modifier, keeping in mind that they are cumulative.

For each point of the Margin of Success (MoS), the technician can recover 25% (round down) of the total Salvage Points available (thus, an MoS of 4 or better will recover all the material). Round down to the nearest whole number. Weapons and ammunition cannot be built without the proper facilities; they must be salvaged from destroyed vehicles or purchased new (see page 154 for price and availability).

The time required to salvage parts is equal to the total Salvage Points gained, divided by the best technician's Skill level, times two, in minutes. Add one to the tech's Skill for each assistant working with him, up to a maximum work crew equal to the donor vehicle's Size Rating (there is only so much elbow room to work in).

Bryce Hubbard (order #959915)

SALVAGE POINTS:

Mechanical Salvage Points = (Size of the Donor Vehicle)² x (Donor Vehicle's Current Armor Rating)

Electronic Salvage Points = (Size of the Donor Vehicle)² x (Electronic Multiplier)

Electronic Multiplier Table

Total ES*	Multiplier	Total ES	Multiplier
9 and more	81	-1	0.667
8	64	-2	0.5
7	49	-3	0.4
6	36	-4	0.333
5	25	-5	0.286
4	16	-6	0.25
3	9	-7	0.222
2	4	-8	0.2
1	2	-9 and less	0.182
0	1		

*Total Electronic System is the sum of the donor vehicle's Sensor, Communication and Fire Control Attributes. If a system is absent (e.g. No Sensor Flaw), count its value as -5.

Salvage Threshold Table

Percent*	Threshold	Percent	Threshold
100%	3	40%	8
90%	4	30%	9
70%	5	20%	10
60%	6	10% and less	No salvage
50%	7		

*This percentage is based on the vehicle's original Armor Rating. Round value down to the nearest ten percent. Example: a Hunter has Armor 11; this is (11÷15) x 100 = 73.3%, rounded to 70%.

Modifiers To Salvage Threshold

Salvage is done in the field	+2
Salvage is done without the proper tools	+2
Parts from a similar vehicle (e.g. Gear to Gear)	+0
Parts from different vehicle (e.g. Gear to Tank)	+1
Parts from different sized vehicles (Size Diff. 3 or more)	+1
Parts from worn-out vehicle (Condition 7+)	+2
Parts from Overkilled vehicle	+3

Salvage Example

Joe, a Skill level 3 technician, and his two assistants are field-stripping a brand-new Hunter. The Threshold is 3, since the vehicle is undamaged. With modifiers (including the +2 of the Hunter's "Easy to Modify" Perk), Joe rolls a 7. He will thus get (6)2 x (15) x ((8-3) x 25%, max. 100%) = 540 Mechanical Salvage Points and (6)2 x (1) x ((8-3) x 25%, max. 100%) = 36 Electronic Salvage Points. This will take (540 ÷ (3+2)) + (36 ÷ (3+2)) = 115.2, times 2, or 230.4 minutes, or 2 hour and 50 minutes.

7.3.3 - Building the Vehicle

Skilled technicians will be needed to put all those salvaged parts together and make the resulting patch-up into a functional vehicle. Five separate Skill tests are required: one for each major group of vehicle components. The number of Salvage Points necessary is as indicated in the formulas below. Until the full number of points required in each category is paid, the vehicle cannot function. The Skill tests and type of Salvage Point linked to each group is listed in the Scratchbuilding Table. Each test must succeed in order to get a functional vehicle.

The Threshold for the Mechanical tests is equal to the vehicle's Threat Value divided by 100, rounded up. Technicians pool their Attributes but use the Skill level of the most experienced in the group. The Threshold for the Electronic test is equal to the vehicle's total electronic Attributes plus 4, with a minimum of 2.

If a test is failed, a number of Salvage Points equal to the MoF times 10 is lost. Some time is also lost: the MoF times 10, in minutes, is added to the final count. On a fumble, the same thing occurs, except that an embarrassing mistake is also made — spilled the oil drum, broke the best wrench, etc.

The time required to build the new vehicle is equal to the total Salvage Points used times 4, divided by the best technician's Skill level. Add one to the tech's Skill for each assistant working with him, up to a maximum equal to the donor vehicle's Size Rating. The resulting number is the total time of the operation in minutes, not counting lunch breaks or other unavoidable pauses.

SALVAGE POINTS REQUIREMENTS:

Mechanical Salvage Points = (Scratchbuilt Vehicle's Size)² x (Vehicle's Armor Rating)

Electronic Salvage Points = (Scratchbuilt Vehicle's Size)² x (Electronic Multiplier)

Scratchbuilding Table

Component Group	Skill	Salvage Point Type
Fire Control	Mechanical or Electronic*	Mechanical
Structure	Mechanical	Mechanical
Crew	Mechanical or Electronic*	Mechanical
Movement	Mechanical	Mechanical
Auxiliary Systems	Electronic	Electronic

*Roll against lowest of the two Skills

Scratchbuilding Example

Joe, a Skill level 3 technician, and his two buddies are reassembling the aforementioned Hunter. The Mechanical Threshold is (380 ÷ 100, rounded up) 4; the Electronic Threshold is (0 + 4 =) 4. Joe rolls 6, 2, 5, 5, and 7. He will need (6)2 x (15) = 540 Mechanical Salvage Points (plus the 20 lost because of his failure, assuming he made the roll the second time around). He will also need (6)2 x (1) = 36 Electronic Salvage Points.

This will take (560 ÷ (3+2)) + (36 ÷ (3+2)) = (119.2 x 4 =) 476.8 minutes, or 7 hours and 56 minutes. Add the 20 minutes they lost trying to bolt a shoulder actuator onto a knee, and the final time is 8 hours and 16 minutes.

Bryce Hubbard (order #959915)

7.4 - Vehicle Maintenance

Even though Gears and other Terranovan combat vehicles tend to be rugged machines capable of handling more than their fair share of abuse, they still need regular maintenance in order to function properly. Guns must be cleaned, rocket pods checked, electronics tested for bugs, engine parts lubricated, etc. Much of the maintenance is composed of utterly repetitive and boring tasks that are nonetheless vital to the continued good functioning of the various systems and equipment.

A minimum number of man-hours equal to the Size of the vehicle times the Maintenance Multiplier(s) must be allocated every Terranovan week for general routine maintenance. Skipping this is possible, but it might lead to mechanical breakdowns later. Skipping more than one session is a recipe for trouble. The table below lists the Maintenance Multipliers; more than one modifier may apply to a given vehicle.

Each vehicle is also assigned a Condition Rating that quantifies its mechanical status and general "good health." It is used to determine the chances of a breakdown in the advent of bad maintenance. Condition goes from 1 (mint, factory fresh) to 6 (barely functional hulk). Anything higher than 6 is a total wreck, unable to move or fight.

Whenever a new vehicle is introduced during the campaign, roll one die to determine its actual Condition. Note that a vehicle currently employed by an army will never have a Condition Rating worse than 3 (divide the die result by half, rounded up — so 1-2 become 1, 3-4 become 2 and 5-6 become 3).

Maintenance Multiplier Table

Vehicle's Characteristics	Multiplier
Testbed Prototype	x10
Early Prototype	x5
Late Prototype	x4
Early Production	x3
Limited Production	x2
Mass Production	x1
Scratch-Build	x3
Walker Vehicle	x2
Flying Vehicle	x3
Space Vehicle	x5
Easy to Modify Perk	x0.5
Heavy Combat*	x2

*The vehicle has been used in at least one battle per day.

Wear

Normal use and breakdowns will take their toll on the vehicle after a while (see the rules for Breakdown in the column at right). After ten (10) breakdowns, no matter which system is affected, the vehicle's Condition goes up by one point.

If the Condition goes above 6, the vehicle cannot be repaired further — it is completely worn out and may only be salvaged for parts. Even then, it only yields half as many Mechanical or Electronic salvage points as normal.

7.4.1 - Breakdowns

Before any battle or after a complete Deployment Range cycle, the player must make a Piloting (or Drive) Skill roll against a Threshold equal to the Condition Rating of the vehicle. If the vehicle did not receive its minimum amount of maintenance the week before, the Threshold is increased by 2 for each week missed.

If the test is failed, the vehicle suffers from a potential problem: strange noises will be heard, smoke and/or oil will leak out, etc. Fumbles are ignored and count as a result of one. A number of man-hours equal to the Size of the vehicle are required to correct the situation, or the next check for breakdown will be at +2 (cumulative with the +2 for missed maintenance, if applicable). If the vehicle did not receive its minimum amount of maintenance the week before, it automatically suffers a breakdown.

If the vehicle does suffer a breakdown, roll one die to determine the exact location of the damage: the vehicle takes Light Damage to its Movement System (1-2), Auxiliary System (3-4) or Structure (5-6). If the breakdown roll is fumbled, the vehicle takes Heavy Damage instead of Light.

7.4.2 - Weapon Maintenance

Any weapon with moving or electronic parts also needs to be maintained to keep operating at peak performance. Although the weapons are quite rugged, they still need regular maintenance even when they are not used. Ammunition must be checked, gun barrels cleaned, etc.

Each weapon requires weekly maintenance equal to its Damage Multiplier plus its ROF bonus, times 5, in man-minutes (one man working for one minute). This applies both to personal and vehicular weaponry. Personal weapons should use the Personal Scale Damage Multiplier and vehicular weapons use the Vehicle Scale Damage Multiplier for calculation purposes. A number of technicians equal to the weapon's minimum size can work on the weapon at any one time.

If the weapon does not receive its weekly maintenance, it may break down during use. Whenever a fumble is rolled when firing the weapon, the latter jams and must be cleared before firing again. One die should be rolled to determine the problem: 1-2, the weapon requires one action to clear; 3-4, the weapon requires one action to clear and one die's worth of ammo is lost; 5-6, the weapon is useless and must be repaired. Add 2 to this die roll for each week of maintenance missed.

Multipliers To Weapon Maintenance Time

Weapon/Ammo has the Guided Perk	x2
Weapon/Ammo has the Haywire perk	x2
Weapon is a Laser	x5
Weapon is a Particle Cannon	x5
Weapon is a Railgun	x5
Weapon has Mass-Destruction ammo	x10
Weapon has been in more than one battle per day	x2
Weapon has not been used during the week	x0.5
Maintenance is performed in optimal conditions	x0.75
Maintenance is performed in poor conditions	x1.5

Bryce Hubbard (order #959915)

7.4.3 - Fuel and Deployment Range

Although most internal combustion engines of the 62nd century can use almost any fuel, some are more efficient than others. Using adequate, but non-standard fuel (such as refined alcohol), may reduce the vehicle's range by 30 to 40%. Grossly inappropriate fuel (cheap booze, industrial solvents, flamer fuel) may reduce the range by 50 to 70% and speed by up to 1d6 MP. Moreover, the engine will have to be cleaned and overhauled twice as often to get the unburned deposits out.

The energy of each type of fuel allows one to calculate the Deployment Range of the vehicle using it. Each type of fuel gives a certain number of Energy Points per weight. Energy Points are a gross simplification (for game purposes) of the actual energy contained in the fuel and the efficiency of the vehicle's powerplant.

The Movement Mode table just below gives the number of Energy Points required to move the vehicle over one kilometer. Engine and drivetrain efficiencies were simplified for each type of vehicle, again for increased playability.

Fuel

Name	Volume	Weight	Energy (EP)
Standard Fuel	1 liter	0.75 kg	300
	1 m^3	750 kg	300,000
Adequate Fuel	1 liter	0.85 kg	200
	1 m^3	850 kg	200,000
Inappropriate Fuel	1 liter	1 kg	100
	1 m^3	1000 kg	100,000

Movement Mode Fuel Consumption

Movement Mode	Energy Point per km
Walker	(Mass* x Combat Speed**) x 0.525
Ground	(Mass x Combat Speed) x 0.175
Hover	(Mass x Combat Speed) x 0.35
Naval	(Mass x Combat Speed) x 0.2
Submarine	(Mass x Combat Speed) x 0.45
Flight	(Mass x Combat Speed) x 0.2
Flight (VTOL)	(Mass x Combat Speed) x 0.3

*Mass in metric tons

**Combat Speed in kph

Carrying Fuel

Prudent travelers may want to carry extra fuel with them. Standard fuel (a high grade petroleum derivative) is used as the measure for weight and volume. Other fuels are also possible, since most internal combustion engines on Terra Nova are multifuel burners and can gulp down almost anything that will burn (though at varying levels of performance).

A Cargo Bay can be defined as a fuel tank during the construction process. Note that the fuel contained inside cannot be used by the engine unless the vehicle stops and refuels its own fuel tank from the Cargo Bay.

Converting Ammo to Fuel

The jellied propellant from unfired shells can be converted to a type of raw fuel that can be used by rugged IC engines such as V-engines and diesels. In addition to the shells themselves, a mechanical tool kit, a large vat, a heat source, a pack of conversion catalysts (10 marks/dinars each) and someone with either the Demolition or Physical Science Skills are required.

First, the propellant gels must be put into the vat. Only ammunition from cannon-type weapons can be used, never rockets or MG ammo. Each full point of ammunition (calculated from the ammunition's TV cost) yields one liter of unrefined liquid. This must be placed into the vat along with the catalyst and processed by heating for a period of one hour per ten liters or part thereof.

A Skill test with either Demolition or Physical Science Skills is required to know how much fuel is formed. The Threshold to beat is 6; add any applicable modifier, not forgetting they are cumulative. For each point of the Margin of Success (MoS), the technician can recover 25% (round down) of the total fuel (thus, an MoS of 4 or more will recover all the material). Round down to the nearest whole number. The resulting liquid is considered to be Inappropriate Fuel, but will otherwise work.

If not all the liquid is converted, the remaining murky solution is unusable for both fuel and ammunition purposes and must be discarded. It is mildly toxic, so do not just throw it out.



Bryce Hubbard (order #959915)

◆ Electrical Power

Some vehicles use electrical motors instead of (or in addition to) a standard fuel-burning engine. The energy required is stored in superconducting banks and can come from a wide variety of sources, generally the base's main power grid or the local one. The table below lists three typical sources that can be used to recharge batteries in the field.

Solar panels are thin sheets of polymer coated with a highly energy absorbant black material. They need only be unrolled and laid out in the sun to soak up energy. Larger models have bigger converters and are somewhat more efficient. Kinetic and gas powered generators are very similar, except that one has a small engine attached to it while the other has a crank. One can turn the latter by hand, but it is generally simpler to rig it to a pack animal, a windmill or a small waterfall.

Energy Generation

Name	Type	Weight (kg)	Fuel (l/Hr)	EP/Hr
Solar Panel	1 m²	5	-	200
	10 m²	55	-	2300
	100 m²	550	-	25,000
Kinetic Generator	Small	15	-	1,500
	Medium	50	-	5,000
	Large	100	-	10,000
Gas Engine Generator	Small	150	1	15,000
	Medium	500	3	52,500
	Large	1000	6	105,000

◆ Recharging Energy Weapons

A vehicle powerplant can be used to recharge the batteries of an energy weapon. Although the process is not very efficient, it permits "reloading" in the field. All that is required is a pair of cables and some jury-rigging (Tinker Skill versus a Threshold of 5) to build a convertor to translate the engine's output to electricity that can be used to reload the power banks.

Each engine is capable of putting out a certain amount of Energy Points that can be used for recharging. For simplicity, use the Fuel Consumption table on page 153. The number of Energy Points supplied by the engine in one hour is equal to the Energy Points required to run for one hour at Combat Speed, multiplied by 0.33. Fuel is consumed for one hour of travel at Combat Speed.

Energy Weapon Recharge

Weapon	Energy Point required per shot
Sniper Laser	1200
Gatling Laser	3600
Light Laser Cannon	3600
Heavy Laser Cannon	9000
Light Pulse Laser Cannon	9000
Heavy Pulse Laser Cannon	19,000
Light Particle Accelerator	600
Heavy Particle Accelerator	3000
Light Railgun	2400
Heavy Railgun	98,000

7.5 - Repairs

In many campaigns, Players will have the opportunity to repair vehicles that survived previous battles. In tactical campaigns, both Players should agree on the quality and quantity of each faction's technicians. The quality of a technician is represented by his total rating, the sum of his Skill and relevant Attributes. Better technicians can do more work, but they cost more TV points.

Each technician generates a number of Labor points per day equal to his Rating times five. These Labor points are expended to repair vehicles. Each attempt to repair damage requires a number of Labor points equal to the vehicle's Size plus a modifier from the *Damage Effect Modifier* table below.

Once the required points are expended, the technicians must pass a Skill test. If multiple technicians of differing Skill levels are present, use the average Skill of the group, rounding up. The Thresholds against which they must roll are found in the *Repair Threshold* table. Failed or draw rolls do not produce any results and the Labor points are wasted. Fumbles cause one random Light Damage to the vehicle in addition to a failure to do the repairs.

Technician Threat Value

Tech Rating	TV	Tech Rating	TV
1	50	5	800
2	100	6	1600
3	200	7	3200
4	400	8	6400

Damage Effect Modifier

Damage Effect	Labor Point Modifier
Armor Rating Loss	+1 per point
MP Loss	+1 per MP
Maneuverability Loss	+2 per point
Weapon Accuracy Loss	+1 per point/weapon
Weapon Destroyed	+5
Fire Control Destroyed	+6
Power Transfer Failure	+5
Catastrophic Crew Compartment Failure	+10
Complete Structural Failure	+vehicle size
Auxiliary Systems Perk	+3

Repair Threshold Table

Damage Effect	Tech Skill Threshold
Armor Rating Loss	1 per point
MP Loss	1+1 per MP
Maneuverability Loss	2+2 per point
Weapon Accuracy Loss	2+1 per point/weapon
Weapon Destroyed	5
Fire Control Destroyed	6
Power Transfer Failure	5
Catastrophic Crew Compartment Failure	7
Complete Structural Failure	8
Auxiliary Systems Perk	4

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7.6 - Technological Skills

The **Heavy Gear** roleplaying game offers a good number of Skills (see rulebook page 57). For those wishing for a more complete and varied campaign — especially one which features characters which delve in technology — technological Skills such as those listed below may be a welcome addition. Individual Gamemasters may create new ones as long as they make sure they are not overly specific or unbalancing.

◆ Electronic Design (KNO based)

Electronic Design represents a character's ability to design totally new or highly modified electronic or computerized systems and configurations. The Skill includes expertise in testing such systems.

The character must already possess either the Computer or Electronics Skill at level 2 in order to learn Electronic Design.

Complexity:	**Complex**
Specializations:	**Computers, Sensors, Communications**
Pre-Requisites:	**Computers 2 or Electronics 2**
Often Possessed By:	**Electrical Engineers, Computer Design Specialists**

◆ Heavy Gear Architecture (KNO based)

This Skill is used by many designers in order to acquire a very specific and intricate knowledge of a Gear or a family of Gears. Also, some elite HG pilots use this Skill to learn the weaknesses of their opponents' Gears and defeat them in simple Gear hand-to-hand combat.

After a successful check against a Threshold of 8, the defending Gear's Armor is reduced by half for damage purposes. An Overkill result is treated as an automatic shutdown of all systems on the Gear. If the Gear already has either a Weak Spot or a Weak Point Flaw, then the roll is performed at +1. If it has both Flaws, the roll is at +2.

Complexity:	**Complex**
Specializations:	**Specific Gear**
Pre-Requisites:	**Electronics 2 and Mechanics 2**
Often Possessed By:	**Gear Designers, Engineers, Elite Gear Pilots**

◆ Mechanical Design (KNO based)

Mechanical Design represents a character's ability to design totally new or highly modified complex mechanical systems such as vehicles and processing equipment. The Skill includes expertise in testing such systems, but Electronic Design is required to create the computerized operating systems for such devices.

The character must already possess the Mechanics Skill at level 2 in order to learn Mechanical Design.

Complexity:	**Complex**
Specializations:	**Vehicles, Industrial Equipment, Farm Equipment**
Pre-Requisites:	**Mechanics 2**
Often Possessed By:	**Mechanical Engineers, Vehicle Designers**

7.7 - Stock Non-Player Characters

Because of the underlying storyline inherent to Heavy Gear, Non-Player Characters have been divided into five categories: Historical Figures, Restricted Characters, Very Important People, Social Encounters and Expendables. These categories will help the Gamemaster determine which characters he can or cannot use in his campaign and who among them is expendable. Most Historical Figures, Restricted Characters and Very Important People have no stats, while Social Encounters and Expendables often do. This reflects the fact that stats are most useful for combat involving PCs, and the first three categories do not run that risk. This book contains only Expendable characters, so we only cover this category below.

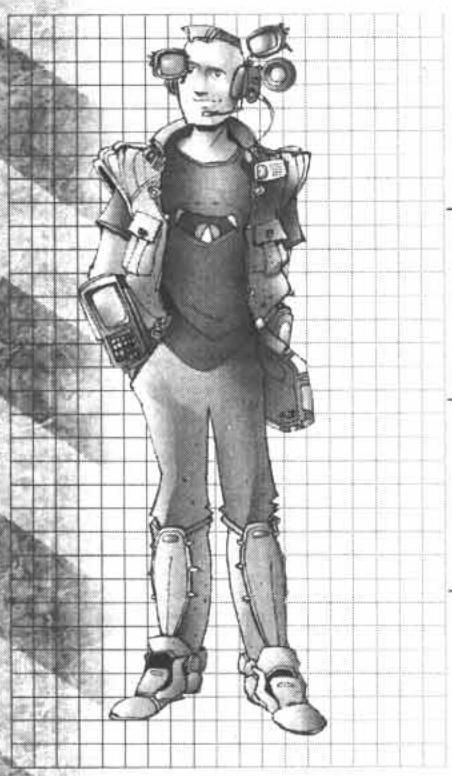
◆ Expendables

These are the typical, faceless characters who populate Terra Nova by the millions. They include those characters who are meant to challenge the Player Characters during scenarios. While mindless slaughter should never be encouraged, these are the most expendable characters.



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Computer Technician



While some companies use artificial intelligence and expert systems to operate and monitor their internal computer network, they still require the services of computer technicians to keep those complex systems working. The militaries of Terra Nova much prefer to train their own experts to maintain the complex battlefield systems that are so much a part of military strategy in the 62nd century. These technicians are generally much more skilled than standard and have a higher security clearance to access the specs and necessary information required to perform their job.

Attributes

AGI	0	APP	0	BUI	0	CRE	+2	FIT	0
INF	0	KNO	+1	PER	+1	PSY	0	WIL	0
STR	0	HEA	0	STA	25	UD	3	AD	3

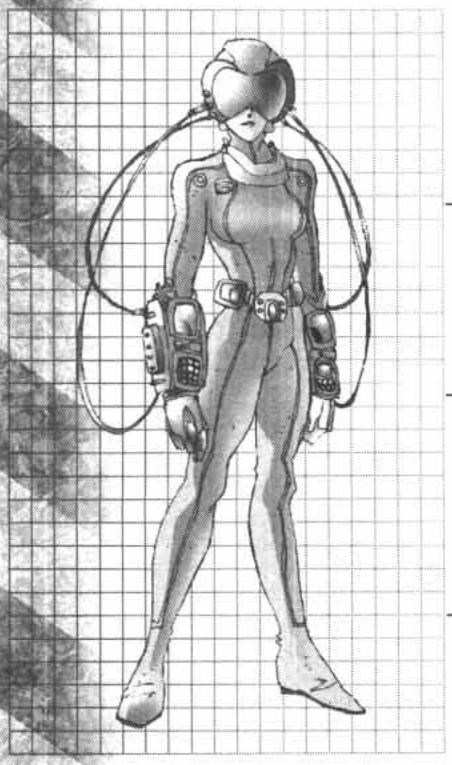
Skills

Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.
Communications	1	+1	Electronics	3	+1	Notice	1	1	Teaching	1	+2
Computer	2	+1	Electronic Design	2	+1	Physical Sciences	1	1	Tinker	2	+2

Equipment and Cost

Typical Equipment:	dataglove, personal computer, electronics tool kit, various diagnostic software, spare parts.
Salary:	Varies depending on employment
Basic Character Costs:	24 Character Points and 42 Skill Points

Cyb Surgeon



Although genetic reconstruction and cell-cloning techniques can solve many medical problems in the 62nd century, these techniques are not fool-proof. For simple limb or organ replacement, cybernetic prosthetics (called cybs) are sometimes a more viable option. Despite the trideo-drama portrayal of back-room body-snatchers and cyber-mutilations, cyb surgeons are actually part of the medical elite, performing cutting edge surgery for extreme amounts of money. Most live in luxury and set many of their own rules, although genetic reconstruction specialists outpace them in terms of status.

Attributes

AGI	+1	APP	0	BUI	0	CRE	+1	FIT	0
INF	0	KNO	+1	PER	+1	PSY	0	WIL	0
STR	0	HEA	0	STA	25	UD	3	AD	3

Skills

Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.
Business	1	+1	First Aid	2	+1	Life Sciences	1	+1	Notice	1	+1
Computer	1	+1	Law	1	+1	Medicine (cybs)*	3	+1	*(specialization)		
Electronics (cybs)*	2	+1									

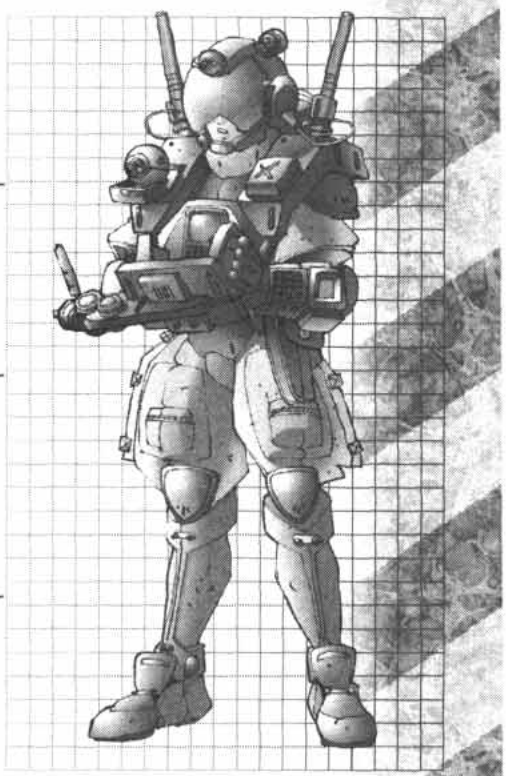
Equipment and Cost

Typical Equipment:	Luxury house and automobile, fully equipped surgical lab.
Salary:	Varies depending on employment
Basic Character Costs:	18 Character Points and 47 Skill Points

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Drone Operator

Drone operators are often the eyes and ears of the commander in the field. If no orbital recon assets are available, or the area is too dense or too dangerous to send in a recon unit, their little remotely-piloted vehicles will get in and do the job. It takes a unique perspective to be a drone operator: one has to be able to split his attention between the current situation and the drone, leading to the current slang of "schizo" for the more extreme (read: skilled) operators.



Attributes

AGI	+1	APP	0	BUI	0	CRE	0	FIT	0
INF	0	KNO	+1	PER	+1	PSY	0	WIL	0
STR	0	HEA	0	STA	25	UD	5	AD	5

Skills

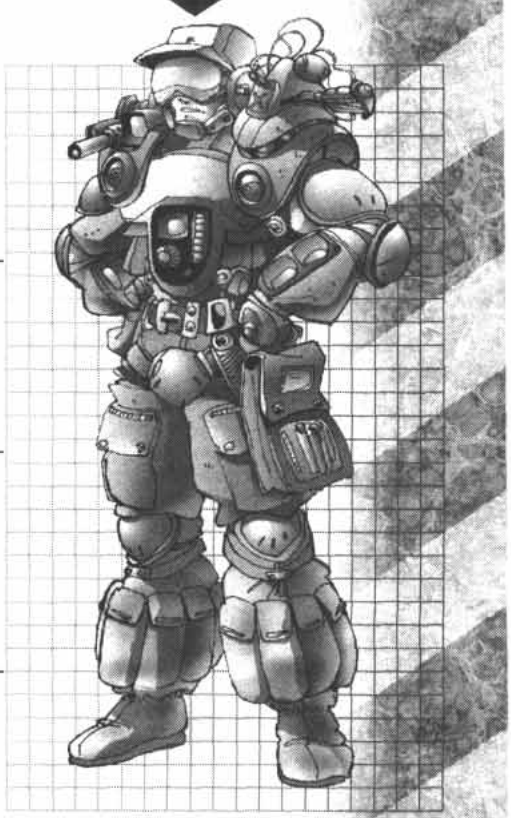
Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.
Combat Sense	1	0	Drone Gunnery	1	+1	Electronic Warfare	1	+2	Small Arms	1	0
Communications	1	+1	Drone Piloting	1	0	Mechanics	2	+1	Tinker	2	+2
Computer	1	+1	Electronics	2	+1	Notice	1	0			

Equipment and Cost

Typical Equipment:	Drone control rig, tool kit, field uniform, sidearm.
Salary:	Varies depending on employment
Basic Character Costs:	12 Character Points and 33 Skill Points

Field Mechanic

Those who keep the cogs of the military machine working in the field are a hardy lot. Often long-time veterans, these mechanics live in their own world of spare parts and improvised repairs. Unlike many of their non-field colleagues, they are extremely competent and hard working. The job comes first, always. They have little time for prima donna pilots or cocky troops who think they know what is best. Pilots with a little experience know that keeping the field tech happy is a key part of surviving a tour of duty.



Attributes

AGI	0	APP	-1	BUI	+1	CRE	+2	FIT	+1
INF	0	KNO	+1	PER	0	PSY	0	WIL	0
STR	+1	HEA	0	STA	30	UD	5	AD	5

Skills

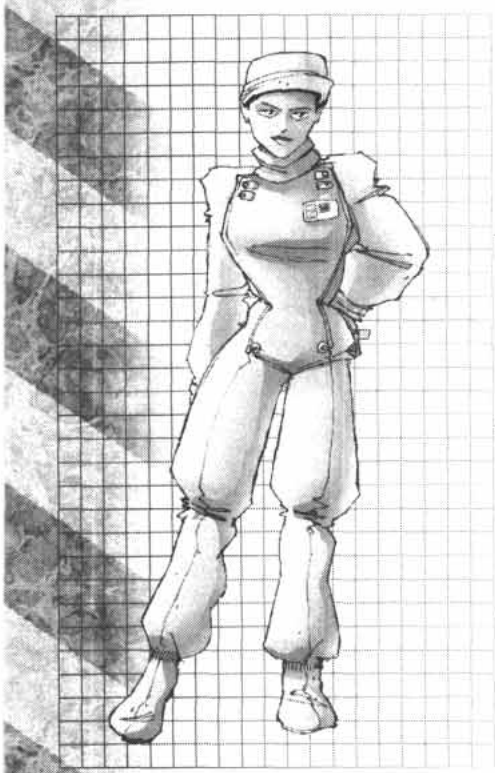
Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.
Combat Sense	1	0	Demolition	1	+1	Electronic Warfare	1	+2	Small Arms	1	0
Communications	1	+1	Drive	1	0	Mechanics	2	+1	Tinker	2	+2
Computer	1	+1	Electronics	2	+1	Notice	1	0			

Equipment and Cost

Typical Equipment:	Dataglove with design specs, extensive tool kit, field uniform.
Salary:	Varies depending on employment
Basic Character Costs:	26 Character Points and 32 Skill Points

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Genetic Engineer



The lucky and the wealthy can benefit from the cutting edge of genetic science on Terra Nova and find birth defects eliminated, natural strengths enhanced and weaknesses neutralized. Without doubt, one of the most prestigious — or "sexiest" — of applied sciences is genetic engineering. Across Terra Nova, universities and research laboratories are actively involved in a cutthroat competition to make the next discovery or to finalize the next surgical technique. Most of these scientists and researchers do their work for the benefit of medical science, but in the most secret of laboratories some develop "new and better" bioweapons and other less-than-ethical genetic applications.

Attributes

AGI	0	APP	0	BUI	0	CRE	+1	FIT	0
INF	0	KNO	+2	PER	+1	PSY	0	WIL	0
STR	0	HEA	0	STA	25	UD	3	AD	3

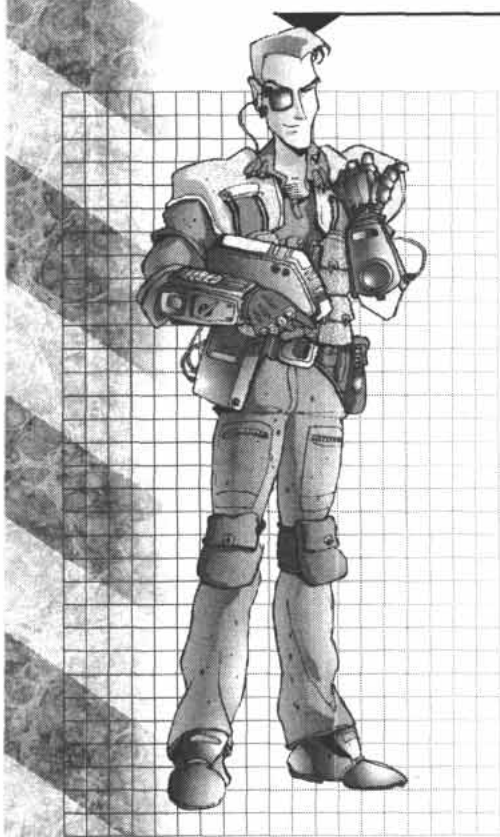
Skills

Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.
Computer	1	+2	Law (ethics laws)	1	+2	Medicine (surgery)	2	+2	*(specialization)		
First Aid	1	+2	Life Sc. (genetics)	3	+2	Physical Sciences	1	+2			

Equipment and Cost

Typical Equipment:	genetic laboratory, dedicated computer system, high-priced home and luxury automobile.
Salary:	Varies depending on employment
Basic Character Costs:	24 Character Points and 40 Skill Points

Heavy Gear Designer



Armies require designs that are as light, fast and lethal as possible, and which require the least amount of maintenance. The men and women who make their living designing and updating these versatile machines are on a constant quest to reach the next level of design without sacrificing their legendary durability and versatility. Some scoff at the limited variety of Gears, but engineers usually ignore such comments. They can tell at a glance which Gear is which and what its strengths and weaknesses are. As far as they're concerned, each machine produced is unique.

Attributes

AGI	0	APP	0	BUI	0	CRE	+2	FIT	0
INF	0	KNO	+1	PER	+1	PSY	0	WIL	0
STR	0	HEA	0	STA	25	UD	3	AD	3

Skills

Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.
Communications	1	+1	Electronic Warfare	1	+2	Mechanics	2	+1	Tinker	1	+2
Computer (NNets)	2	+1	HG Architecture	2	+1	Mech. Design (HG)	3	+1	*(specialization)		
Electronics	2	+1									

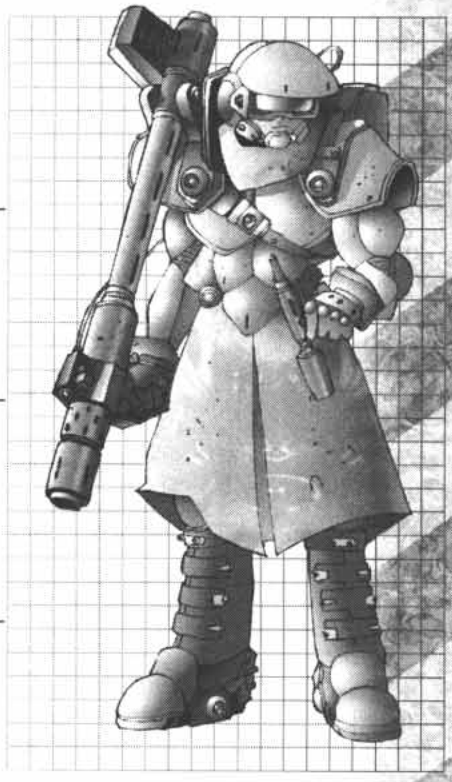
Equipment and Cost

Typical Equipment:	Three-dimensional CAD station, NNet simulator station, dataglove.
Salary:	Varies depending on employment
Basic Character Costs:	24 Character Points and 66 Skill Points

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Heavy Weapons Trooper

On a battlefield where highly mobile armored machines are commonplace, the lowly infantryman needs something to even the odds. Highly sophisticated personal weapons fit the bill, allowing a single trooper to damage and possibly even destroy a light combat craft with a single attack. Even heavier weaponry exist to fight larger threats, but these expensive tools require specialist training to carry and operate correctly. Depending n its nature and assignment, an infantry squad can include between one and eight of these deadly warriors.



Attributes

AGI	0	APP	0	BUI	+1	CRE	0	FIT	+1
INF	0	KNO	0	PER	+1	PSY	0	WIL	0
STR	+1	HEA	0	STA	30	UD	5	AD	5

Skills

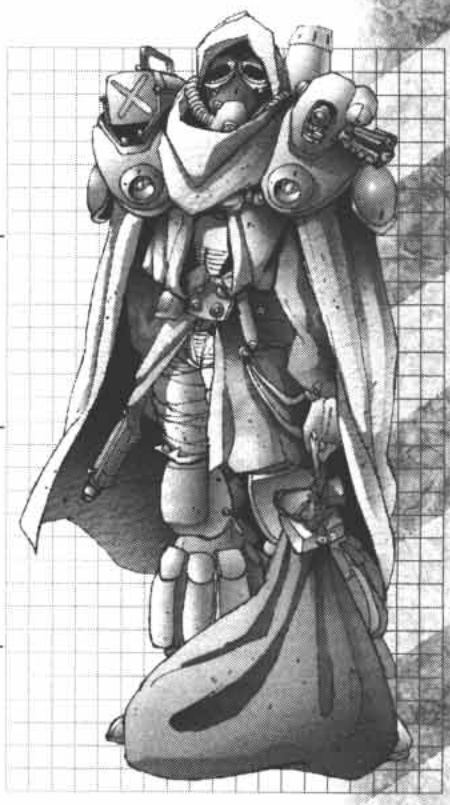
Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.
Communications	1	+1	Electronic Warfare	1	+2	Mechanics	2	+1	Tinker	1	+2
Computer	1	0	HW Gunnery	2	+1	Small Arms	2	+1	*(specialization)		
Electronics	2	+1									

Equipment and Cost

Typical Equipment:	Heavy weapon, heavy flak armor, field uniform.
Salary:	Varies depending on employment
Basic Character Costs:	19 Character Points and 28 Skill Points

Salvage Expert

Very little can afford to be wasted in the harsh conditions of the Badlands, and a class of specialists has evolved around the salvage of abandoned and damaged equipment. Civilian "scavengers" are a common site at junkyards or on scarred and pacified battlefields. All these men and women are renowned for their extreme resourcefulness, able to find a missing actuator in a pile of tin cans and a cerachip amongst industrial waste barrels. Many make a handsome living selling to small communities, caravans and rover gangs.



Attributes

AGI	0	APP	0	BUI	0	CRE	+2	FIT	0
INF	0	KNO	+1	PER	+2	PSY	0	WIL	0
STR	0	HEA	0	STA	25	UD	3	AD	3

Skills

Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.	Skill	Level	Attr.
Business	1	+1	Demolition	1	+1	Mechanics	2	+1	Streetwise	1	0
Communications	1	+1	Drive	1	0	Notice	2	+2	Tinker	3	+2
Computer	1	+1	Electronics	2	+1						

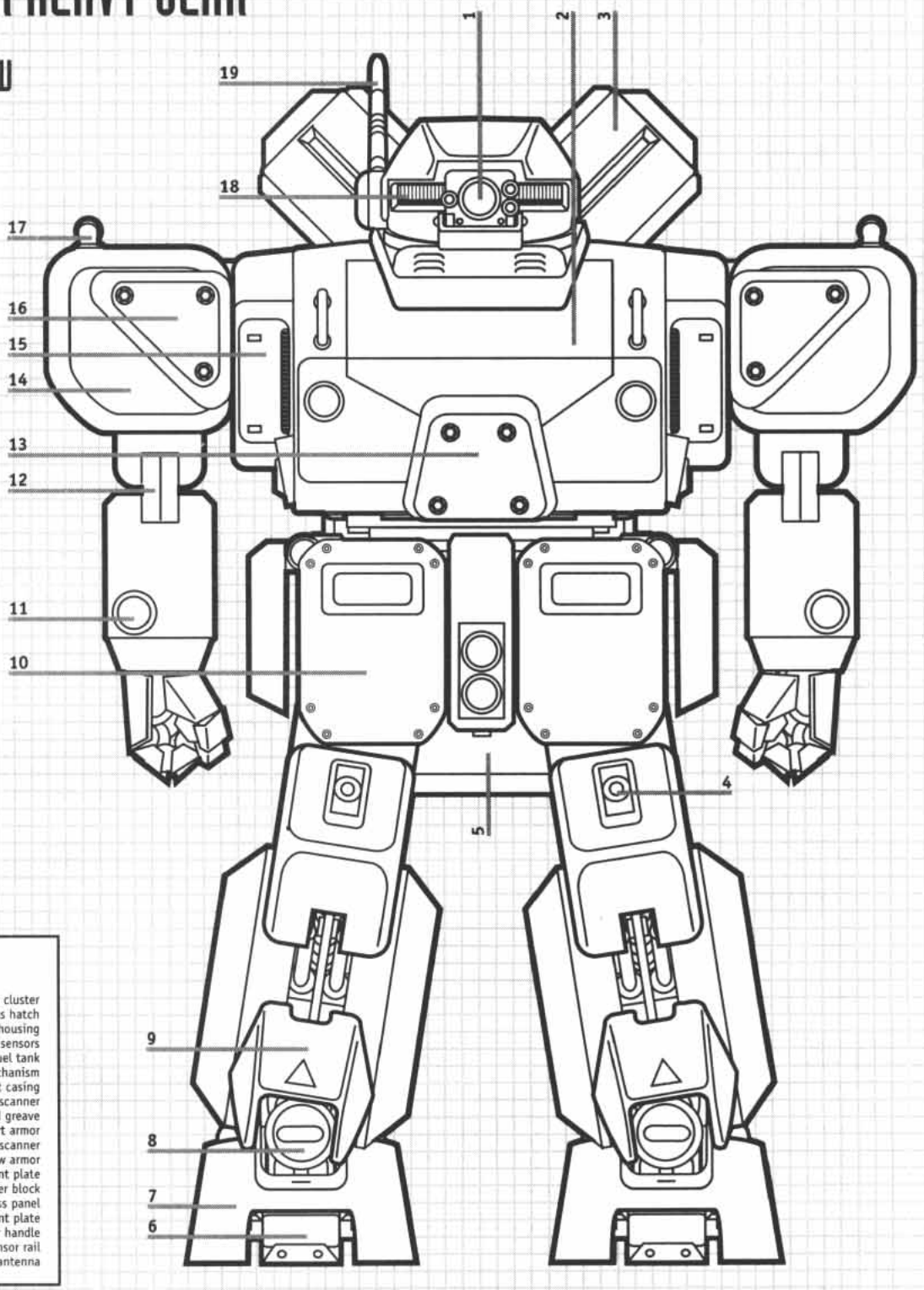
Equipment and Cost

Typical Equipment:	Extensive repair kit, magnometer, desert survival gear, heavy tools.
Salary:	Varies depending on employment
Basic Character Costs:	29 Character Points and 44 Skill Points

Bryce Hubbard (order #959915)

HUNTER HEAVY GEAR

Front View



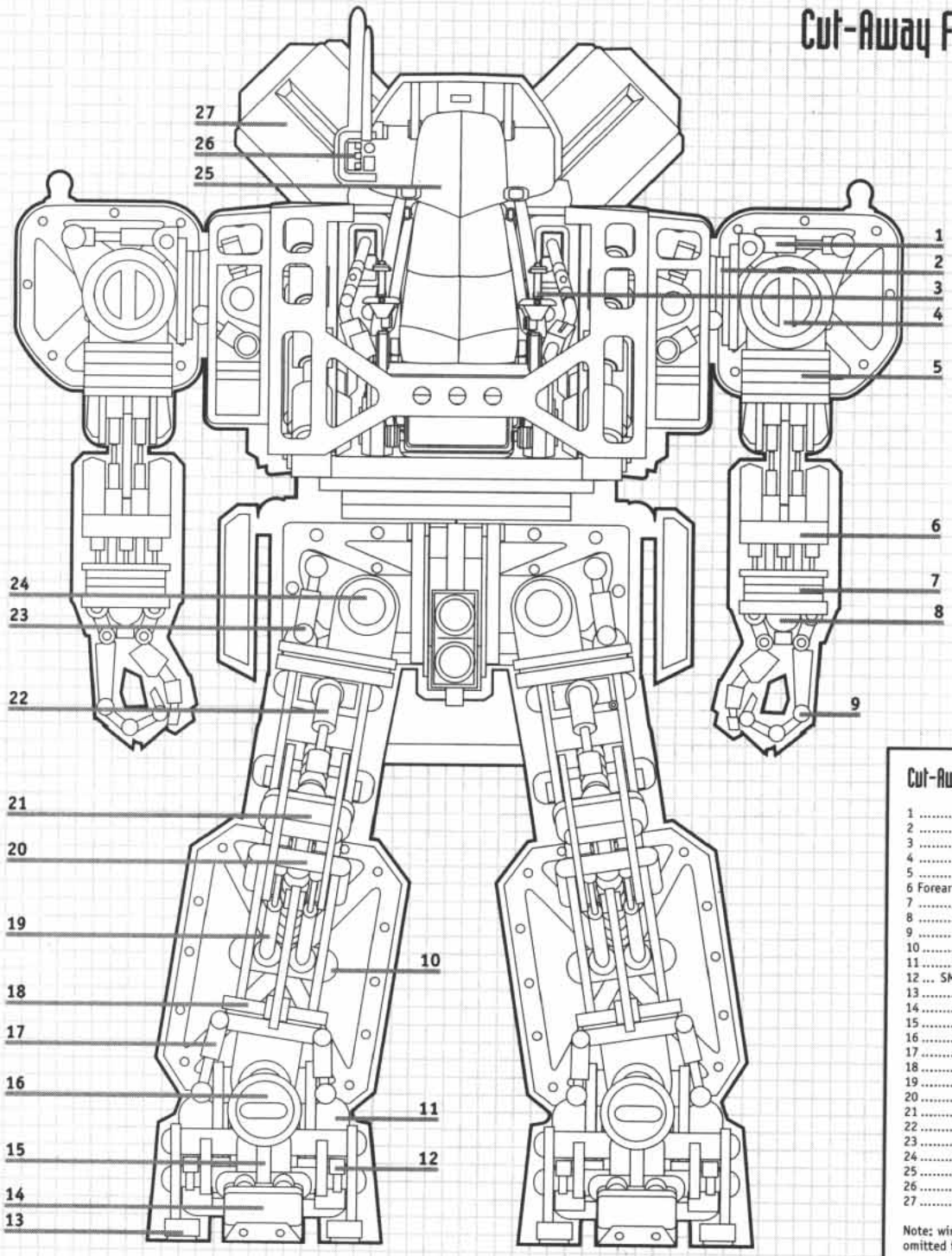
Front View

1 ..... Main sensor cluster
2 ..... Main access hatch
3 ..... Generator/pump housing
4 ..... Lower body sensors
5 ..... Armored fuel tank
6 ..... Support and balancing mechanism
7 ..... Armored foot casing
8 ..... Short range ground scanner
9 ..... Armored greave
10 ..... Front skirt armor
11 ..... Short range scanner
12 ..... Elbow armor
13 ..... Torso reinforcement plate
14 ..... Shoulder block
15 ..... Maintenance access panel
16 ..... Shoulder block reinforcement plate
17 ..... Shoulder handle
18 ..... Sensor rail
19 ..... Communication antenna

Bryce Hubbard (order #959915)

HUNTER HEAVY GEAR

Cut-Away Front View



Cut-Away Front View

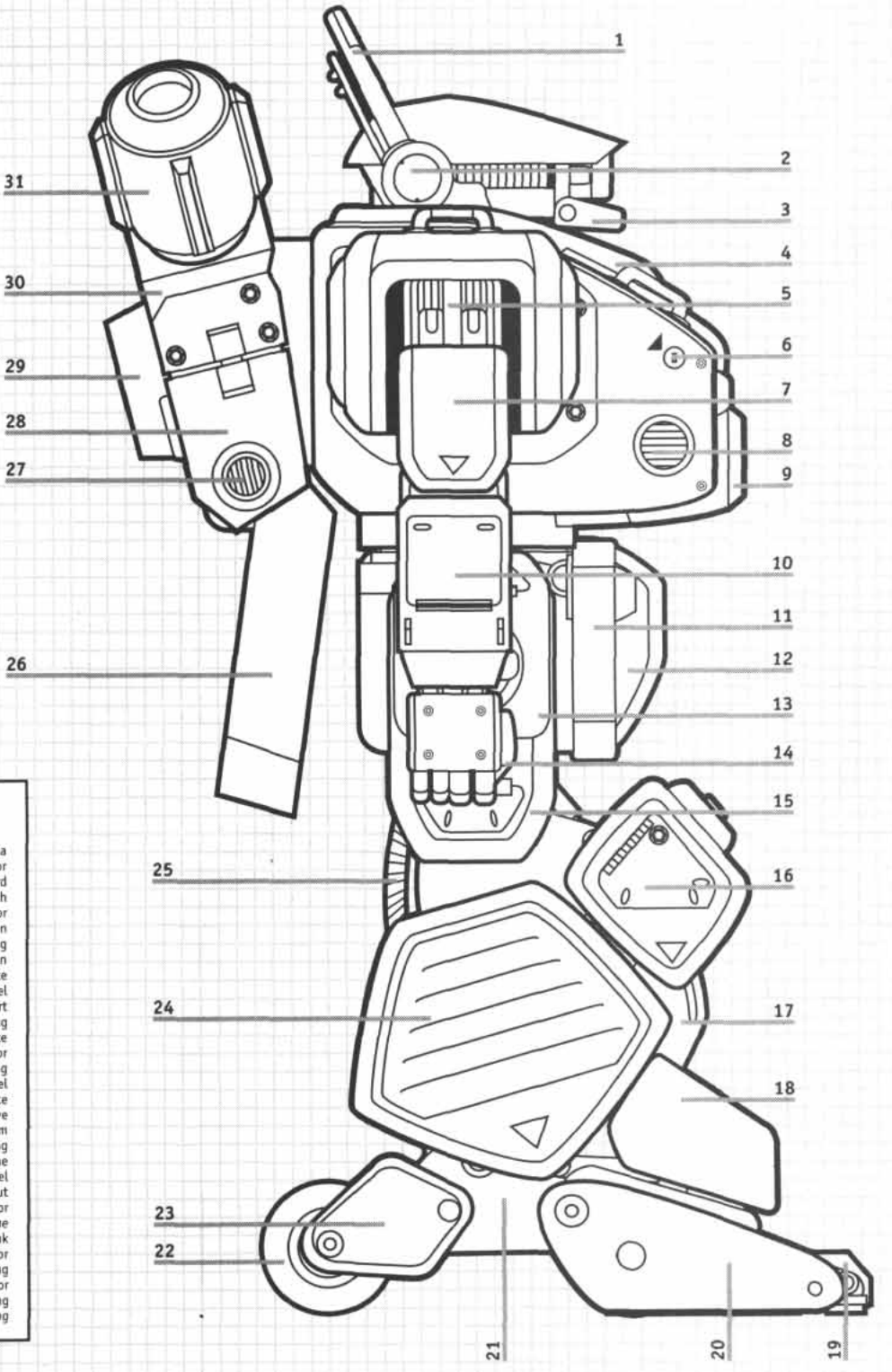
1 ..... Arm elevation actuator
2 ..... Shoulder rotation assembly
3 ..... Joystick
4 ..... Arm elevation rotor
5 ..... Lower arm rotation assembly
6 Forearm actuator/shock absorber assembly
7 ..... Wrist rotation assembly
8 ..... Main wrist support
9 ..... Knuckle rotor
10 ..... Knee actuator mounting point
11 ..... Ankle actuator mounting point
12 ... SMS wheel assembly lowering actuator
13 ..... Footplate
14 ..... Support and balancing mechanism
15 ..... Foot structural member
16 ..... Short range ground scanner
17 ..... Ankle actuator
18 ..... Foot rotation assembly
19 ..... Lower knee actuator
20 ..... Knee block structural member
21 ..... Knee block mainframe
22 ..... Upper knee actuator
23 ..... Leg elevation actuator
24 ..... Hip rotor assembly
25 ..... Pilot seat
26 ..... Communication equipment
27 ..... Generator/pump housing

Note; wiring and access hatch actuators omitted for clarity.

Bryce Hubbard (order #959915)

HUNTER HEAVY GEAR

Side View



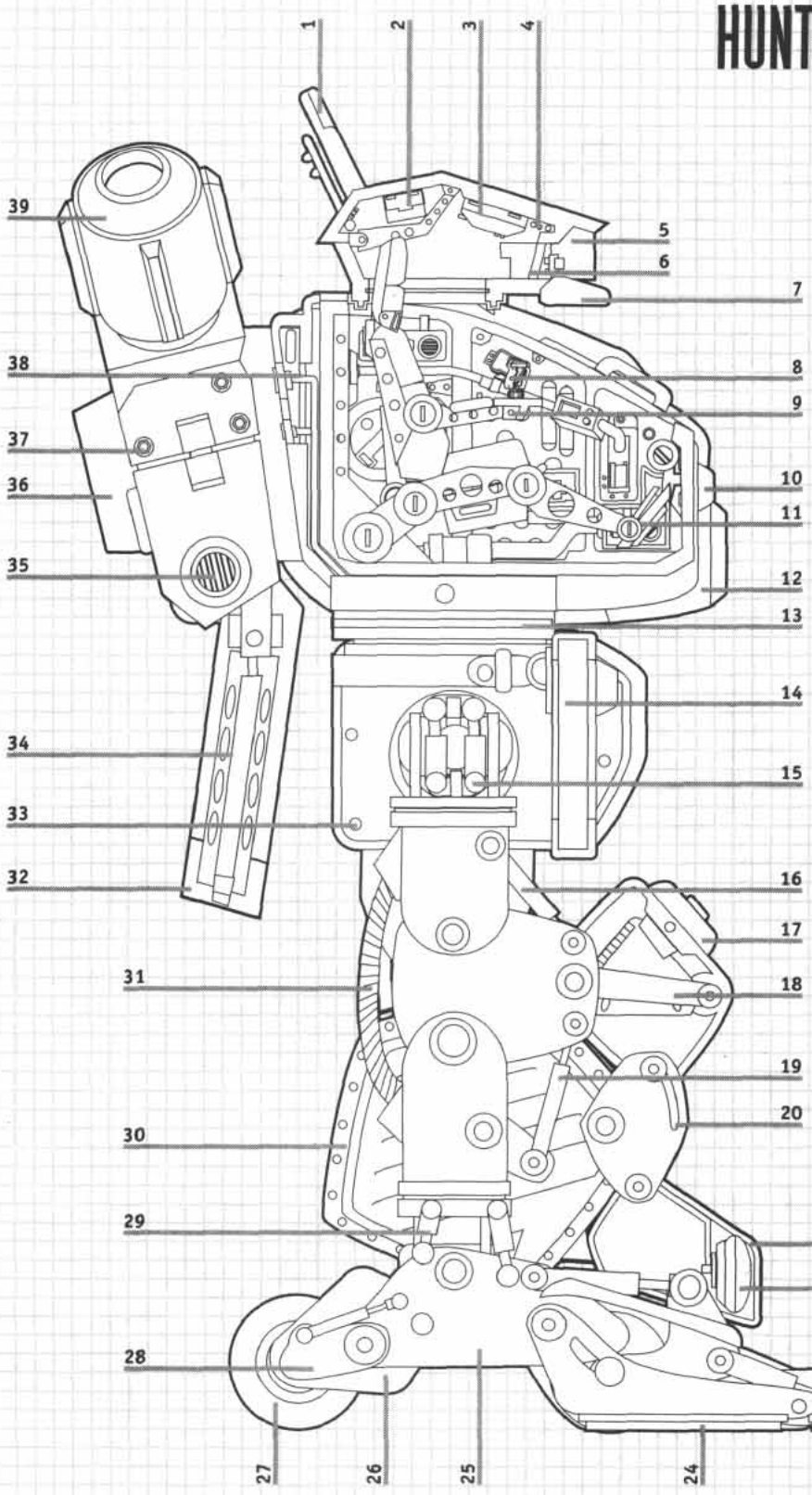
Side View

1- ..... Communication antenna
2- ..... Antenna mount and rotation motor
3- ..... Sensor crash guard
4- ..... Upper torso hatch
5- ..... Arm elevation actuator
6- ..... Armor pin
7- ..... Upper arm armor casing
8- ..... Cooling fan
9- ..... Torso reinforcement plate
10- ..... Forearm access panel
11- ..... Front armor skirt
12- ..... Lower body sensor housing
13- ..... Hip armor plate
14- ..... Manipulator
15- ..... Upper leg armored casing
16- ..... Knee block access panel
17- ..... Knee block/greave support plate
18- ..... Greave
19- ..... Support and balancing mechanism
20- ..... Armored foot casing
21- ..... Foot mainframe
22- ..... SMS road wheel
23- ..... Road wheel support strut
24- ..... Lower leg radiator
25- ..... Armored *power transfer line*
26- ..... Armored fuel tank
27- ..... Multi-connector
28- ..... battery housing
29- ..... Main radiator
30- ..... V-engine housing
31- ..... *Generator/pump* housing

Bryce Hubbard (order #959915)

HUNTER HEAVY GEAR

Cut-Away Side View



Cut-Away Side View

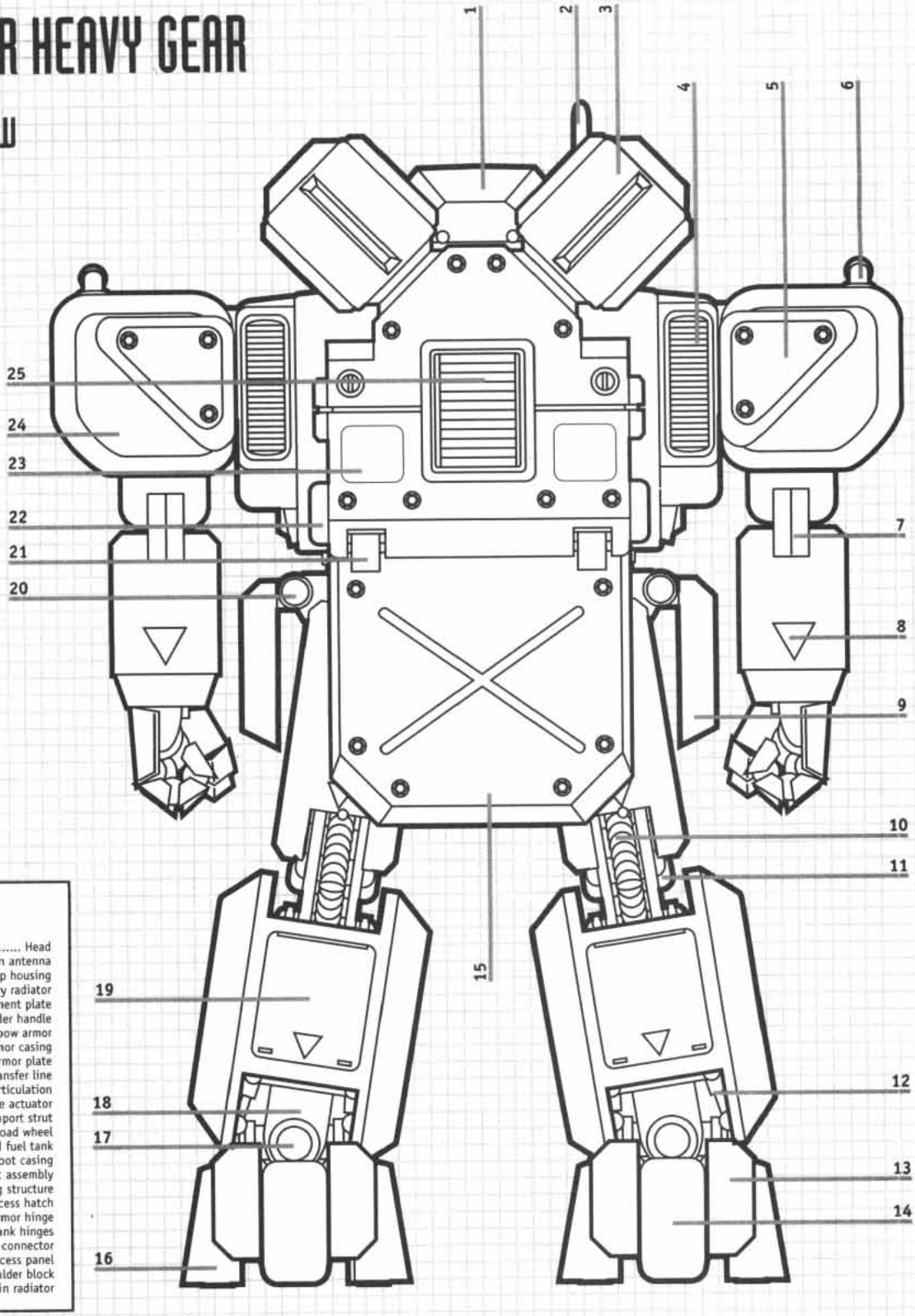
1- ..... Communication antenna
2- ..... Communication relay circuitry
3- ..... Visual sub-processor
4- ..... Radar array power conduits
5- ..... Main sensor cluster
6- ..... Armored viewpane
7- ..... Sensor crash guard
8- ..... Control stick
9- ..... Arm rest strut
10- ..... Headlight
11- ..... Foot rest and pedals
12- ..... Torso reinforcement plate
13- ..... Lower body rotation ring
14- ..... Laminated skirt armor plate
15- ..... Hip actuator assembly
16- ..... Upper knee actuator
17- ..... Knee block sensor unit
18- ..... Knee block structural support
19- ..... Lower knee actuator
20- ..... Connector plate
21- ..... Armored greave
22- ..... Short range scanner
23- ..... Support and balancing mechanism
24- ..... Foot plate
25- ..... Main foot structure
26- ..... SMS strut armor plate
27- ..... SMS road wheel
28- ..... SMS road wheel support strut
29- ..... Ankle actuator assembly
30- ..... Lower leg armor structural rib
31- ..... Armored power transfer line
32- ..... Armored fuel tank casing
33- ..... Lower body casing
34- ..... Self-sealing fuel tank
35- ..... Multi-connector
36- ..... Main radiator
37- ..... Retaining bolt
38- ..... Power and pressure connectors
39- ..... Armored casing

Note: wiring and access hatch actuators omitted for clarity.

Bryce Hubbard (order #959915)

HUNTER HEAVY GEAR

Back View



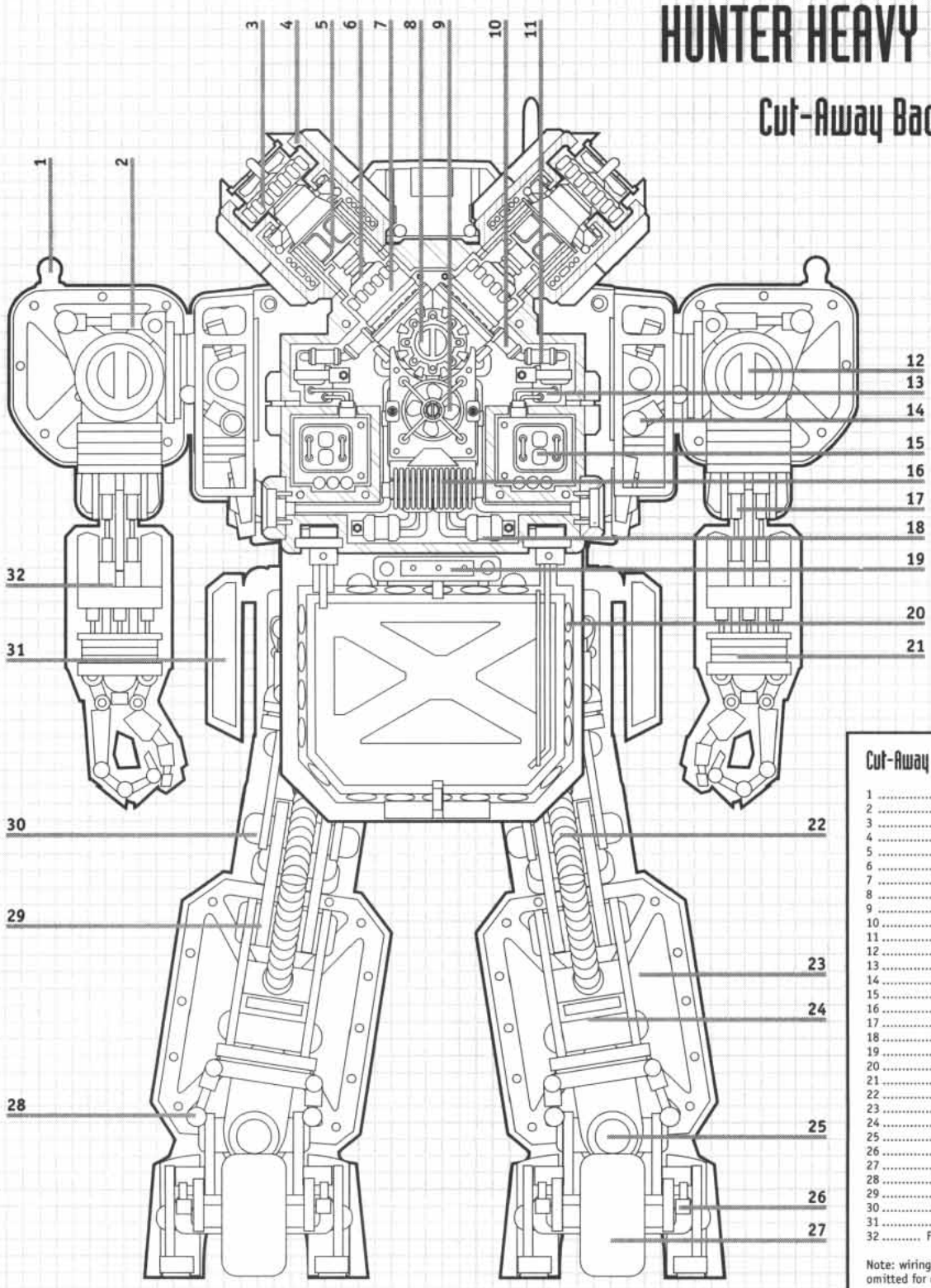
Back View

1- ..... Head
2- ..... Communication antenna
3- ..... Generator/pump housing
4- ..... Secondary radiator
5- ..... Shoulder block reinforcement plate
6- ..... Shoulder handle
7- ..... Elbow armor
8- ..... Forearm armor casing
9- ..... Starboard hip armor plate
10- ..... Armored power transfer line
11- ..... Knee articulation
12- ..... Ankle actuator
13- ..... SMS road wheel support strut
14- ..... SMS road wheel
15- ..... Armored fuel tank
16- ..... Armored foot casing
17- ..... Ankle support assembly
18- ..... Lower leg structure
19- ..... Lower leg access hatch
20- ..... Hip armor hinge
21- ..... Fuel tank hinges
22- ..... Multi-connector
23- ..... Battery access panel
24- ..... Shoulder block
25- ..... Main radiator

Bryce Hubbard (order #959915)

HUNTER HEAVY GEAR

Cut-Away Back View



Cut-Away Back View

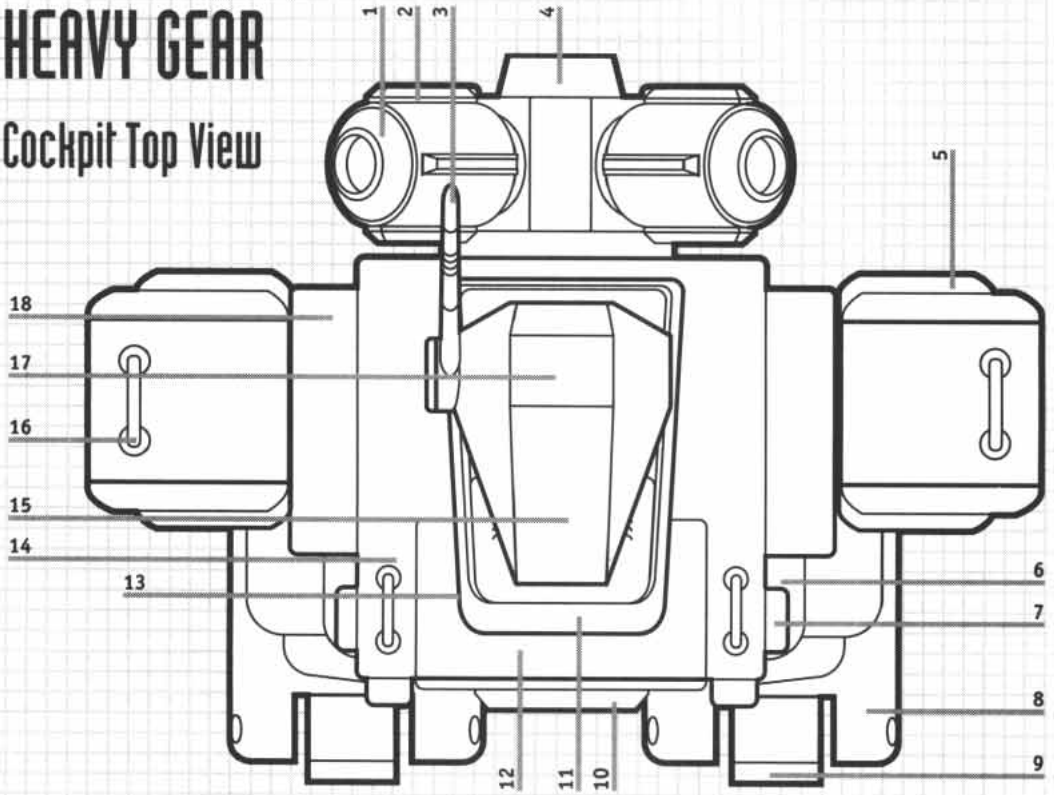
1 ..... Shoulder handle
2 ..... Shoulder elevation actuator
3 ..... Generator
4 ..... Main armor casing
5 ..... Main pump
6 ..... Drive shaft
7 ..... Main engine block
8 ..... Carburetor
9 ..... Radiator fan
10 ..... Power coupling
11 ..... Backup power coupling
12 ..... Arm elevation rotor
13 ..... Connector
14 ..... Shoulder elevation actuator
15 ..... Battery
16 ..... Cooling coil
17 ..... Elbor articulation
18 ..... Fuel filter/fuel tank connector
19 ..... Fuel filter
20 ..... Fuel tank shock absorbers
21 ..... Wrist rotation assembly
22 ..... Armored power transfer line
23 ..... Lower leg structure
24 ..... Knee actuator mounting point
25 ..... Ankle support assembly
26 ..... SMS wheel lowering actuator
27 ..... SMS road wheel
28 ..... Ankle articulation actuator
29 ..... Lower leg support structure
30 ..... Knee articulation
31 ..... Hip armor
32 ..... Forearm shock absorber assembly

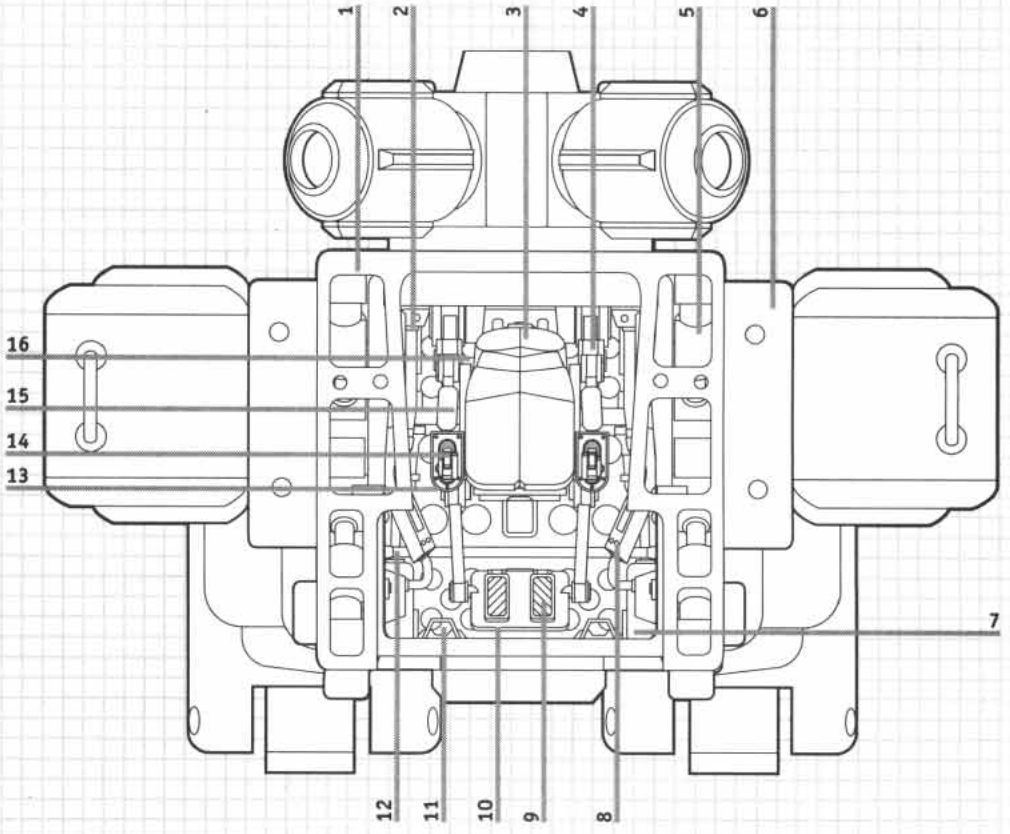
Note: wiring and access hatch actuators omitted for clarity.

Bryce Hubbard (order #959915)

HUNTER HEAVY GEAR

Top View & Cockpit Top View





Top View

1 ..... Generator/pump housing
2 ..... Reinforcement rib
3 ..... Communication antenna
4 ..... Main radiator
5 ..... Shoulder reinforcement plate
6 ..... Knee block
7 ..... Cooling port
8 ..... Armored foot casing
9 ..... Support and balance mechanism
10 ..... Torso reinforcement plate
11 ..... Armored collar
12 ..... Lower torso access hatch
13 ..... Upper torso access hatch
14 ..... Upper torso armor plating
15 ..... Main radar emitter
16 ..... Service handle
17 ..... Aerial EMS array
18 ..... Shoulder housing

Cockpit Top View

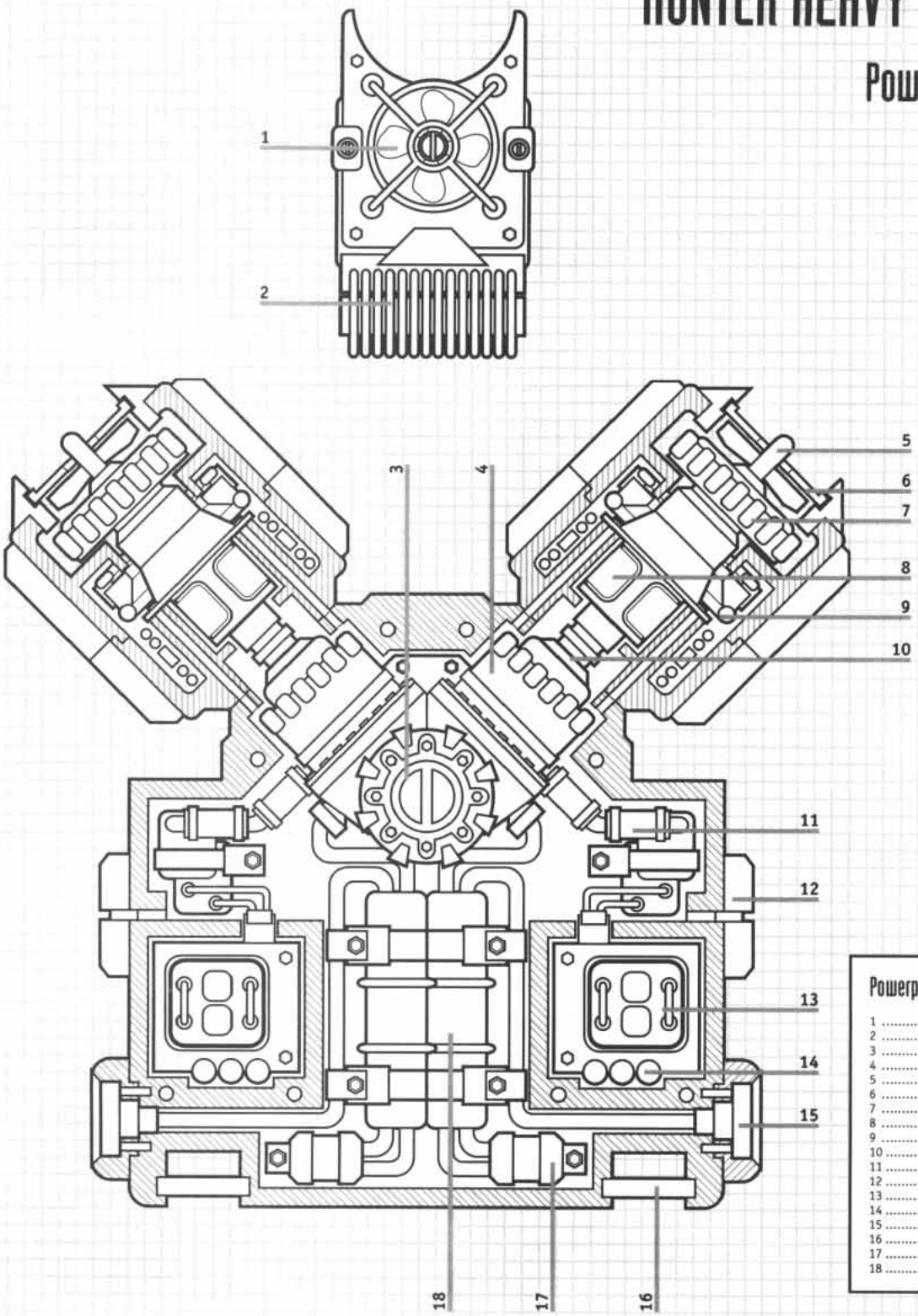
1 ..... Upper torso support ring
2 ..... Main fiber optic computer line
3 ..... Crash-absorbent padding
4 ..... Seat support struts
5 ..... Torso shock absorber
6 ..... Shoulder support frame
7 ..... Cooling unit
8 ..... Diagnostic panel
9 ..... Foot pedal
10 ..... Footrest
11 ..... Front hatch actuator mount
12 ..... Cockpit tub reinforced strut
13 ..... Dataglove mount
14 ..... Control stick
15 ..... Padded armrest
16 ..... Belt mount

Note: wiring and access hatch actuators omitted for clarity.

Bryce Hubbard (order #959915)

HUNTER HEAVY GEAR

Powerplant



Powerplant

1 ..... Radiator fan
2 ..... Cooling coil
3 ..... Carburetor
4 ..... Main engine block
5 ..... Cooling fan
6 ..... Protective mesh cover
7 ..... Generator
8 ..... Main pump
9 ..... Conduits and power lines
10 ..... Drive shaft
11 ..... Power coupling
12 ..... Backpack armor casing coupling
13 ..... Battery
14 ..... Power gauges
15 ..... Lateral exhaust
16 ..... Armored fuel tank hinge
17 ..... Fuel filter/fuel tank connector
18 ..... Cooling muffler

Bryce Hubbard (order #959915)

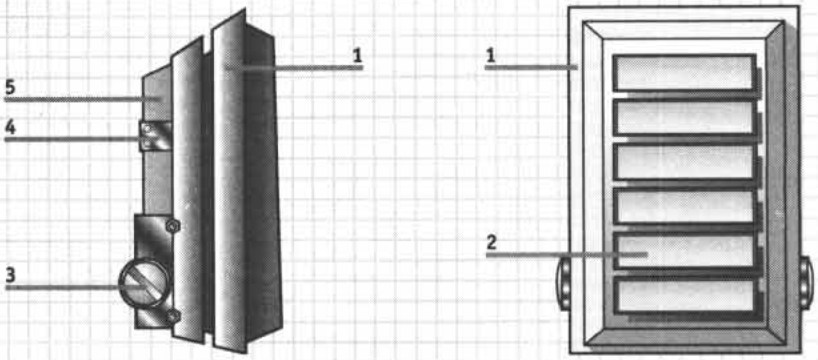
COMPONENTS

Pressure Sensor

Pressure sensors are used to gauge the hardness of a given surface and the strength exerted on said surface. These sensors are used extensively on walker vehicles, though other types of vehicles have been known to employ them.

The pressure sensor is usually submitted to some very rough treatments and consequently suffer from a high failure rate. It has thus been designed as a modular unit for easy replacement.

1 ..... Outer casing
2 ..... Pressure plates
3 ..... Mounting point
4 ..... Reinforcement brace
5 ..... Main instrument casing

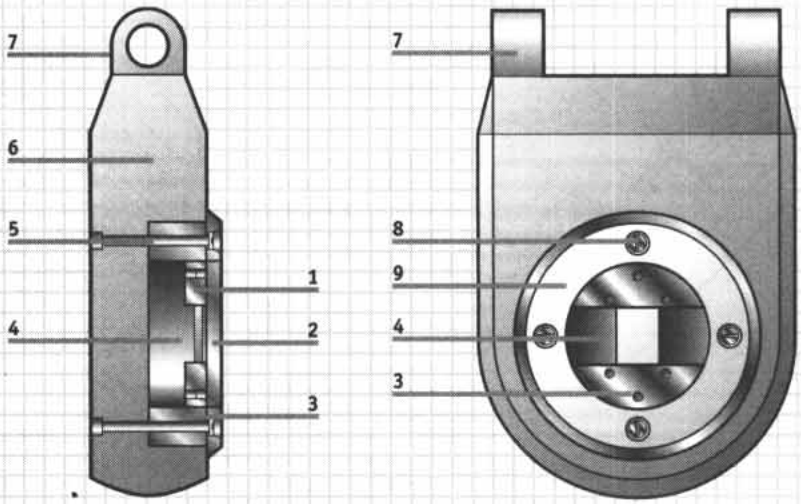


Hardpoint

Hardpoints are reinforced tabs and pins placed on the hull of vehicles to enable additional weapons and equipment to be attached to the body without taking any interior space. This increases the payload potential of the vehicle as well as its overall versatility

Most hardpoint designs are standardized to accept a wide variety of optional systems. The whole assembly is attached via explosive bolts or quick-release connectors, enabling it to be dropped instantaneously if required.

1 ..... Explosive bolt mounting hole
2 ..... Support strut
3 ..... Support bolt mounting plate
4 ..... Connector spacing
5 ..... Bolt shaft
6 ..... Laminated armor
7 ..... Support hinge
8 ..... Bolt
9 ..... Outer support ring

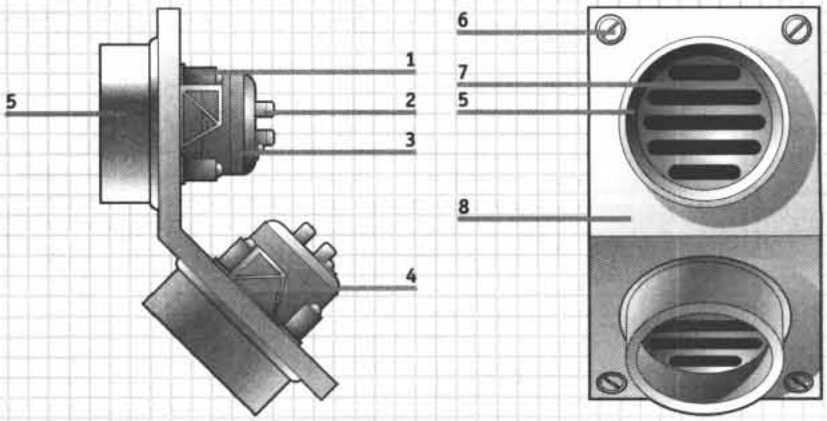


Short range scanner

Short range sensors are small and inexpensive detectors, operating on a principle similar to radar but using low power waves to reduce their electronic signature. If required, they can also operate as motion detectors, using the amount of signal received to determine the movement of an object.

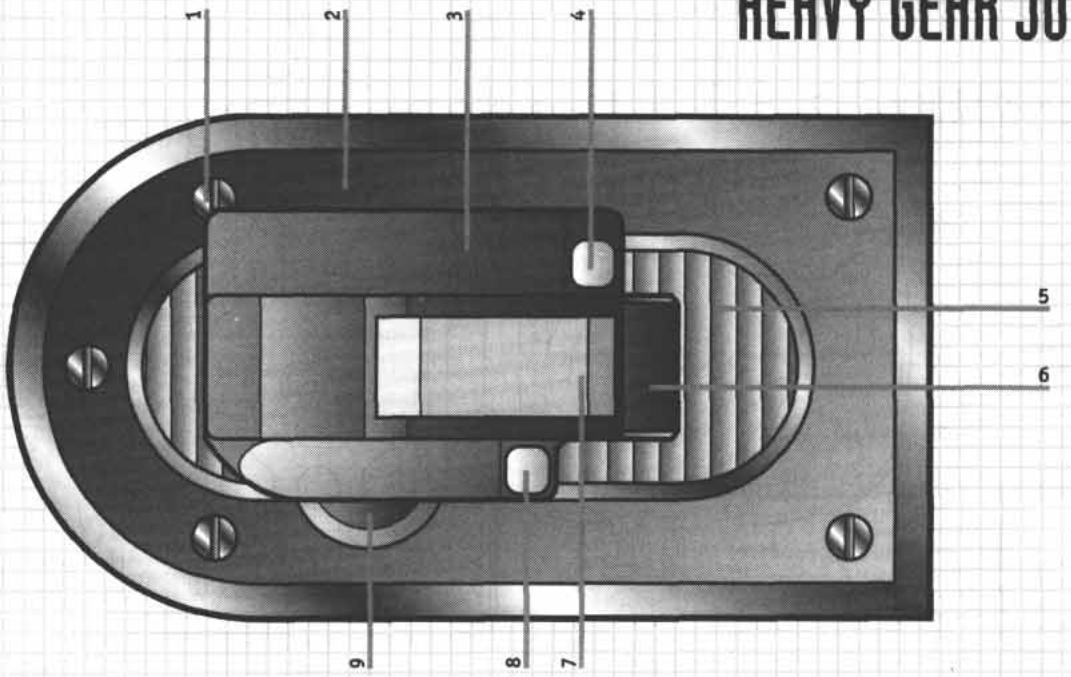
This particular instrument is a typical short range scanner mounted on a Heavy Gear. It has two emitter/receiver arrays for increased area coverage. Like the pressure sensor seen above, it is a modular unit designed for easy replacement.

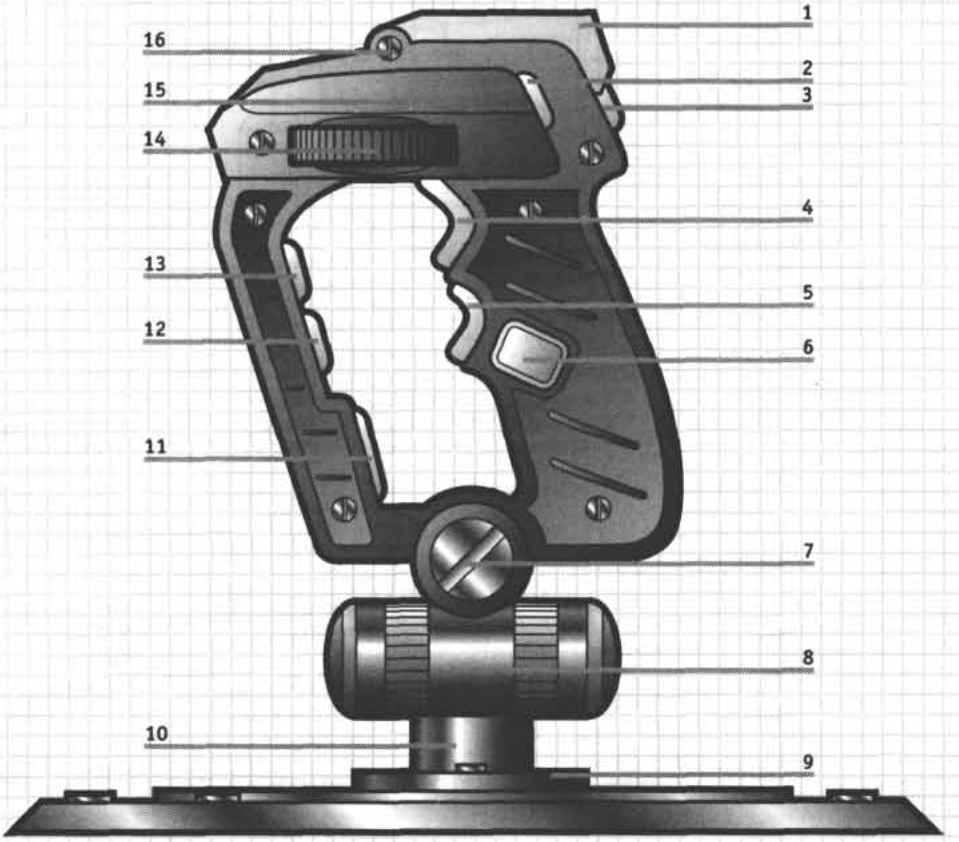
1 ..... Mounting brackets
2 ..... Data line connector
3 ..... Main instrument housing
4 ..... Support strut
5 ..... Scanner housing
6 ..... Mounting bolt
7 ..... Scanner emitter/receiver
8 ..... Main support plate



Bryce Hubbard (order #959915)

HEAVY GEAR JOYSTICK





Top View

1 ..... Bolt
2 ..... Support plate
3 ..... Joystick main casing
4 ..... Macro trigger 2
5 ..... Sliding mount
6 ..... Handle
7 ..... Safety cover
8 ..... Macro trigger 1
9 ..... Mode selector

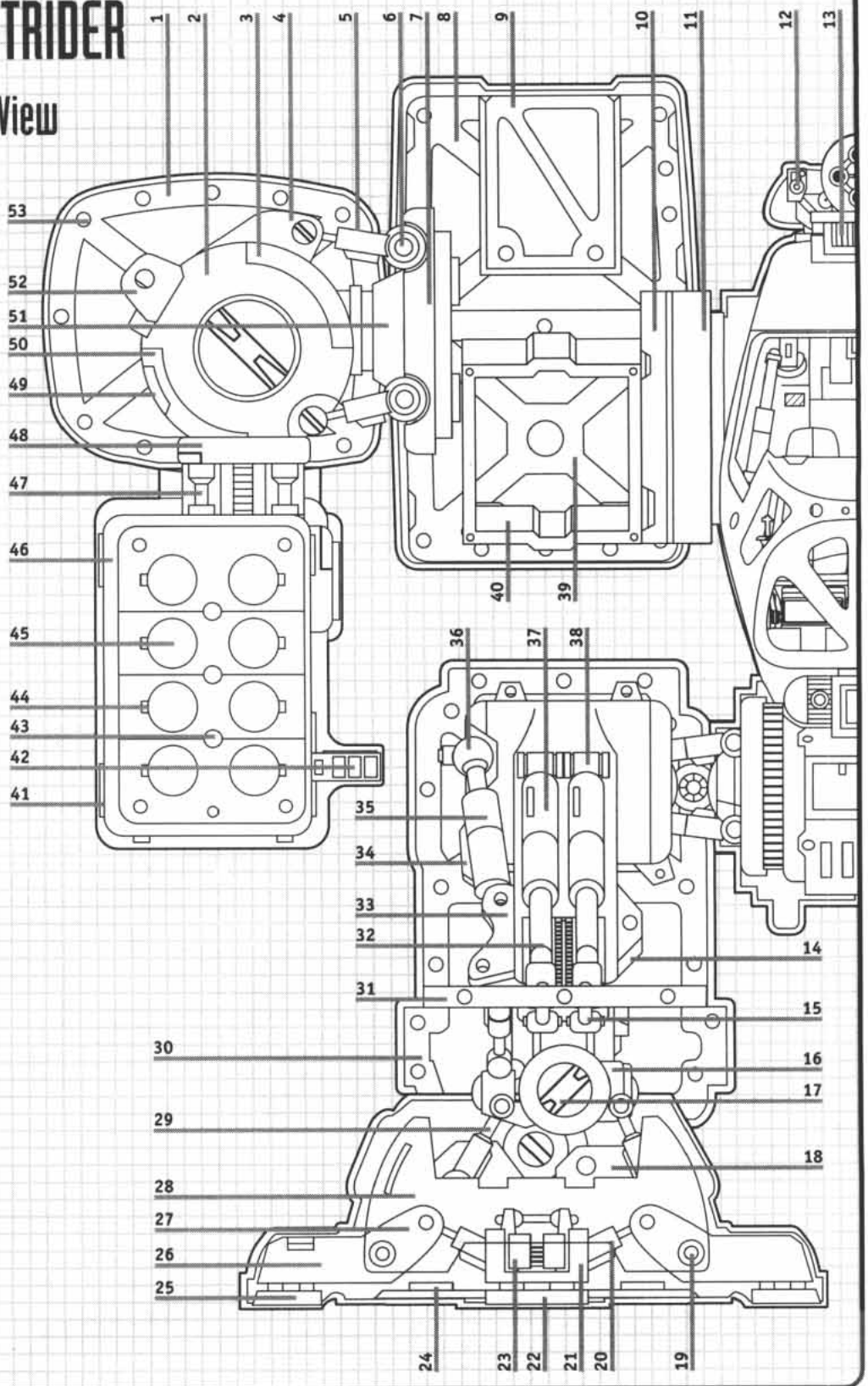
Side View

1 ..... Safety cover
2 ..... Macro trigger 1
3 ..... Fire trigger 2
4 ..... Fire trigger 1
5 ..... Macro Trigger 3
6 ..... Option button
7 ..... Elevation axle
8 ..... Lateral axle
9 ..... Sliding mount
10 ..... Main support
11 ..... Option button
12 ..... Option button
13 ..... Weapon selector
14 ..... Mode selector
15 ..... Outer casing
16 ..... Bolt

Bryce Hubbard (order #959915)

MAMMOTH STRIDER

Cut-Away Front View



Cut-Away Front View

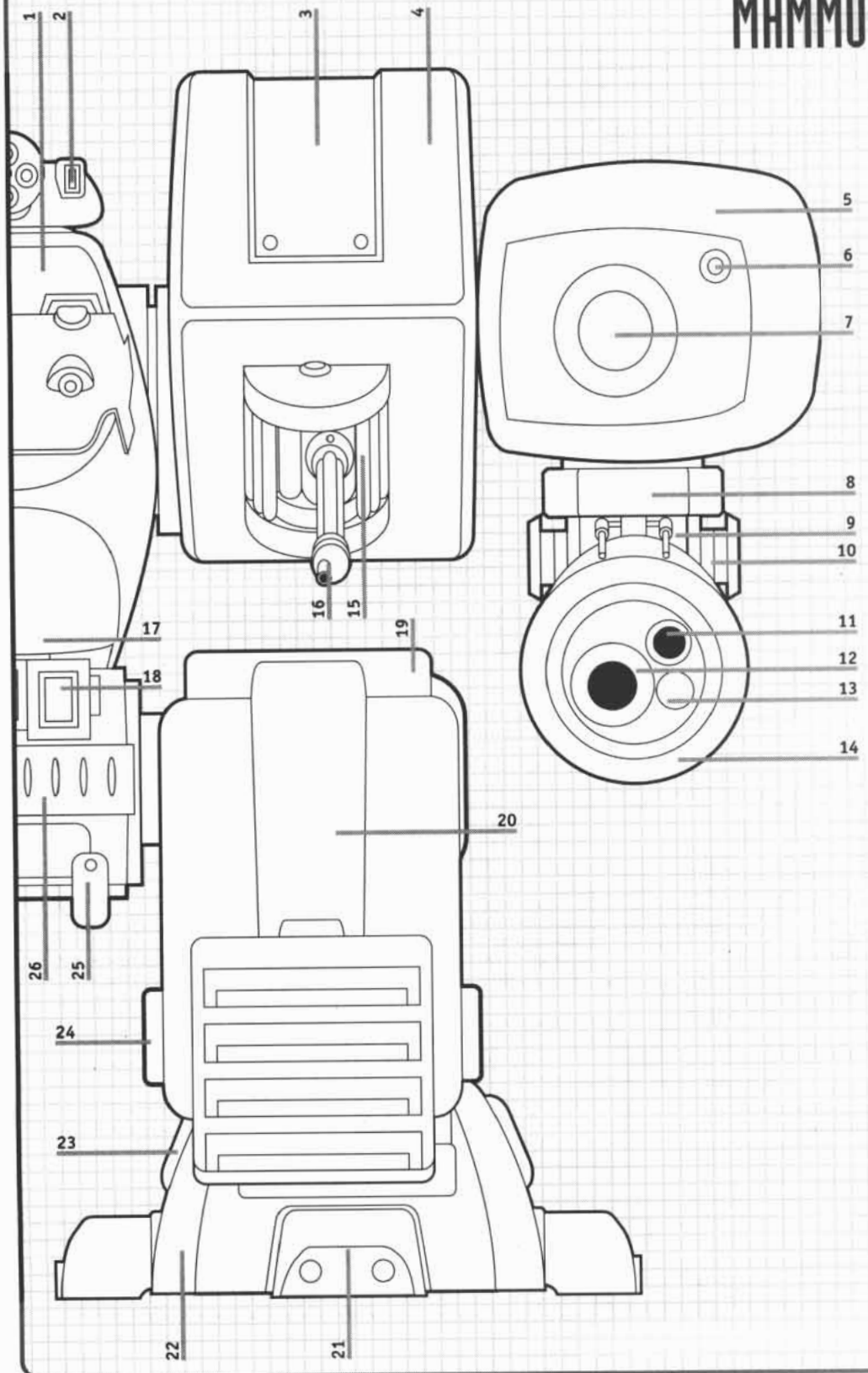
1- ..... Reinforcement rib
2- ..... Main shoulder casing
3- ..... Access panel
4- ..... Actuator mounting point
5- ..... Shoulder elevation actuator
6- ..... Actuator mounting point
7- ..... Shoulder rotation actuator
8- ..... Right torso structure
9- ..... Right torso access panel
10- ..... Torso outer attachment plate
11- ..... Torso inner attachment plate
12- ..... Targeting sensors
13- ..... Radiator
14- ..... Upper leg armor attachment point
15- . Upper knee actuator attachment point
16- ..... Ankle block
17- ..... Ankle mechanism cover
18- ..... Inner foot support plate
19- ..... Claw articulation point
20- ..... Claw actuator
21- ..... Claw structure
22- ..... Rest pad
23- ..... Claw articulation
24- ..... Footplate
25- ..... Shock absorber
26- ..... Shock absorber housing
27- ..... Claw moment arm
28- ..... Outer foot structure (partial view)
29- ..... Ankle actuator
30- ..... Leg armor structural member
31- ..... Armor upper strut
32- ..... Upper knee actuator pushrod
33- ..... Lateral actuator mounting point
34- ..... Pressure regulator
35- ..... Lateral actuator
36- ..... Lateral actuator mounting bracket
37- ..... Upper knee actuator
38- .... Upper knee actuator mounting point
39- ..... Rear torso support struts
40- ..... Machinegun mounting plate
41- ..... Outer armor rest plate
42- . Laser designator and targeting sensors
43- ..... Lightening hole
44- ..... Rail guide bracket
45- ..... Missile port
46- ..... Main launcher structure
47- ..... Elbow actuator
48- ..... Lower arm rotation assembly
49- ..... Access port
50- ..... Access panel
51- ..... Shoulder rotation assembly
52- ..... Armor mounting point
53- ..... Lightening hole

Note: engines, missile launcher unit and wiring omitted for clarity.

Bryce Hubbard (order #959915)

MAMMOTH STRIDER

Front View

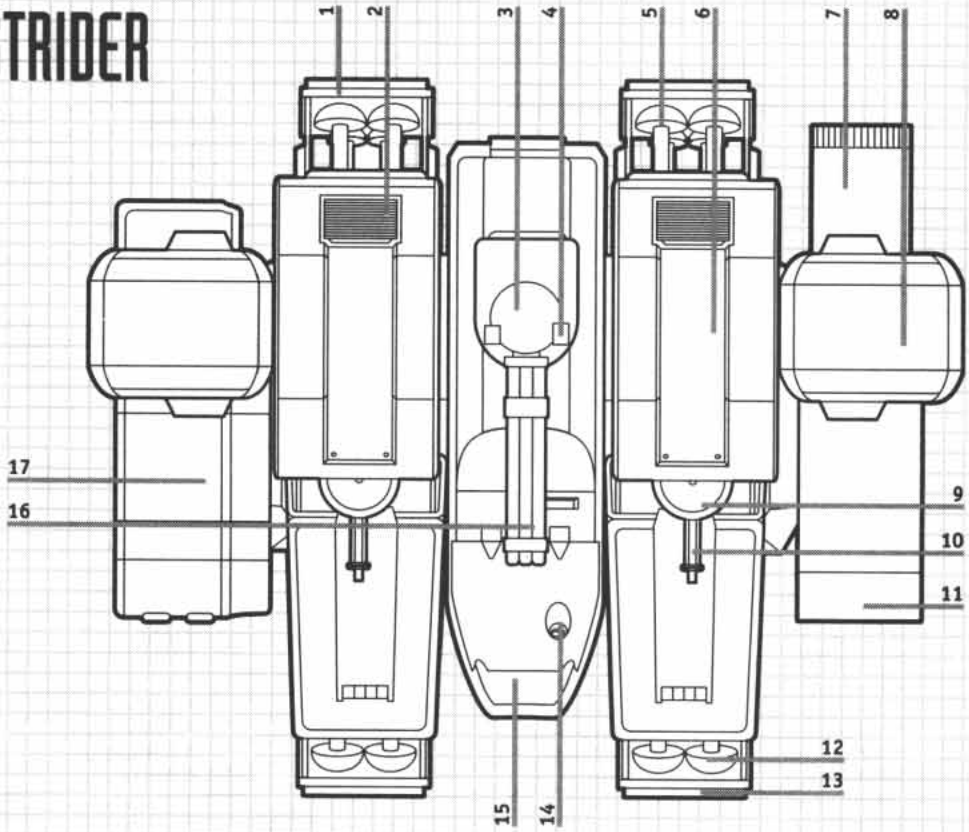


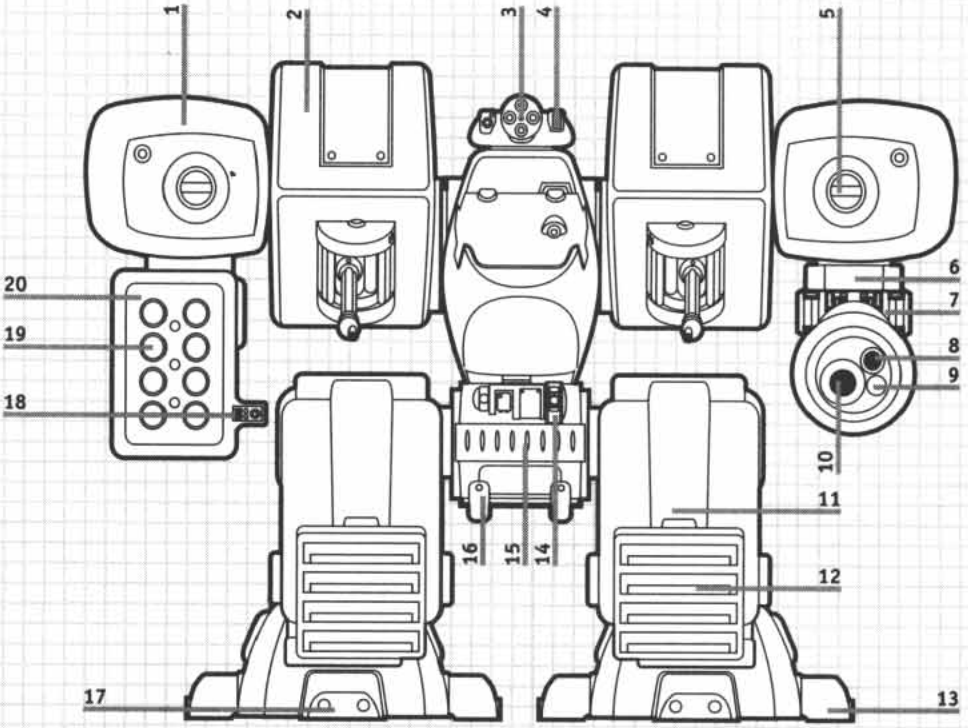
Front View

1- ..... Upper torso armor plate
2- ..... Targeting sensor
3- ..... Left torso access hatch
4- ..... Laminated armor plating
5- ..... Shoulder block
6- ..... Armor mounting pin
7- ..... Armor mounting point
8- ..... Rotation assembly armor belt
9- ..... Elbow actuator
10- ..... Elbow cover
11- ..... Optical sensor
12- ..... 90 mm snub cannon
13- ..... Short range scanner
14- ..... Left arm outer armor casing
15- ..... Steel shutters
16- ..... 10 mm machinegun
17- ..... Main torso armor belt
18- ..... AFLIC
19- ..... Leg armor
20- ..... Upper leg armored cover
21- ..... Articulated claw
22- ..... Foot casing
23- ..... Ankle cover
24- ..... Knee cover
25- ..... Reinforcement rib
26- ..... Radiator

Bryce Hubbard (order #959915)

MAMMOTH STRIDER





Top View

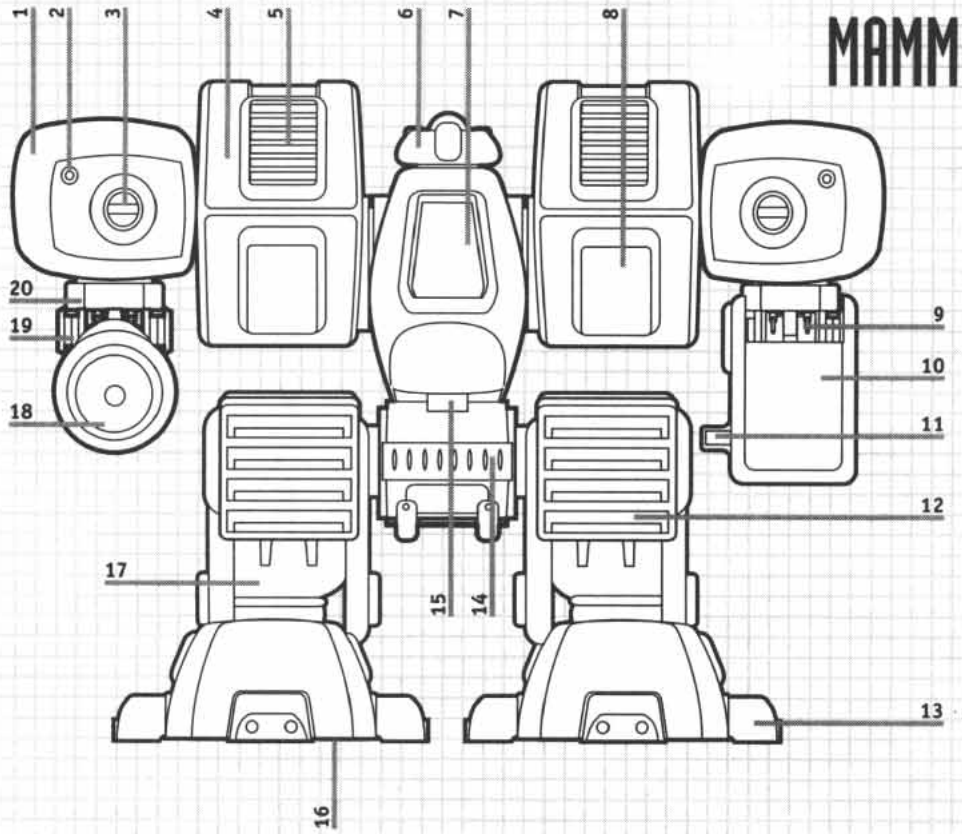
1 ..... Rear ground support plate
2 ..... Starboard torso radiator
3 ..... Autocannon turret
4 ..... Targeting sensors
5 ..... Support plate actuators
6 ..... Port torso access hatch
7 ..... Ammunition drum
8 ..... Shoulder block
9 ..... Machinegun swivel mount
10 ..... 10 mm machinegun
11 ..... Snub cannon housing
12 ..... Support plate actuators
13 ..... Front support plate
14 ..... Periscope
15 ..... Main torso armor belt
16 ..... 30 mm autocannon
17 ..... Missile launcher housing

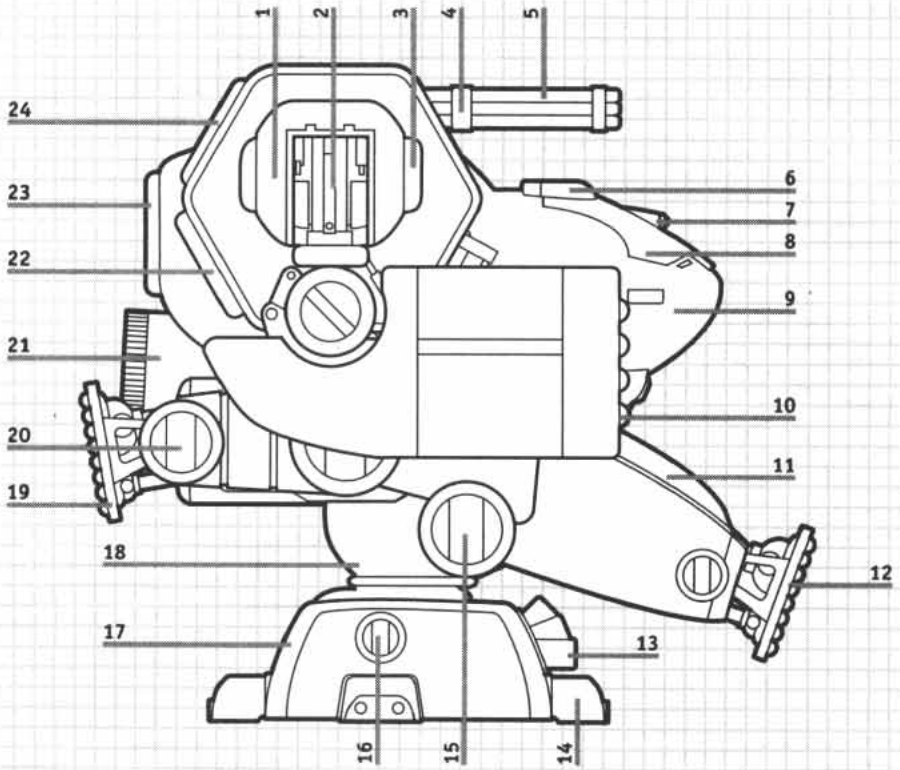
Front View

1 ..... Shoulder block
2 ..... Right torso armor casing
3 ..... Barrel support plate
4 ..... Targeting sensors
5 ..... Shoulder armor mounting point
6 ..... Rotation assembly armor belt
7 ..... Elbow cover
8 ..... Optical sensor
9 ..... Short range scanner
10 ..... Snub cannon
11 ..... Upper leg casing
12 ..... Front ground support plate
13 ..... Articulated claw
14 ..... AFLIC sensor turret
15 ..... Radiator
16 ..... Reinforcement rib
17 ..... Articulated claw
18 ... Laser designator and targeting sensors
19 ..... Anti-armor guided missile
20 ..... Missile launcher housing

Bryce Hubbard (order #959915)

MAMMOTH STRIDER





Back View

1 ..... Shoulder block
2 ..... Armor mounting pin
3 ..... Armor lock-down
4 ..... Laminated torso armor
5 ..... Port torso radiator
6 ..... Autocannon turret
7 ..... Main torso access hatch
8 ..... Starboard rear access hatch
9 ..... Elbow mechanisms
10 ..... Missile launcher housing
11 ..... Targeting sensor housing
12 ..... Rear ground support plate
13 ..... Articulated claw
14 ..... Radiator
15 ..... Rear sensor mount
16 ..... Foot plate
17 ..... Ballistic cloth cover
18 ..... Ammunition drum
19 ..... Snub cannon
20 ..... Arm rotation armor belt

Side View

1 ..... Shoulder block
2 ..... Shoulder actuators
3 ..... Armor mounting point
4 ..... Barrel support ring
5 ..... 30 mm autocannon
6 ..... Cockpit hatch hinges
7 ..... Periscope
8 ..... Main cockpit hatch
9 ..... Main torso armor belt
10 ..... Anti-tank guided missile
11 ..... Upper leg casing
12 ..... Front ground support plate
13 ..... Segmented foot armor
14 ..... Articulated claw
15 ..... Knee articulation cover
16 ..... Foot armor mounting point
17 ..... Armored foot casing
18 ..... Ballistic cloth cover
19 ..... Rear ground support plate
20 ..... Rear support articulation
21 ..... Ammunition drum
22 ..... Starboard rear access hatch
23 ..... Main torso access hatch
24 ..... Starboard torso radiator

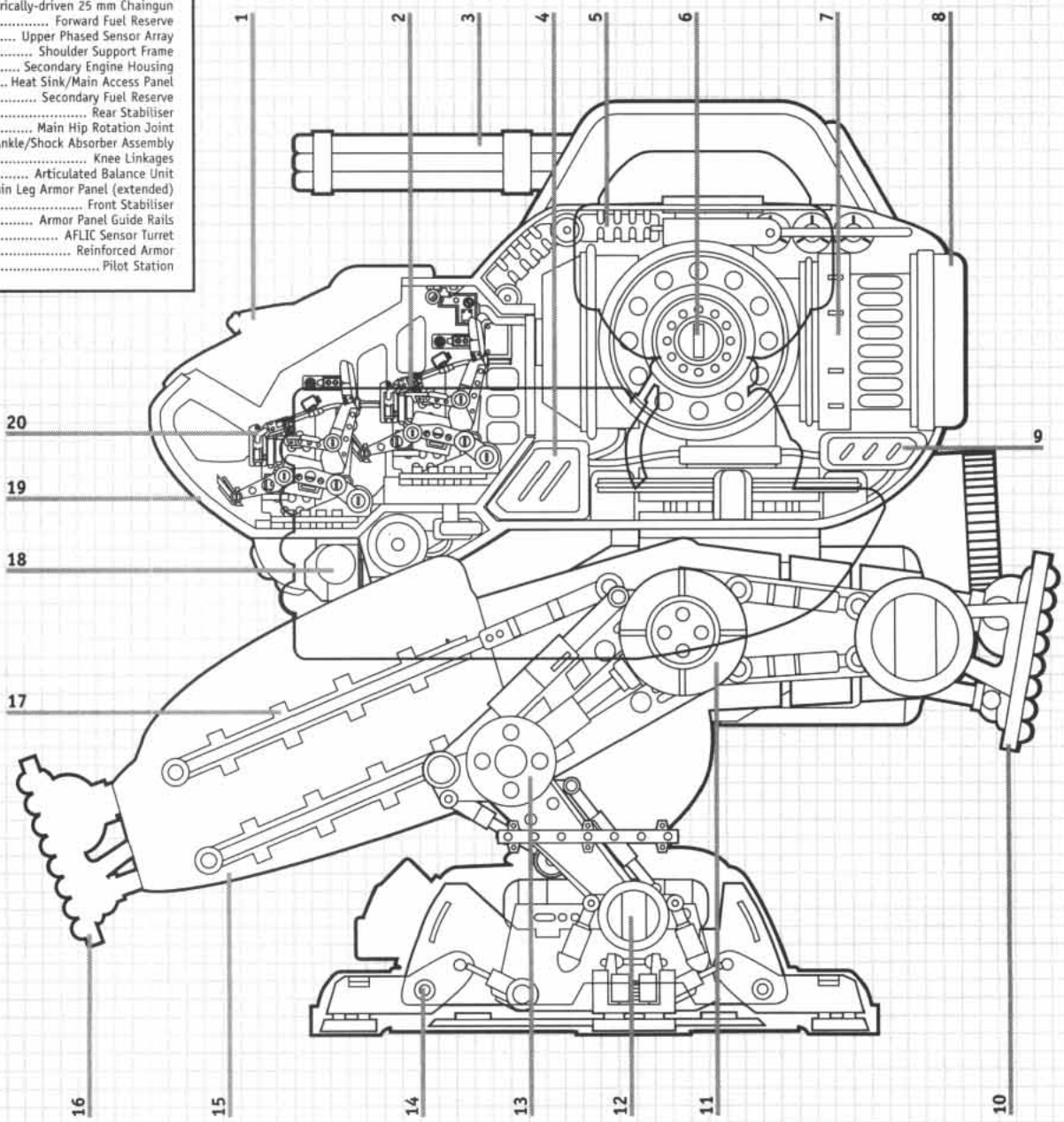
Bryce Hubbard (order #959915)

MAMMOTH STRIDER

Cutaway Side View

CUTAWAY SIDE VIEW

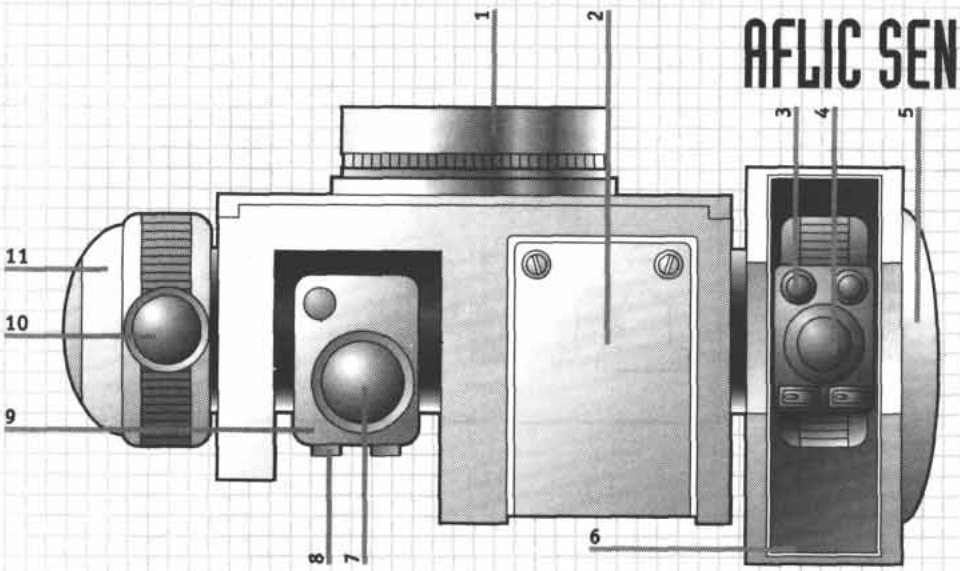
1 ..... Main Cockpit Hatch
2 ..... Weapon Operator Station
3 ..... Electrically-driven 25 mm Chaingun
4 ..... Forward Fuel Reserve
5 ..... Upper Phased Sensor Array
6 ..... Shoulder Support Frame
7 ..... Secondary Engine Housing
8 ..... Heat Sink/Main Access Panel
9 ..... Secondary Fuel Reserve
10 ..... Rear Stabiliser
11 ..... Main Hip Rotation Joint
12 ... Lower Ankle/Shock Absorber Assembly
13 ..... Knee Linkages
14 ..... Articulated Balance Unit
15 ..... Main Leg Armor Panel (extended)
16 ..... Front Stabiliser
17 ..... Armor Panel Guide Rails
18 ..... AFLIC Sensor Turret
19 ..... Reinforced Armor
20 ..... Pilot Station

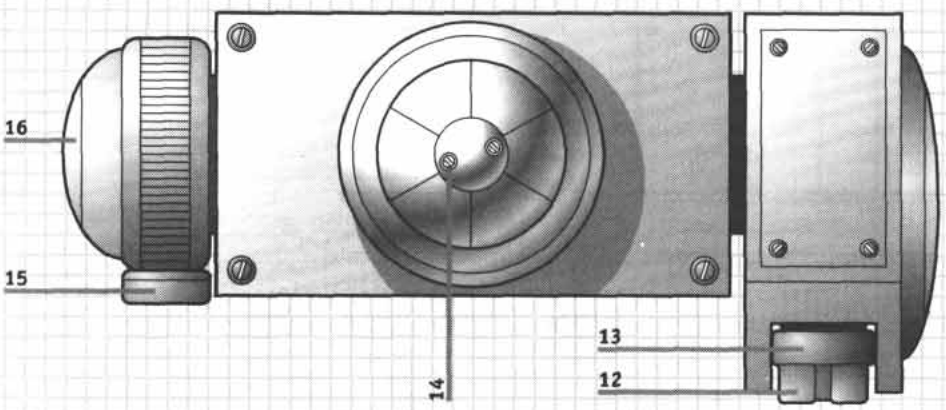


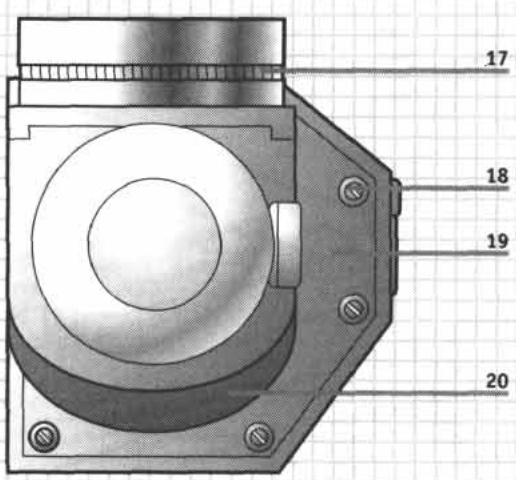
Bryce Hubbard (order #959915)

AFLIC SENSOR TURRET

THREE-VIEW







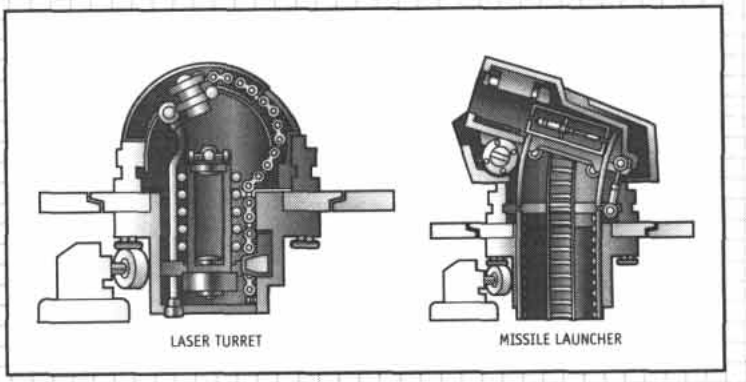
THREE-VIEW

1 ..... Mounting point
2 ..... Instrument access panel
3 ..... Laser rangefinder
4 ..... Low-light camera
5 ..... Armored casing
6 ..... Camera housing
7 ..... Omnicamera
8 ..... Structural reinforcement
9 ..... Omnicamera housing
10 ..... Thermographic camera
11 ..... Sensor turret
12 ..... laser emitter
13 ..... Sensor mounting plate
14 ..... Data lines
15 ..... Lens assembly
16 ..... Mechanism access panel
17 ..... Rotation track
18 ..... Assembly bolt
19 ..... Camera housing
20 ..... Central instrument housing

Bryce Hubbard (order #959915)

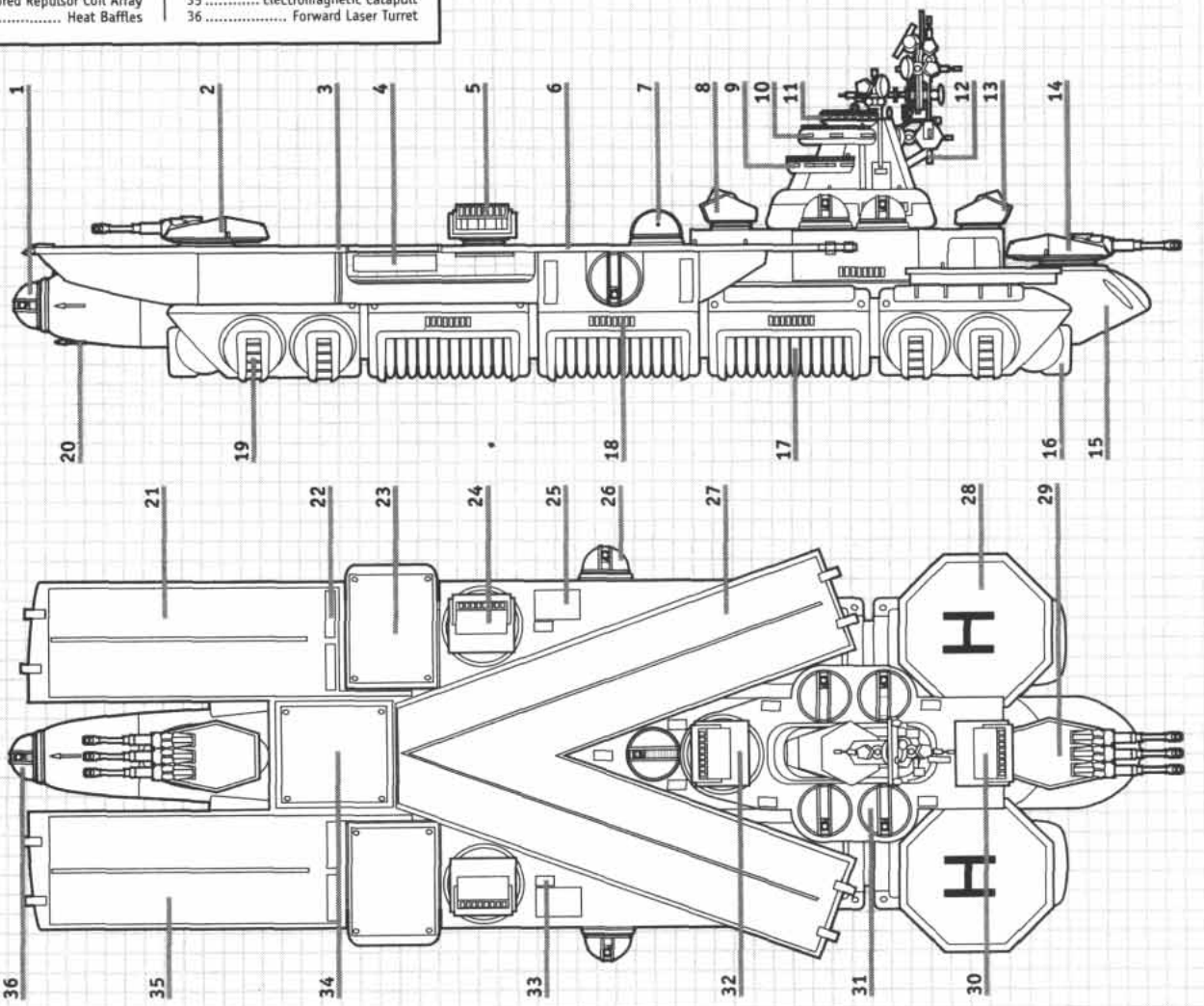
LANDSHIP

Vortex-Class Land Carrier



Landship

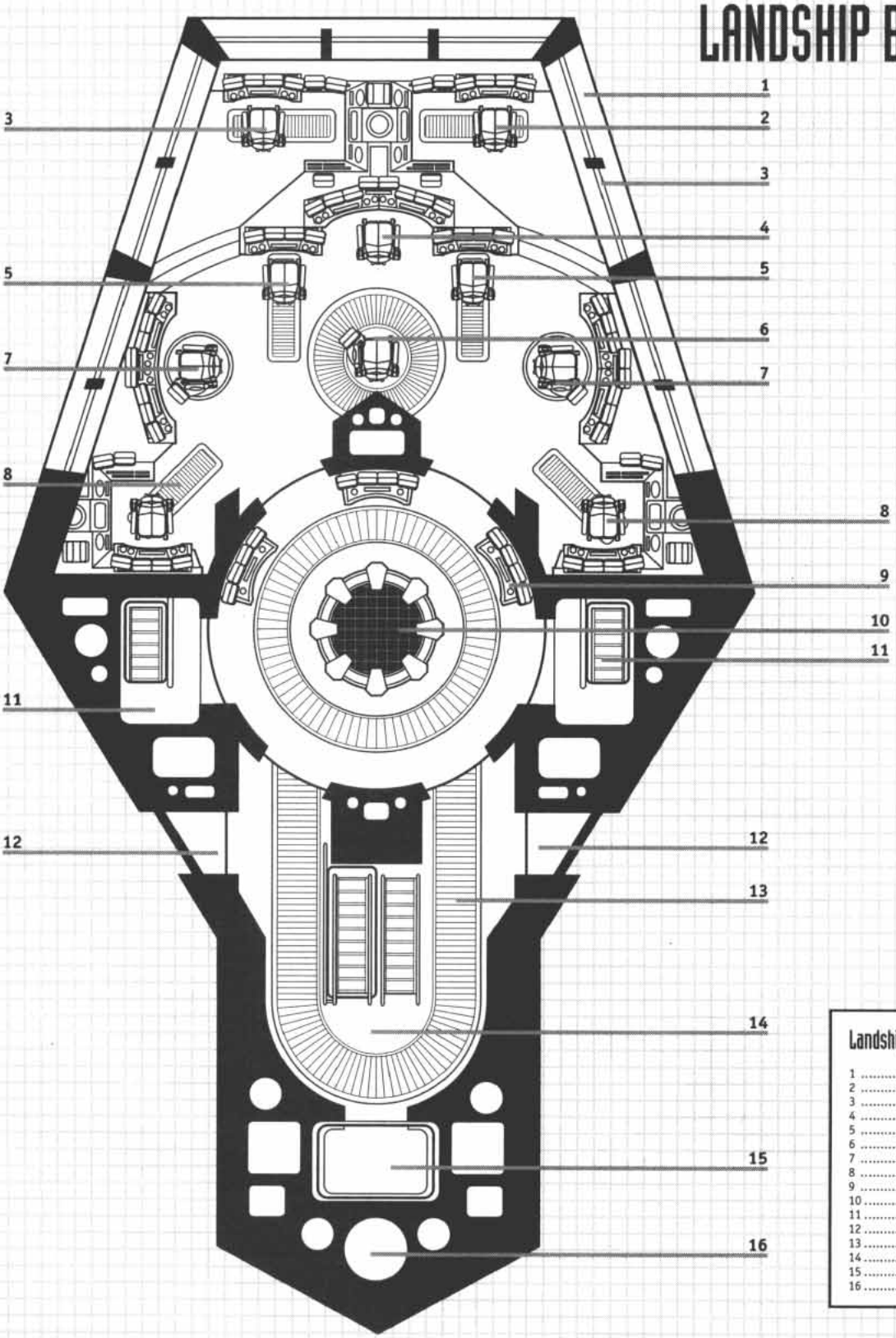
1 ..... Forward Laser Turret
2 ..... Gun Turret #1
3 ..... Runway
4 ..... Elevator Access
5 ..... Lateral Missile Launcher
6 ..... Flight Deck
7 ..... Air-Defense Laser Turrets
8 ..... Forward Missile Launcher
9 ..... Deck Management
10 ..... Bridge
11 ..... Observation Deck
12 ..... Main Antenna Array
13 ..... Rear Missile Launcher
14 ..... Gun Turret #2
15 ..... Main Access Ramp (retracted)
16 ..... Port Thrust Nozzle
17 ..... Armored Repulsor Coil Array
18 ..... Heat Baffles
19 ..... Lateral Thrust Nozzle
20 ..... Forward Sensor Booms
21 ..... Starboard Runway
22 ..... Blast Deflector (retracted)
23 ..... Starboard Deck Elevator
24 ..... Lateral Missile Launcher
25 ..... Hull AMS Housing (retracted)
26 ..... Lateral Laser Turret
27 ..... Starboard Landing Strip
28 ..... VTOL Landing Platform
29 ..... Gun Turret #2
30 ..... Rear Missile Launcher
31 ..... Bridge Laser Turret
32 ..... Forward Missile Launcher
33 Upper Deck Access Port (retracted)
34 ..... Central Elevator
35 ..... Electromagnetic Catapult
36 ..... Forward Laser Turret



Bryce Hubbard (order #959915)

LANDSHIP BRIDGE

TOP VIEW



Landship Bridge

1 ..... Armored viewpanes
2 ..... Sensors and electronic warfare
3 ..... Armored shutters (retracted)
4 ..... Engineering
5 ..... Navigation
6 ..... Command chair
7 ..... Tactical/gunnery
8 ..... System Ops/communication
9 ..... Engineering/tactical display
10 ..... Holographic tactical display
11 ..... Lower deck access stairs
12 ..... External access door
13 ..... Bridge level access corridor
14 ..... Tower access stairs
15 ..... Elevator from lower decks
16 ..... Electronic and power conduits

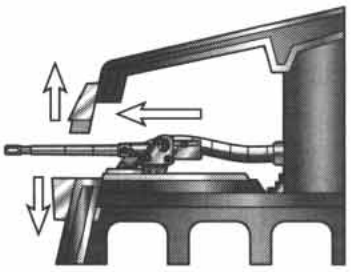
Bryce Hubbard (order #959915)

LANDSHIP

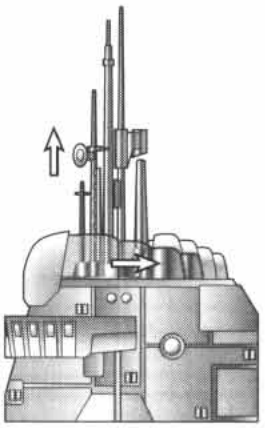
Khan-Class Land Carrier

Landship

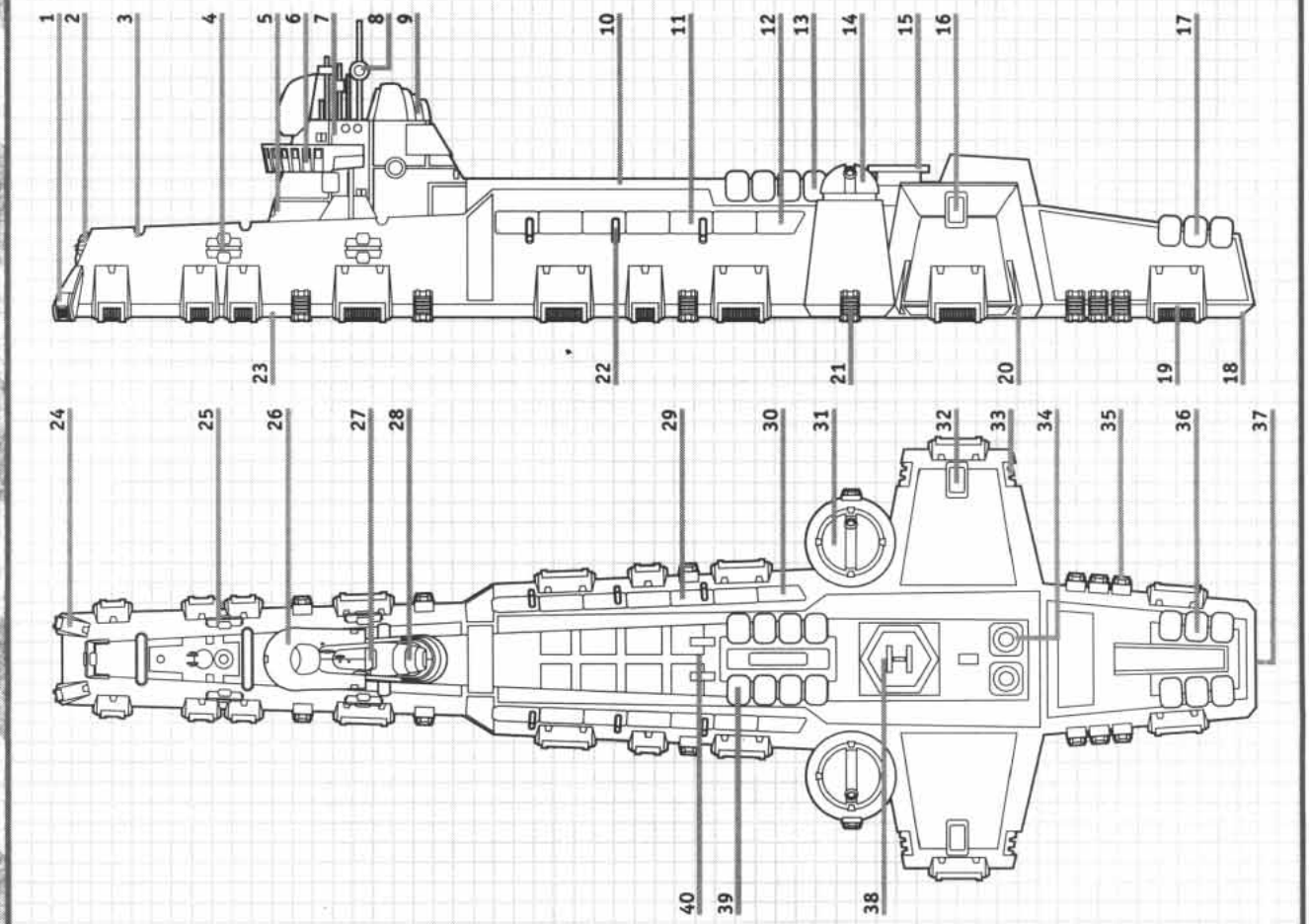
1 ..... Forward Thrust Port
2 ..... Gun Port (closed)
3 Ammunition Loading Door (closed)
4 ..... Lateral Gun Port (closed)
5 ..... Armored Conning Tower
6 ..... Bridge Housing
7 .. Observatoire (w/shutters closed)
8 .... Main Antenna Array (extended)
9 Antenna Compartment Armor (open)
10 .. Dorsal Sensor Array (not visible)
11 ..... Port Runway (retracted)
12 ..... Port Runway Access Door
13 ..... Long Range Missile Silo Doors
14 ..... Port Laser Turret
15 ..... Helipad Elevator
16 ..... Port Rear Hull Sensor Blister
17 ..... Rear Missile Silo Doors
18 ..... Rear Access Ramp (retracted)
19 ..... Thrust Port (typical)
20 ..... Lateral Bay Door
21 ..... Landing Pad (retracted)
22 .... Runway System Hinge Housing
23 ..... Armored Repulsor Coil Array
24 ..... Thrust Port (typical)
25 ..... Gun Port (closed)
26 ..... Bridge Housing
27 ... Main Antenna Array (retracted)
28 ..... Antenna Compartment Armor
29 ..... Starboard Runway (retracted)
30 .... Starboard Runway Access Door
31 ..... Starboard Laser Turret
32 ..... Rear Hull Sensor Blister
33 ..... Lateral Bay Door
34 ..... Heat/Air Vent
35 ..... Landing Pad (retracted)
36 .... Rear Missile Silo Door (closed)
37 ..... Rear Access Ramp (retracted)
38 ..... Helipad Elevator
39 .. Dorsal Missile Silo Door (closed)
40 ..... Hull AMS Housing (retracted)



GUN PORT



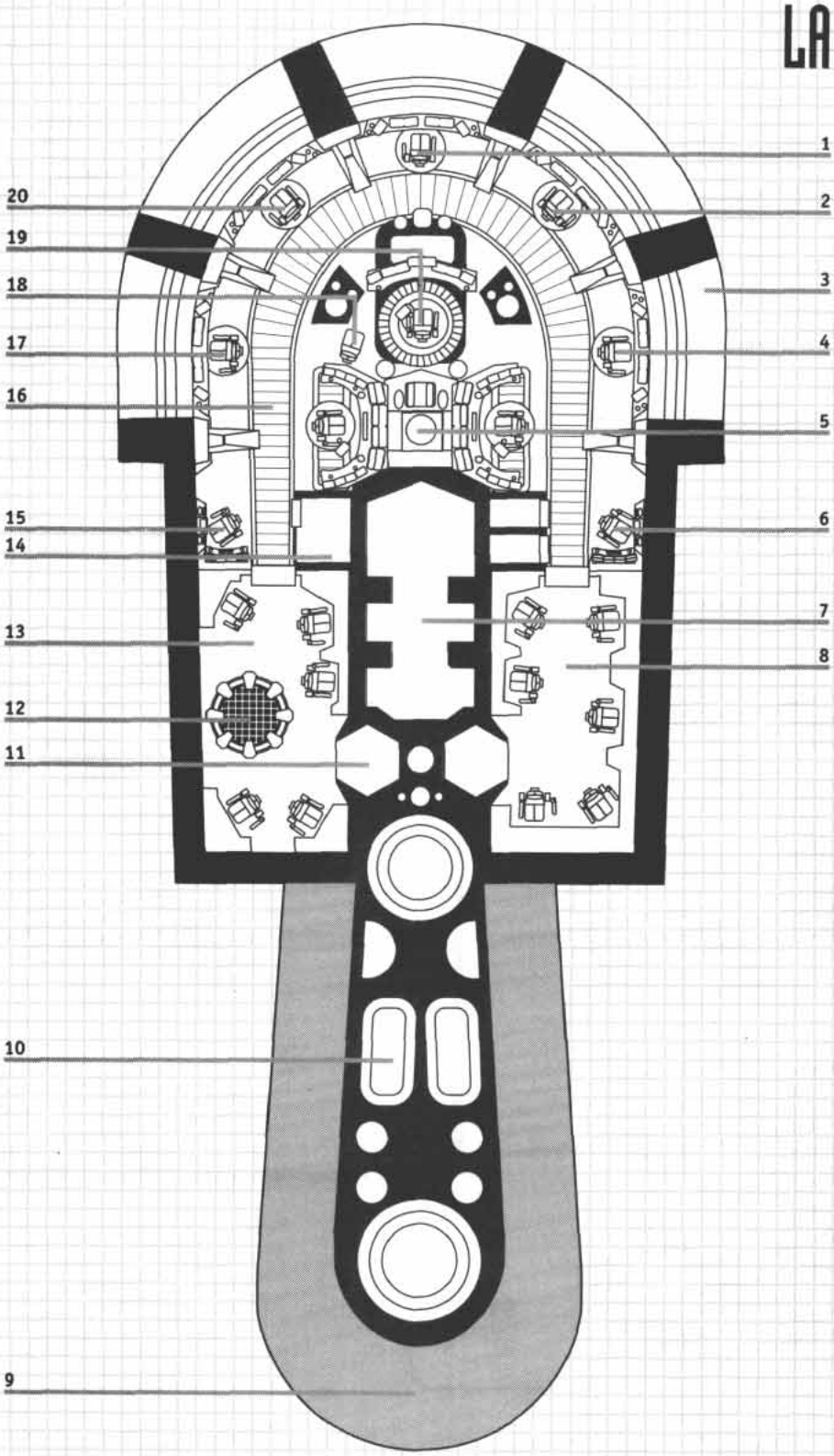
ANTENNA MASTS



Bryce Hubbard (order #959915)

LANDSHIP BRIDGE

TOP VIEW



Landship Bridge

1 ..... Navigation Station
2 ..... Tactical/Gunnery Station
3 ..... Armored Windows (w/shutters open)
4 ..... Sensors Station
5 ..... Engineering Station
6 ..... Electronic Warfare Station
7 ..... Electronic Bay
8 ..... Flight Control and System Monitoring
9 ..... Ship Systems
10 ..... Antenna Array Housing
11 ..... Main Elevator Shaft
12 ..... Holographic Tactical Table
13 ..... Tactical Room
14 ..... Washroom
15 ..... Ground Control
16 ..... Bridge Access Corridor
17 ..... System Ops/Communication Station
18 ..... Political Officer's Seat
19 ..... Command Chair
20 ..... Tactical Display

Bryce Hubbard (order #959915)

HISTORICAL EVENTS

TN 0000
Mankind explores Terra Nova, bringing Hard Hat walking work units to its new home away from home.

TN 1455
Human Concordat withdraws from Terra Nova, plunging the colony into chaos.

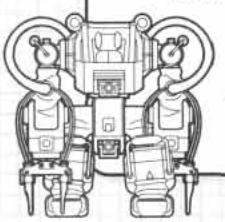
TN 1669
Battle of Pionner: Improvides UMF military walkers repel combine Norlight-Western force.

TN 1670
Anthropomorphic Battle Vehicle Center (ABVC) opens in Siwa Oasis by order of the Republican Ministry of War.

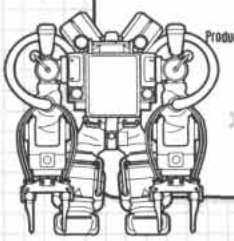
TN 1674
Bipedal-One-Man Tank (BOT) Project: JMDC calls for dedicated military Gears.

NORTHERN FAMILY

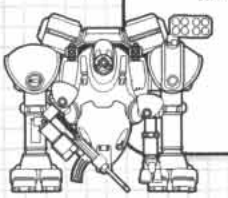
Hard Hat
HU-0124L
Produced by Heerman Utility



TN 1450
Groundhog
EL345
Produced by Elementech

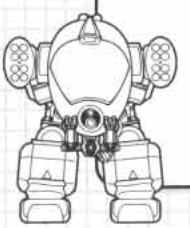


TN 1675
Racoon
XBOT-1-P1
BOT Project Prototype by Northco



SOUTHERN FAMILY

TN 1671
Chevalier
AEV-1
ABVC Prototype



Bryce Hubbard (order #959915)

TN 1678

The Southern War begins. GP-01 ***Hunter*** begins production, based on the XBOT-2-P1C prototype. Western commanos steal the Western ***Hunter*** prototype.

TN 1679

Southern commandos steal the Western ***Hunter*** prototype. ABVC begins full retro-engineering of the Hunter.

TN 1680

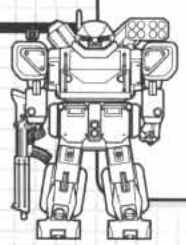
AV-1 ***Jäger*** begins production in the Winter.

TN 1680

Southern War ensds and the Allied Southern Territories are formed.

TN 1802

Badlands-based Paxton Arms starts production of its own Gear model:



Warrior

PA-01

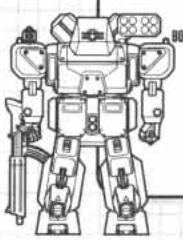
Produced by Paxton Arms

TN 1676

Hunter Mk 1

XBOT-1-P1B

BOT Project Prototype by Northco

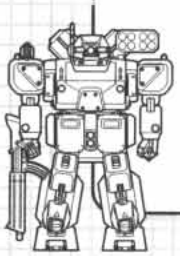


TN 1852

Hunter Mk 2

HACS-01MG-MP

Produced by Northco

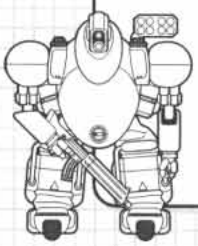


TN 1677

Snake

AEV-2/T-2

ABVC Prototype

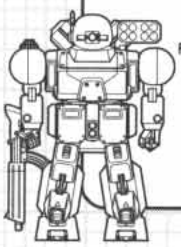


TN 1679

Jäger

AV-1

Produced by Territorial Arms

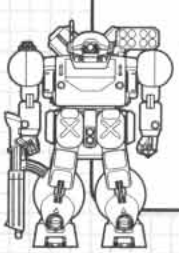


TN 1846

Jäger Alpha

OACS-01M/SU

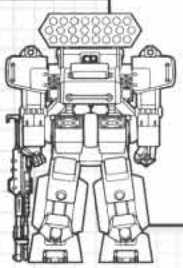
Produced by Territorial Arms



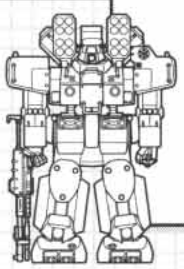
Bryce Hubbard (order #959915)

HEAVY GEARS

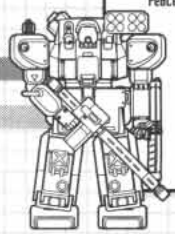
Mad Dog
HACS-15MG-MP
Mad Dog A HACS-15MG-MP/A



Bear
HACS-01HG-FS
Mauler Bear HACS-01HG-AP

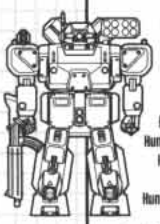


Razorback
HACS-04HG-AST
Peacemaker Razorback HACS-04HG-FS



MEDIUM GEARS

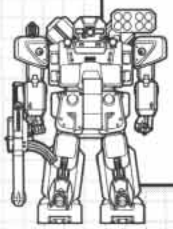
HUNTER
HACS-01MG-MP
Armored Hunter HACS-01MG-FU
Assault Hunter HACS-01MG-AST
Assault Hunter AC HACS-01MG-AC
Bearhunter HACS-01MG-FU/A
Bricklayer HACS-01MG-ENG
Demolisher HACS-01MG-DEM
Headhunter HACS-01MG-C
Hunter Commando HACS-01MG-HC
Hunter Comm. EW HACS-01MG-HG/EW
Hunter Minelayer HACS-01MG-MLY
Hunter NBC HACS-01MG-NBC
Hunter Paratrooper HACS-01MG-PARA
Hunter Recon HACS-01MG-SHT
Hunter Para-Mortar HACS-01MG-PARA/FS
Desert Tankhunter HACS-01MG-DT/TH
Hunter Recon AG HACS-01MG-L/TH
Hunter Zerstörer MK2HACS-01MG-TH
Hunter Zerstörer MK2A HACS-01MG-TH/A
Spearhead HACS-01MG-C/A
Hunter UC HACS-01MG-UC
Bricklayer Bulldozer HACS-01MG-ENG/A



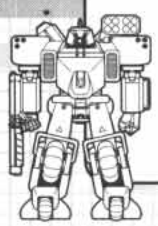
Wildcat
HACS-12LG-SCT
No Variants Produced



Tiger
HACS-08MG-MP
Sabertooth HACS-08MG-C



Bobcat
HACS-03LG-SCT
Bird Arrow HACS-03LG-AA

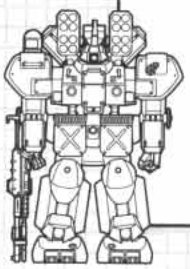


LIGHT GEARS

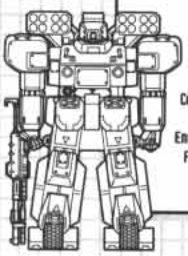
Ferret
HACS-02LG-SCT
Saboteur Ferret HACS-02LG-DEM
Ferret MK. II HACS-02LG-SCT/A
Wild Ferret HACS-02LG-EW
Rabid Ferret HACS-02LG-AST
Mauler Ferret HACS-02LG-DL



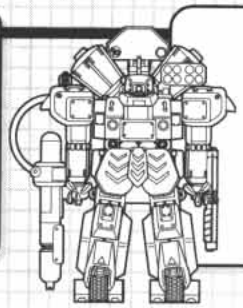
Bryce Hubbard (order #959915)



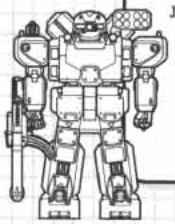
Den Mother
HACS-01HG-ART
Den Mother II HACS-01HG-ART/A



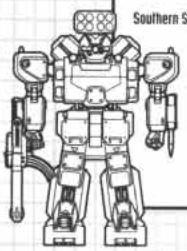
Grizzly
HACS-02HG-MPS
Assault Grizzly HACS-02HG-AST
Defender Grizzly HACS-02HG-AA
Rabid Grizzly HACS-02HG-FS
Thunder Grizzly HACS-02HG-ART
Crossbow Grizzly HACS-02HG-ARST
Grizzly Destroyer HACS-02HG-TH
Engineering Grizzly HACS-02HG-ENG
F. Support Grizzly HACS-02HG-SUP
Polar Grizzly HACS-02HG-ALP



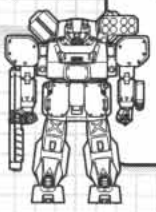
Kodiak
HACS-10HG-AST
Kodiak Destroyer HACS-10HG-TH



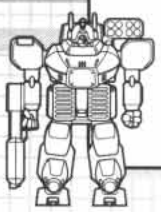
Jaguar
HACS-02MG-MPS
Panther HACS-02MG-STL
Jaguar Pathfinder HACS-02MG-SCT
Predator Jaguar HACS-02MG-JG
Strike Jaguar HACS-02MG-AST
Arrow Jaguar HACS-02MG-AFS
Fire Jaguar HACS-02MG-FS
Flak Jaguar HACS-02MG-AA
Flash Jaguar HACS-02MG-SNP
Jaguar MP HACS-02MG-SEC
Jaguarundi HACS-02MG-ANN
Magma Jaguar HACS-02MG-FL
Firefighter Jaguar HACS-02MG-FF
Mountain Jaguar HACS-02MG-ALP



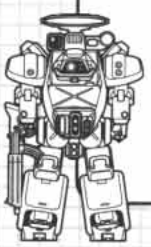
Nemesis Jaguar
HACS-12MG-DL
Southern Special Nemesis HACS-12MG-DL/B



Cheetah
HACS-01LG-SCT
White Cat HACS-01LG-EW
Lightning Cheetah HACS-01LG-HW
White Cat EWH HACS-01LG-EWH
Silver Cat HACS-01LG-EW/A
Cheetah Air Claw HACS-01LG-AA
Cheetah Fang HACS-01LG-TH
Cheetah MP HACS-01LG-SEC
Cheetah Para. HACS-01LG-PARA
Cheetah Polizei HACS-01LG-CP
Stalking Cheetah HACS-01LG-SNP
Cheetah RFL HACS-01LG-SNP/A
Strike Cheetah HACS-01LG-AST
Str. Cheetah SC HACS-01LG-AST/C



Black Cat
HACS-01LG-STH
Black Claw HACS-01LG-STH/SNP

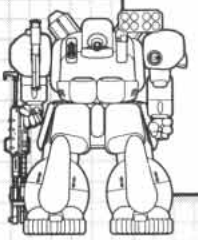


Weasel
HACS-05LG-EW
Tattletale HACS-05LG-C

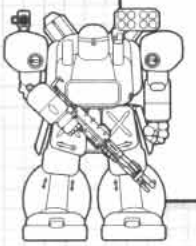
Bryce Hubbard (order #959915)

HEAVY GEARS

ANACONDA
OACS-16H/FS
No Variants Produced

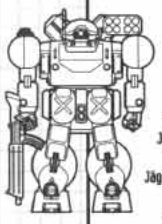


BOA
OACS-15H/FS
No Variants Produced

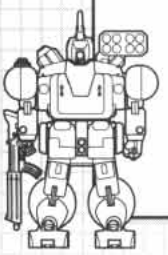


MEDIUM GEARS

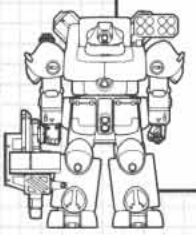
JÄGER
OACS-01M/SU
Armored Jäger OACS-01M/HA
Blitz Jäger OACS-01M/AS
Darkjäger OACS-01M/ARV
Desert Jäger OACS-01M/DST
Flammjäger OACS-01M/FLM
Jäger Blacksmith OACS-01M/M
Jäger Command OACS-01M/OU
Jäger Commando OACS-01M/ARS
Jäger Force Recon OACS-01M/HSC
Jäger Grenadier OACS-01M/PTG
Jäger Command Hero OACS-01M/HOU
Jäger Observer OACS-01M/FO
Jäger Paratrooper OACS-01M/PT
Flammjäger Bunker Buster OACS-01M/FLM-A
Heavy Shooter Jäger OACS-01M/HARV
Jäger Recon OACS-01M/SC
Jäger Red Eye OACS-01M/AA
Long Bow Blitz OACS-01M/ARS
Long Bow Jäger OACS-01M/TE
Long Bow Para OACS-01M/TEPT
Spark Jäger OACS-01M/EWP
Stone Mason OACS-01M/ENG
Stone Mason Logger OACS-01M/LOG
Stone Mason Rescue OACS-01M/MED
Swamp Jäger OACS-01M/SW



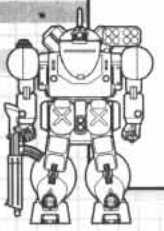
COPPERHEAD
OACS-07M/SU
No Variants Produced



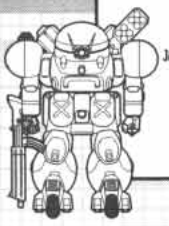
DESERT VIPER
OACS-02M/SU
Pit Viper OACS-02M/AS



RATTLESNAKE
OACS-06M/SU
Swamp Snake OACS-06M/SW



BASILISK
OACS-03M/SU
Elint Silverscale OACS-03M/COM
Jammer Silverscale OACS-03M/EW
Nash Basilisk OACS-03M/AA
Sapper Basilisk OACS-03M/FLM
Silverscale OACS-03M/SC

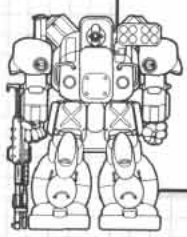


LIGHT GEARS

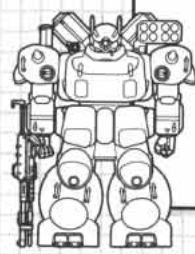
ANOLIS
OACS-03L/SC
Anolis Refit OACS-03L/SC-A



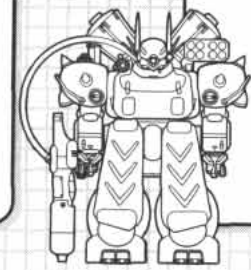
Bryce Hubbard (order #959915)



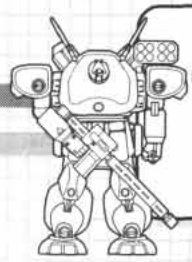
PYTHON
OACS-03H/FS
Badlands Python OACS-03H/FS-A



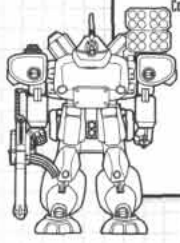
SPITTING COBRA
OACS-01H/SU
Air Support Cobra OACS-01H/AA
Artillery Cobra OACS-01H/FS
Cobra MP OACS-01H/MP
Engineering Cobra OACS-01H/ENG
Flammcobra OACS-01H/FLM
Razor Fang Cobra OACS-01H/OU
Slashing Cobra OACS-01H/ART-A
Striking Cobra OACS-01H/AS
Support Cobra OACS-01H/ART



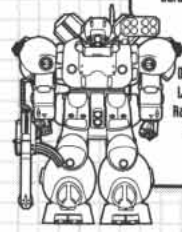
KING COBRA
OACS-12H/AS
Hooded Cobra OACS-12H/FS



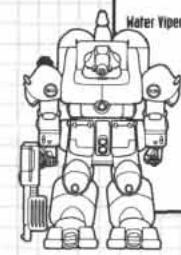
BLACK ADDER
OACS-04M/AR
Long Fang Black Adder OACS-04M/FS



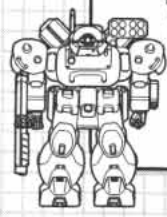
SIDEWINDER
OACS-04M/SU
Command Sidewinder OACS-04M/OU



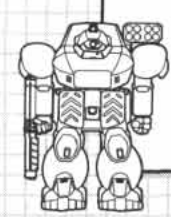
BLACK MAMBA
OACS-05M/SU
Barbed Fang Black Mamba OACS-05M/HFS
Black Mamba MP OACS-05M/MP
Blazing Mamba OACS-05M/LRS
Brawler Black Mamba OACS-05M/AS
Defender Black Mamba OACS-05M/DEF
Long Fang Black Mamba OACS-05M/FS
Razor Fang Black Mamba OACS-05M/OU
Snakeye Black Mamba OACS-05M/TE
Spitting Mamba OACS-05M/AP



WATER VIPER
OACS-02M/AQ
Water Viper Silent Running OACS-02M/AQ-STL



IGUANA
OACS-01L/SC
Urban Rescue Iguana OAVS-01L/SP
Racer Iguana OACS-01L/RAV
Rapier Iguana OACS-01L/DL
Sortie Iguana OACS-01L/LAP
Black Box Iguana OACS-01L/EW
Blitz Iguana OACS-01L/AS
Chatterbox OACS-01L/COM
Iguana Commando OACS-01L/HPT
Iguana MP OACS-01L/MP
Iguana Paratrooper OACS-01L/PT
Iguana Paratrooper Gunner OACS-01L/PTE
Lidded Iguana OACS-01L/FO
Loudmouth OACS-01L/COM-A



CHAMELEON
OACS-01L/STL
Hunting Chameleon OACS-01L/TE

Bryce Hubbard (order #959915)

INDEX

A
Accuracy (Weapon) 27
Accuracy 138
Actual Size 134
Aerial Warfare 33
AFLIC 14
Airborne Torpedoes 142
Airdroppable Perk 113
Alloys 7
Ammunition 29, 140-145
Ammunition Availability 145
Ammunition Cost 145
Ammunition Feed 144
Ammunition Reference Table 144
Ammunition Types 140-145
Annoyance Flaw 128
Anti-Aircraft Laser Platforms 31, 138
Anti-Laser Aerosol 140
Anti-Structure Ammunition 140
Area Effect Ammunition 140
Arm Perk 115, 122, 127
Armoplast 8
Armor 30, 49, 55, 59, 74, 149
B
Biological Ammunition 142
Boosted Damage Ammunition 142
Boosted Range Ammunition 142
Breakdowns 152
Bridge (Landship) 58
C
Cargo Bay 116
Central Processing Unit 34, 43
Ceramic Chip 10
Ceramics 7
Chemical Ammunition 143
Clip (Ammunition) 144
Cockpit 41, 52, 54, 59
Command, Control and Communications 32
Communications 12, 111
Composites 8
Control Apparatus 42
Crew 70
D
Damage 138
Default Score 134
Default Size 134
Defensive Score 132
Deployment Range 73, 153
Drone 13
Durasheet 8
E
Easy to Modify Perk 117
ECM/ECCM 117
Ejection Systems 117
Electric Motor 46
Electronic Defenses 31
Electronic Multiplier Table (Scratchbuilding) 151
Electronics 10
Emergency Medical Perk 117
Exposed Auxiliary Systems Flaw 128
Exposed Crew Compartment Flaw 128
Exposed Movement System Flaw 128
F
Fasteners 9
Final Cost 136
Fire Arc 132
Fire Control 110
Fire-Fighting Foam 140
Flexite 7
Fragile Chassis Flaw 139
Fragmentation Ammunition 140
Fuel (Carrying) 153
Fuel (Converting Ammo to) 153
Fuel 46, 153
G
Gas Turbine 46
Genetics 20
Geological Sensors 168
Gun Emplacements 31, 138
Gyroscope 45
H
Hardhat 39
Hardpoints 50
Haywire Ammunition 143
HEAT-Resistant Armor 119
Heavy Gear 38
Heavy Gear Development 39
Hostile Environment Protection Perk 119
Hovertanks 56-57
I
Illumination Ammunition 141
Improved Off-Road Ability 120
Improved Rear Defense Perk 120
Incendiary Ammunition 143
Information Display 42
J
Joints 49
Jump Jets 121
L
Ladar 15
Laser 28, 31
Landships 58-59
Large Sensor Profile Flaw 130
Lemon Rolls 135
Life Support Equipment 121
M
Maintenance (Vehicles) 152
Maintenance (Weapons) 152
Maneuverability 72
Manipulators 48, 122
Mass Destruction Ammunition 143
Materials 7
Medicine 19
Minefields 31
Minelayer Ammunition 143
Mining Equipment 123
Miscellaneous Score 133
Modifications (Armor) 149

Bryce Hubbard (order #959915)

Modifications (Movement) 149
Modifications (Perks and Flaws) 148
Modifications (Vehicle) 148
Modifications (Weapons) 149
Motion Sensors 15
Movement Modes 71, 153
N Naval Warfare 34
Neural Net Learning Table 17
Neural Network 11
Neural Network Evolution 11
No Sensor Flaw 130
Non-Lethal Ammunition 141
Nuclear Armament 29
O Offensive Score 132
Omnicamera 14
Optical Neural Network 11
Optical Sensors 14
P Paint Ammunition 141
Passenger Accomodations 123
Passenger Seating 123
Polymers 8
Poor Off-road Ability Flaw 130
Poor Workmanship (Weapon) 139
Powerplant 46, 53, 54, 59
Pre-production Cost 134
Pressure Fluid 48
Production Types 135
Prosthetics (Limbs) 22
Prosthetics (Maintenance) 23
Prosthetics (Power Source) 23
Prosthetics (Sensory Organs) 22
Prosthetics 21
Prosthetics Reference Table 23
R Radar 15
Radiation-based Sensors 15
Range 139
Rate Of Fire 139
Refueling 46
Remote Control 13, 17
Roleplaying Repair and Design 150
S Salvage Threshold Table (Scratchbuidling) 151
Satellite Uplink 125
Scratchbuilding Vehicles 150-151
Secondary Movement System 39, 49
Sensor Dependent Flaw 131
Sensor Eject Function 45
Sensor System 44
Sensor-Homing Ammunition 143
Sensors 14, 59, 110-111
Shock-Absorbers 49
Size (Default) 134
Size (Final) 134
Smart Glue 9
Smoke Ammunition 141
Sonar 15
Specialized Sensors 15
Stealth 27
Striders 51-53
Subroc Ammunition 143
T Target Designator 127
Technology Levels 5
Threat Value 132-133
Tracer Ammunition 141
Transmission 48, 55, 59
U Underwater Ammunition 143
V-Engine 46, 47
V Vehicle Bay 127
Vehicle Design 68-145
Vulnerable to Haywire Flaw 131
W Weak Facing/Point Flaw 131
Weapon Customization 139
Weapons (Gear) 50
Weapons (Personal) 28
Weapons (Vehicular) 28, 55. 59, 74, 138-139
Wear 152
Webbling 24
Welding 9

Bryce Hubbard (order #959915)

AA Laser Platform:
A static laser weapon designed for area defense. See page 31.

Accuracy:
The precision of a given weapon system. Accuracy is a zero-average attribute. See page 138.

Actual Size:
The final Size rating of a vehicle after all design steps are done. See page 134.

AFV:
Acronym for Armored Fighting Vehicle.

Alloy:
A material composed of a mix of two or more metals. See page 7

Ammunition:
The shots carried in the ammo bins of a weapon system. See page 29.

Area Effect:
The area covered by a weapon's blast. The radius is expressed in hexes for the tactical rules and in meters for roleplaying. See page 140.

Armoplast:
A high-density polymer which has a number of military applications such as armor plate component. See page 8.

Armor:
The general resistance of a vehicle to damage. This statistic includes the armor itself, the angle at which it is mounted on the vehicle, and the vehicle's general structure. See page 74.

Autocannon:
A rapid-loading projectile weapon. Autocannons are widespread because they are rugged and easy to maintain. See page 80.

C3:
Short for Command, Control and Communication. See page 32

Cerachip:
Slang term for a computer chip. See page 10.

Ceramic:
Blanket term for a non-metallic crystalline material. See page 10.

Combat Speed:
The cruising speed of a vehicle, i.e. the speed at which it normally moves when traveling or engaging in combat. See page 71.

Composite:
A material composed of two or more different materials. See page 8.

Crew:
The number of people required to operate a vehicle. Having more crew aboard allows more actions to be undertaken at once. See page 70.

Damage Multiplier:
The minimum damage caused by a weapon. This is multiplied by the Margin of Success to yield the final damage. See page 138.

Default Size:
The original size of the vehicle, before adjustment. See page 134.

Defensive Score:
A rating of a combat unit's ability to survive combat. See page 132.

Deployment Range:
The maximum distance covered by a vehicle before needing refueling or maintenance. See page 73.

Drone:
A remotely controlled vehicle, used for tasks too dangerous or impractical for humans. See page 13.

Durasheet:
A highly resistant composite material made of several interwoven layers of polymer, metal and ceramic. Durasheet armor is almost five times as resistant as the best molecular armor steel while weighing perhaps a hundredth of the normal weight. See page 8.

Fire Control:
The equipment used to direct and control the weapon systems on a vehicle. See page 110.

Fire Arc:
The zone in which a specific weapon can be aimed and fired.

Flaw:
A weakness in the design of a vehicle, either planned as part of the cost-cutting measures or acquired through faulty engineering. See pages 128-131.

Flexite:
An extremely resilient steel alloy used in engineering. See page 8.

Genetics:
Catch-all name for treatments involving gene manipulations and splicing. See page 20.

Gun Emplacement:
A weapon placed in a static defensive emplacement. See page 31.

Heavy Gear:
A one-man infantry fighting vehicle. Humanoid in shape, Heavy Gears are versatile, agile and rugged. See page 38.

Hopper:
Slang term for a Vertical Take-Off and Landing vehicle held aloft by thrusters. See page 62.

Hovertank:
A generic name for the advanced ground-effect vehicles used by the CEF during the Terra Nova campaign. See page 56.

Ladar:
Short for LAser Detecting And Ranging, a system that uses the reflection of low-power laser beams to gather information about its surroundings. See page 15.

Landship:
Huge land-going vessels which use magnetic repulsion and hoverfan technologies to float a few meters off the ground. See page 58.

Laser:
Acronym for Light Amplification by Stimulated Emission of Radiations. A laser is a device which amplifies and concentrates light waves, converting them into a narrow beam of coherent light. See page 28.

Bryce Hubbard (order #959915)

Lemon Roll:
One of the final construction steps, this roll determines if the vehicle was correctly designed and put together. Failure results in a certain number of defects which reduce the capabilities of the design. See page 135.

Line of Sight:
A clear, unobstructed view to an intended target.

Maintenance:
The day-to-day upkeep and cleaning required to keep a mechanical item or vehicle in functional order. See page 152.

Maneuver:
A rating of a vehicle's handling and overall reaction speed. See page 72.

Minefield:
An area littered with small contact or proximity warheads. See page 31.

Miscellaneous Score:
A rating of a combat unit's ability to perform specialized tasks. See page 133.

Missile:
A guided self-propelled projectile, capable of carrying a warhead to a target and make course corrections in mid-flight. See page 28,

Neural Network:
An artificial brain constructed out of self-growing crystals. Extremely fast but not very intelligent, neural networks form the basic computer of the Heavy Gears. See page 11.

NNet:
Slang term for neural networks. See page 11.

Offensive Score:
A rating of a combat unit's ability to inflict damage in combat. See page 132.

Perk:
A special advantage possessed by a vehicle. See pages 112-1278.

Polymer:
A material composed of long strings of organic and/or semi-organic molecules artificially attached to one another. See page 8.

Production Type:
The stage of development a particular vehicle has reached (ex.: prototype, mass production, etc.) See page 135.

Prosthetics:
Blanket name for artificial limb and organ replacements. See page 21.

Radar:
Short for RAdio Detecting And Ranging, a system that uses the reflection of high-frequency radio waves to gather information about its surroundings. See page 15.

Railgun:
A weapon which uses magnetic acceleration technology to propel a projectile at several times the speed of sound. See page 94.

Range:
The maximum distance at which a weapon can be used effectively. See page 139.

Rate of Fire:
A rating defining how fast a weapon can fire. See page 139.

Rocket:
An unguided self-propelled projectile carrying a warhead. See page 28.

Sensors:
The various detection and data-gathering systems of a given vehicle. See page 14

Size:
A rating of the bulk of a vehicle, roughly analogous to mass. Size is an exponential rating. See page 134.

Smart Glue:
An advanced chemical compound that can be adapted to many repair tasks by the addition of the proper catalysers. See page 9.

Stealth:
blanket name for techniques designed to reduce the effective signature of a combat unit. See page 27.

Strider:
Slang term for large, non-humanoid walker vehicles. See page 51.

Tank:
An armored vehicle designed to assault a defended position and exploit gaps in the enemy defensive line. See page 54.

Threat Value:
A rating measuring the overall worth of a military unit such as a vehicle. See page 132.

Top Speed:
The maximum possible speed that can be achieved by a vehicle. See page 71.

Turtleshell:
Slang term for hard infantry body armor. Made out of high tech composite, it is nevertheless quite cumbersome. See page 30.

V-Engine:
An advanced, powerful internal combustion engine. Its compact design and ability to use almost any kind of fuel makes it a prime choice for many military vehicles. See page 46.

Webbling:
An advanced surgical technique for augmenting the mental capacities of an animal. See page 24.

Zero-Average:
A rating that is used to modify the dice roll. Zero (0) is considered an average rating, with lower than average ratings being negatives and superior ratings positive numbers.

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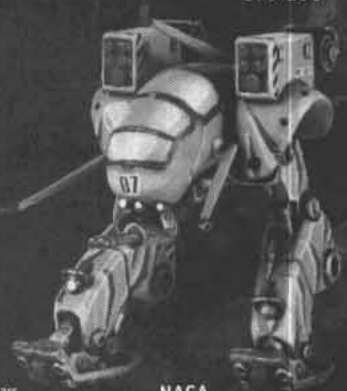


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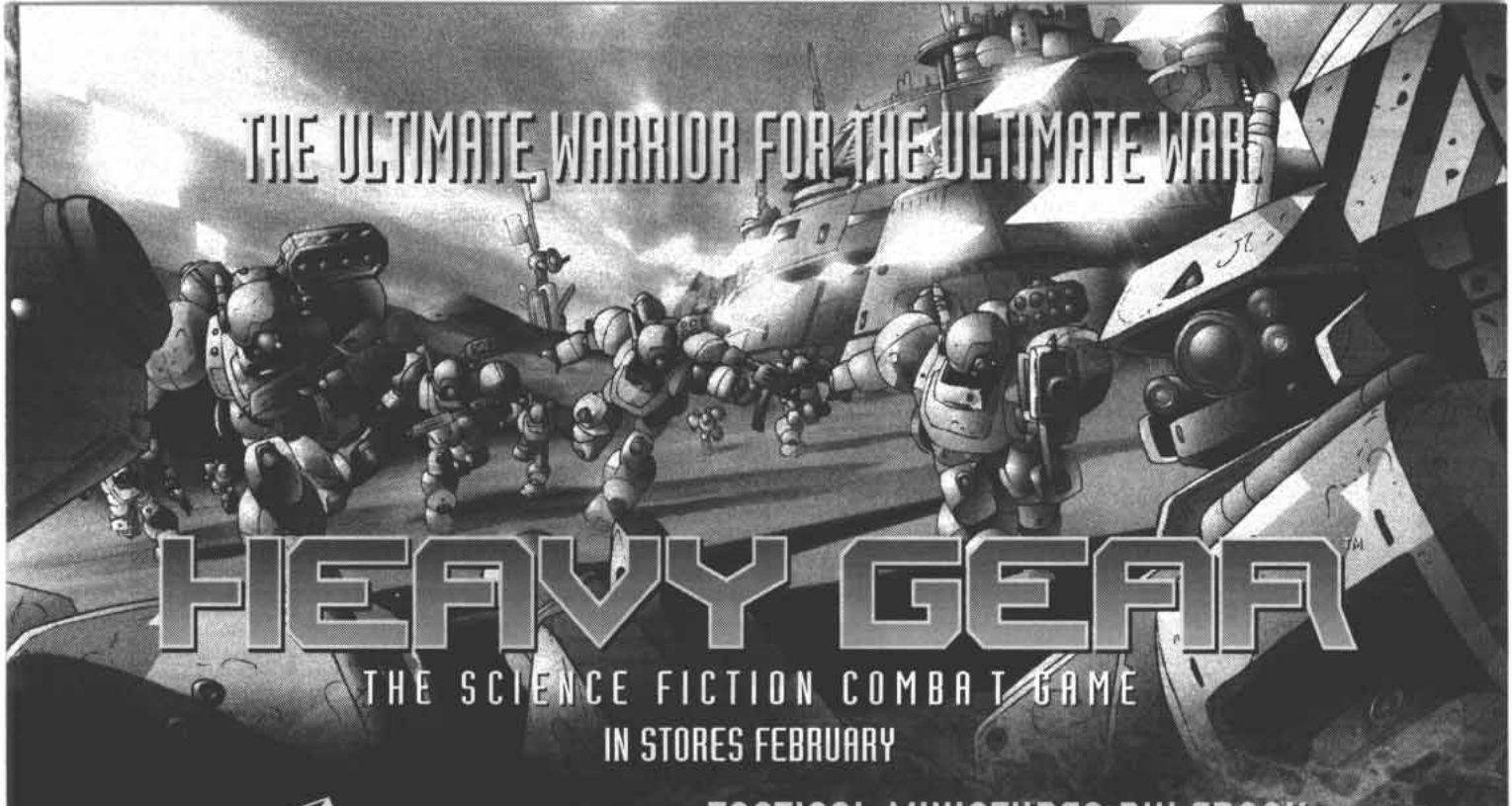


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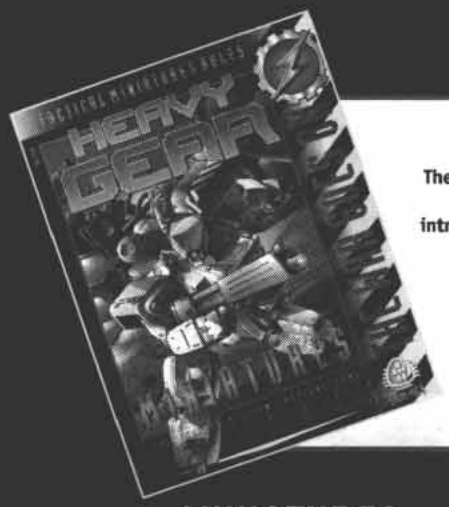


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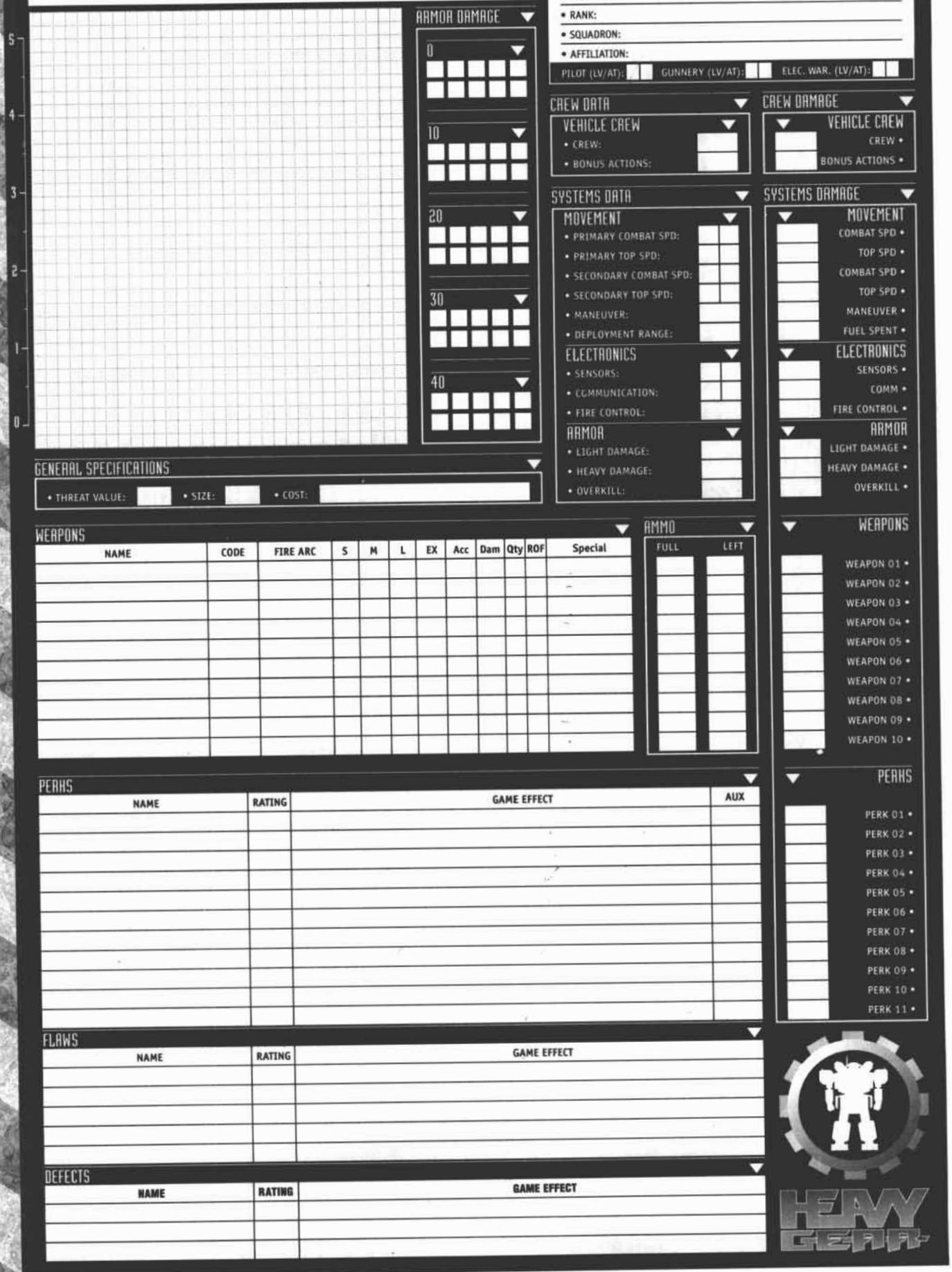
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