
for EABA™
Stuff!™
you make it, you break it...
BTRC
greg porter

Stuff!™ **v1.0**
©2006 by Greg Porter
ISBN 0-943891-50-7
BTRC#6109

Published by: BTRC
P.O. Box 1121
Collinsville VA 24078 USA
btrc@btrc.net
www.btrc.net

Design & programming: Greg Porter

Cover art: derived from **Future Combat System** White Paper, 2004
Interior art: US Defense Intelligence Agency, NASA Ames Research Center, NOAA Archives, US Department of Defense

Playtesters: Jerry A!, William Hostman, Aaron Kavli, Abel Lindberg, Phil McGregor, William Myers, Ross Pippin, Rich Spainhour

Special kudos: Phil McGregor

Other thanks: Dream Pod 9, Gold Rush Games, Hero Games, Marco Chacon, Pinnacle Entertainment, Politically Incorrect Games, Sanguine Productions and Steve Jackson Games, for technical assistance

Dedication: for Cathy

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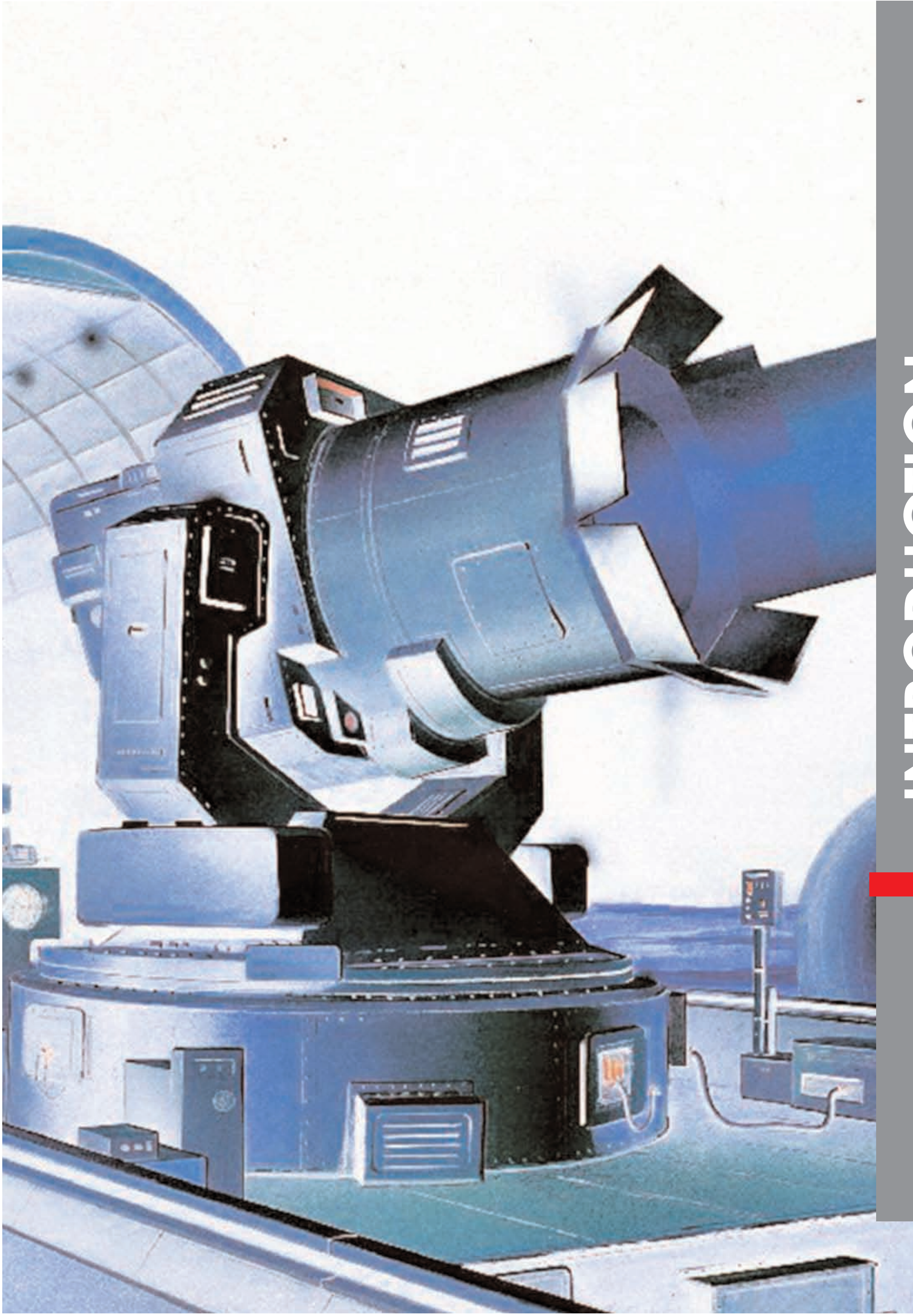
INTRODUCTION



In the Orwell Helicopter Corporation's plant only a few troubleshooters are visible, and these respond to lights that flare up on a board whenever a vacuum tube burns out or there is a short circuit. By holes punched in a roll of paper, every operation necessary to produce a helicopter is indicated. The punched roll is fed into a machine that virtually gives orders to all the other machines in the plant.

-from "Miracles of the Next 50 Years" (written in 1950)

INTRODUCTION - This is the rather unimaginately titled **EABA** supplement called...well...**Stuff!** It carries on a long **BTRC** tradition of design tools for role-players. Most of these have been mind-numbingly dense treatises full of equations and exponents, suitable only for that type of gamer known as the "gearhead". *Much like the author of this book is*.

However, **EABA** is a light, think-on-your-feet, know-the-rules-like-the-back-of-your-hand kind of system, and so a design tool for **EABA** needs to be something you can do on the fly or at worst, with a pencil and some scrap paper. *No calculator required. Guaranteed.*

That may seem like heresy to long-time **BTRC** fans, but trust me, it works. The idea, like in **EABA**, is to break certain things down to only what you need, and to keep that in terms and units you should already be familiar with from **EABA** and the real world. There are still plenty of equations and obscure interrelations in **Stuff!**, but they are all hidden from view in the process of distilling them into **EABA**-centric game stats.

Like our previous major design product (**3G³**), **Stuff!** will try to provide enough data that you can convert items made with **Stuff!** into other game systems with little difficulty. To keep **Stuff!** current, system conversions will be available on the **BTRC** web site as they are developed, rather than being a published part of the system.

TO THINK ABOUT - **Stuff!** can design just about anything that *can* be designed for a campaign. You can design a city from the top down, from the government to the rats infesting the alleys and the salary of the guy who picks up the trash. You can use it to recreate a medieval culture, or build a futuristic space vehicle. But keep the opening text in mind. It is a reminder about the one consistent feature of our prognostications on the future and its technology. *We always get something wrong, even when we get something right*. The 1950 article actually does a pretty good job (except for the ubiquitous predictions of personal helicopters), but the timescale is where we mess things up. The robotic factory description isn't bad, but our writer in 1950 didn't see how fast computers would advance. The **EABA** timescale is broken down into broad eras to minimize the problems in year-based tech scales. But if you design stuff for the present or near future, correlations may not be perfect, just because technology is advancing faster than we can predict which way it is going to go...

Many of you will use **Stuff!** just for weapons and vehicles. *That's fine*. **Stuff!** is broken into themed sections, so if you want to design a gun, you use the **Weapons** chapter. A car is the **Vehicles** chapter and a radio is the **Gadgets** chapter. Some things will be a more complicated. A tank with a detailed gun and a detailed radio needs all three chapters. Most chapters will be broken down into basic and advanced sections. The basics cover ninety percent or more of your design needs, and are supposed to cover the most common aspects of that design tool. If there is an advanced section, it will cover all the esoteric bits you will want to do *after* you are satisfied you understand the basics. The advanced section might be several times as long as the basic section, depending on the subject matter.

EXAMPLE: You can design a mundane car, plane or boat using just the basic vehicle rules. If you want a mobile anti-aircraft gun, an antimatter-powered exoskeleton or a warp-capable battleship, then don't be surprised if it requires advanced rules.

Every chapter in **Stuff!** ends up relating to everything else *somehow*. Vehicles (chapter 3) will often mount weapons (chapter 2). The same rules that let you make an electric car also end up powering your flashlight (chapter 4). Your wagon ends up being pulled by oxen (chapter 5), and everything is regulated by the government (chapter 6). While each chapter stands alone, it can be used more effectively with info from the other chapters.

EABA

GROUND RULES - *First things first*. You will not *need* **EABA** to use this book for many purposes, but to get *full* use of it, you will have to refer back to concepts or rules that are referenced like (see **EABA**, page 3.4). Similarly, you don't need **EABA** to *use* your final results. You could be designing things for some *other* game system and just want a simple design tool whose results you convert over to some other game.

That's fine with us. Kilograms and meters and liters and watts are universal units that can find a home in any game system.

Universal Chart - Most real-world measurements in **Stuff!** will probably relate to the **EABA Universal Chart**, an expanded version of which is in the back of this book. The **EABA Universal Chart** attempts to relate a whole bunch of different quantities and how they relate to each other. For your purposes, the ones that deal with mass, cost, distance and size will be the most important. If a unit is given in some unrecognizable quantity, like "a cost of +6", just assume that this means "a Money level of 6 on the **EABA Universal Chart**". Once the design process is done, you use the **EABA Universal Chart** to get the real-world measurement you are looking for.

EXAMPLE: If you jump to the back of the rules, you can see that Money of +6 translates out to 8,000 Credits. A distance of +6 is 3 meters, and a time of +6 is 8 seconds. If you design something with a base cost of +6, and you give it some enhance-ment that is a +2 cost modifier, you can see that the gadget now costs 16,000 Credits. *Go look it up and see what we're talking about.*

If you are only going to print two pages from this book, it should be the expanded **EABA Universal Chart** at the back of these rules. You *will* be using it quite a bit.

Hexagons - **Stuff!** and **EABA** have one unique unit of measurement that you have to wrap your head around. The unit of size in **Stuff!** is a hexagon (or hex). This is a hexagonal area 1 meter across (face to face) and one meter high. It is completely useless for anything except roleplaying, but for that purpose it is absolutely perfect. One hexagon has a footprint of .75 square meters (8 square feet) and a volume of .75 cubic meters (26.5 cubic feet). Many games use one meter or one yard hexes and this is simply a convenient way to represent your stuff on a game map.

An area that a person occupies in a vehicle seat is about one hexagon. A person standing in a hexagon is about two hexagons of volume (2 meters high), while most structures take about three hexagons of volume from one floor to another. This is the only real thing you need to remember when laying out a vehicle or structure floor plan. A van that occupies ten hexes on a game map might actually be a twenty hexagon vehicle in terms of volume. Volume as such is used mostly in the design process. Things related to volume may be used later (such as size modifiers in combat), but the actual volume is seldom a concern once the item rolls off the drawing board and into your game.

If you are not using **EABA**, and play in a game with two meter hexagons, a hexagon that is two meters across and two meters high will hold eight **Stuff!** hexagons of equipment.

Since most handheld equipment by its nature is a wee bit smaller than a hexagon, small items will have a size measured in milli-hexagons, or one-thousandath of a hexagon. One millihex is about the size of your fist. The smallest unit that will be used in **Stuff!** is .1 millihex, which is about the volume of a wristwatch and strap.

Example	Millihexes
Wristwatch	.1
Pocket calculator	.5
Small pistol, soda bottle	1
Medium pistol	2
Heavy pistol	4
Portable computer or light rifle	8
Heavy rifle, large briefcase	12
Desktop computer	16
Large shoulder-fired rocket	32

What about bigger stuff? In general something with the listed size in hexagons will have the approximate dimensions below:

Hexagons	Dimensions	
(example)	Cube	"Ship"
1	.9m on a side	2.3m x .6m
5	1.6m on a side	3.9m x .1.0m
10	2.0m on a side	4.9m x 1.2m
50	3.3m on a side	8.4m x 2.1m
100	4.2m on a side	11m x 2.7m
500	7.2m on a side	18m x 4.5m
1,000	9.1m on a side	22m x 5.7m
5,000	16m on a side	39m x 10m
10,000	20m on a side	78m x 20m
50,000	34m on a side	134m x 34m
100,000	42m on a side	169m x 42m
500,000	72m on a side	288m x 72m
1,000,000	91m on a side	363m x 91m

A "ship" is just a block four times as long as it is wide and high. It's just a shape that you can relate to better when imagining large vehicles. Remember that a hexagon of volume is .75 cubic meters. As a gamer you may be used to hexes 1 meter across, but not with how this compares to volume.

To make things simple, *most* items are going to have a mass of 500 kilograms per hexagon. This is a density of about .65 tons per cubic meter, or about the same as many woods. This takes into account the fact that even heavy machinery has empty space so you can get in to change the spark plugs, and so on. A person takes up a volume of about .1 hexagon and has a mass of up to 100 kilograms. However, a person who access vehicle controls or get at worn items will take up a full hexagon. *It makes a difference*. Body armor is designed to fit a *person*, not the hexagon they are standing in.

For your first practical use of the **EABA Universal Chart**, an item's diameter as a sphere would be its Size level in hexagons minus 3, with the result divided by 3. Some useful relationships are below. Try some to get a feel for the **EABA Universal Chart**. Results are not perfect, but *are* good enough for game uses.

Volume:

Diameter of a sphere(meters): (Size - 3) / 3
Side of a cube(meters): (Size / 3) - 1
Length of a "ship"(meters): (Size / 3) + 1

Money:

Pay rate(Credits): Money
Daily pay(8hr)(Credits): Money + 6
Weekly pay(Credits): Money + 11
Monthly pay(Credits): Money + 15
Yearly pay(Credits): Money + 22
12 hour work day: +1 to total
7 day work week: +1 to total

Distance:

Time of flight(seconds): Dist. - Movement - 5
Accel. to speed(seconds): Move_1 - Move_2
Accelerate to dist.(seconds): (Distance - Move) / 2 - 2
Throw dist.(meters): Strength - Weight - 3

EXAMPLE: If you are paying a lackey 8 Credits an hour (Money level of -14) for a 12 hour work day, then you owe the lackey a Money level of (-14 + 11 + 1) = -2 for a week's work, or 500 Credits.

EXAMPLE: You have a spaceship that can do .4 gees (Movement level of 2) and want to know how long it will take to accelerate to 1% of the speed of light (a movement level of 41). The answer is (41 - 2) = a Time level of 39, or 8 days. Like we said, no calculator required!

Stuff!^v1.0

Dice - **Stuff!** does everything according to the progressions on the **EABA Universal Chart** (**EABA**, page 3.4). Each level of effect is a change of 0d+1 to the final total, and each 3 levels is a change of 1d+0. All of the intermediate steps in **Stuff!** are figured as non-dice levels. See below:

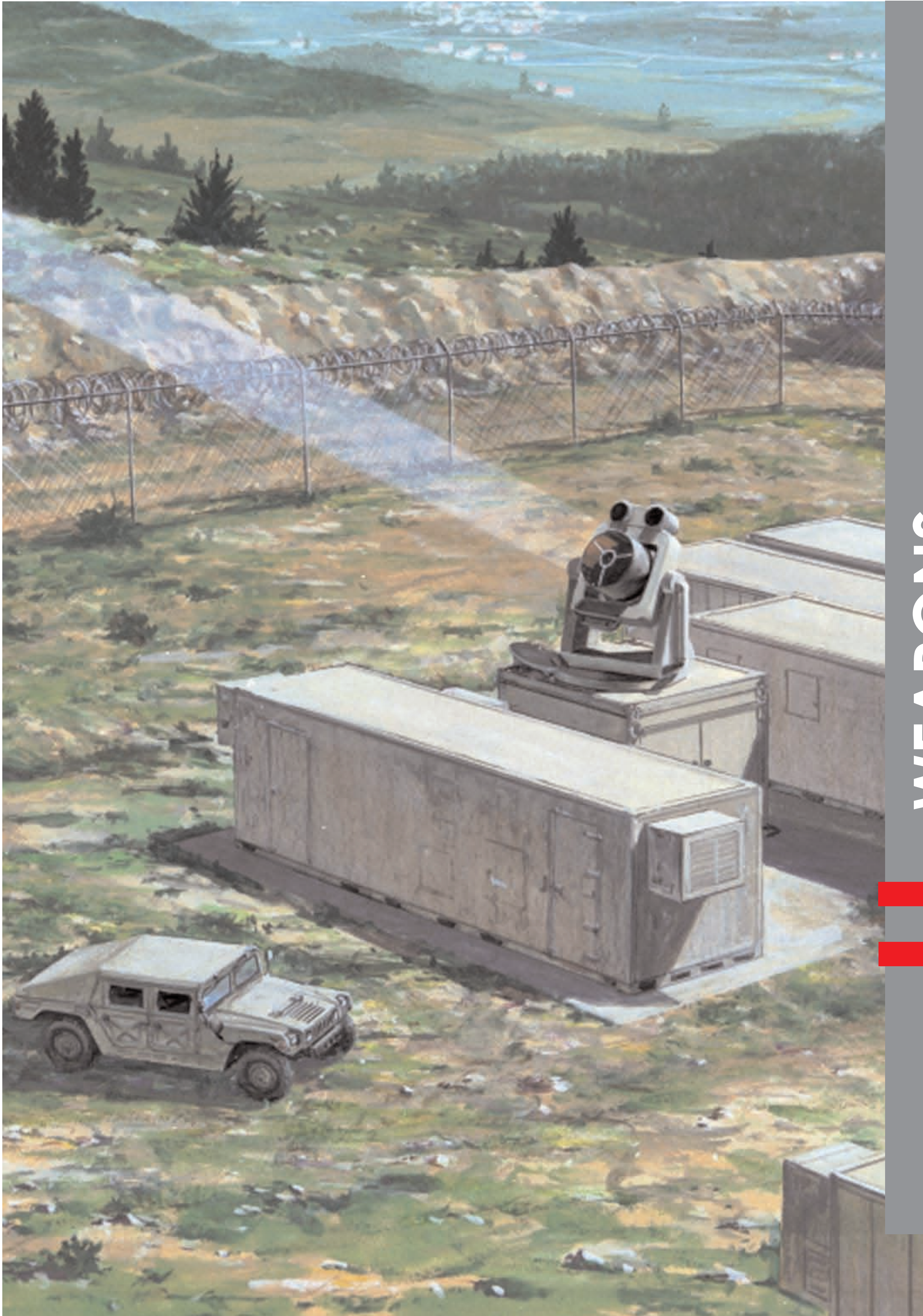
Basic Era weapon	+18 lethal
Late part of an era	+2 bonus
1 hexagon weapon(500kg)	+0 bonus
Takes a minute to reload	+3 bonus
Unreliable in wet conditions	+1 bonus
Manually aimed weapon	+0 bonus
Modifier total	+24 lethal
Total	8d+0 lethal damage

EXAMPLE: A weapon with a base damage of +18 has modifiers that add up to +6, for a total of +24. Since each +3 is 1d+0 of damage, you have a weapon with a final damage of 8d+0. What the listing above represents is the entire design process for a muzzle loading cannon. That's how easy **Stuff!** can be.

You *never* keep a remainder of more than +2. In the previous example, you would *never* end up with a 6d+6 weapon. The +6 always ends up a +2d in the end. It's just easier to add single digits and convert later than to try to add the dice and fractions in your head.

The Pizza Principle - **Stuff!** is sort of a pizza topping system. Instead of lots of equations, it is just a system of simple additions and subtractions, as you saw in the example above (though these tables *are* based on equations). If you are going to use **Stuff!** as an equipment guide for a particular game-world, you will need to apply it *consistently*. If a weapon or a technology has certain characteristics, then it should *always* have those characteristics. One point of difference in a piece of **Stuff!** gear is usually important, just as it is important whether your adventurer has an Agility of 8 or 9. So, if you say a certain weapon is "unreliable in wet conditions", odds are that *all* examples of that type of weapon have that modifier. Changes in the way technology operates is the hallmark of advancement, whether it is the change from muzzle-loading to cartridge weapons, from vacuum tubes to transistors or from gold to paper money. When someone comes up with something better, all the old stuff tends to fall by the wayside.

Got it? If so, you're ready to go.



WEAPONS

As soldiers are tools of destruction, they are

not properly a gentle person's tools.

On necessity will they will use them,

with calm control.

Even winning is no cause for rejoicing.

To rejoice over a war won is to rejoice

over the slaughter of men

So a person who rejoices

over the slaughter of men

Cannot expect to do well in the world of men.

Tao Te Ching, Chapter 31

INTRODUCTION - Yeah, this is the section you may have bought **Stuff!** for, so we're putting it first. This section covers everything from a penknife up to a battleship gun, orbital bombardment cannon or anti-tank missile. Things like cruise missiles, ICBM's or other very long range, self-guided weapons would be better designed as a vehicle with a payload (and we *do* have a chapter for vehicles). However, you *would* design a nuclear payload using the weapons section...

The chapter is laid out the way all the **Stuff!** chapters will be, a short, basic set of rules that will cover over ninety percent of your needs, and a much longer set that covers the other ten percent.

Basics - The default weapon in **Stuff!** design is very much like a gun. Unless you take modifiers to adjust it, the weapon can be used for one attack per major action, has some sort of penalty after each attack that disrupts your aim (like recoil), does lethal damage and affects armor normally. It is reliable in normal conditions, and will probably function at some reliability, range or damage penalty in abnormal conditions (like underwater, in a vacuum, etc.). Pretty much like a 20th or 21st century firearm. So, without any special modifiers, a 29th century "blaster pistol" will operate under the same **EABA** rules as a plain old 20th century sidearm, with the exception that the blaster pistol will do a *lot* more damage... As a comparison, in modern terms (Atomic Era, *maybe* Late Atomic Era), weapons have damages like this:

Damage	Example	Approx. energy/area
0d+0		100 Joules/cm^2
0d+1	pellet rifle	140 Joules/cm^2
0d+2		185 Joules/cm^2
1d+0	.25 ACP, 00 buckshot	250 Joules/cm^2
1d+1	.22 long rifle, 9mm short	340 Joules/cm^2
1d+2		450 Joules/cm^2
2d+0	.45 ACP	560 Joules/cm^2
2d+1	9mm Parabellum	770 Joules/cm^2
2d+2	.357 magnum, 4.6mm HK	1000 Joules/cm^2
3d+0	5.7mm FN, .44 magnum	1250 Joules/cm^2
3d+1	12ga shotgun slug	1770 Joules/cm^2
3d+2	.30 carbine	2370 Joules/cm^2
4d+0	.454 Casull	2910 Joules/cm^2
4d+1	5.56mm, 4.73mm/c	3990 Joules/cm^2
4d+2	7.62mm	5240 Joules/cm^2
5d+0	.338 magnum	6450 Joules/cm^2
5d+1		8980 Joules/cm^2
5d+2	.460 magnum	11,650 Joules/cm^2
6d+0		14,660 Joules/cm^2
6d+1	12.7mm machinegun	19,830 Joules/cm^2
6d+2	14.5mm machinegun	25,780 Joules/cm^2
7d+0	20mm cannon	32,510 Joules/cm^2
7d+1		44,340 Joules/cm^2
7d+2		58,010 Joules/cm^2
8d+0	30mm cannon	73,500 Joules/cm^2
9d+0		164,000 Joules/cm^2
10d+0	60mm cannon	370,000 Joules/cm^2
11d+0	75mm cannon	895,000 Joules/cm^2
12d+0	light AT rocket	1.9 million Joules/cm^2
13d+0	90mm cannon	4.2 million Joules/cm^2
14d+0	120mm cannon	9.5 million Joules/cm^2
15d+0		21 million Joules/cm^2
16d+0	heavy AT rocket	48 million Joules/cm^2

The "energy/area" column is just that, a way to see how "real world" energy translates into **EABA** damage, and to get an idea of how much extra force per unit of area is required to get those little extra +1's of damage. For the non-gearheads, a Joule(J) can be equated to a kilogram lifted a meter. If you weigh one hundred kilograms and you climb ten vertical meters of stairs, that's a hundred kilograms times ten meters, or a thousand Joules. Energy/area means how much energy is applied over how much area, in this case, one square centimeter. A finger pushing into a lump of clay goes farther than a fist. They have the same *energy*, but the finger concentrates it over a smaller area. Don't worry about it too much, this is the *only* place in the rules where it is goes into this detail. One thing you should keep in mind though, is that it takes a *significant* change in energy/area to get a damage bonus. Most of the time, this will involve an increase in weapon mass, ammunition mass, or both.

Size - Each hexagon of weapon will mass half a ton (or each millihex of weapon will mass .5kg). Ammunition normally takes up as much space as the weapon for 200 shots. Vehicle weapons usually use cargo space for ammunition storage, while handheld weapons usually add the ammo size and mass to the weapon to get the weapon's *final* size. You can use any fraction or multiple of 200 shots that you care to. Ammunition does *not* count towards the Hits of a weapon. Hits represent how hard it is to damage the *weapon*. The ammunition may have Hits of its own, but this is usually not a major consideration.

Weapons *can* have final sizes that are fractions of a millihex. Millihexes are just a design tool, your final weapon or any other **Stuff!** item will probably be mostly referenced in kilograms. For reference, the table below lists the actual mass in kilograms of various real-world weapons (*including* a normal load of ammunition), and a good approximation of this *final* size that you can get in **Stuff!**.

Weapon	Weight	≈Stuff! size
Combat knife	.3kg	.6 millihex
Walther PPK	.7kg	1.5 millihex
Beretta 9mm pistol	1.1kg	2.5 millihex
Mini-Uzi submachinegun	3.2kg	6.0 millihex
M-16A3 assault rifle	3.9kg	8 millihex
RPG-7 rocket launcher	9.9kg	20 millihex
.50 cal. machinegun	70kg	125 millihex
TOW missile (tripod mount)	115kg	250 millihex
20mm autocannon	150kg	313 millihex
12-pounder (archaic)	800kg	1.5 hexagon
32-pounder (archaic)	2100kg	4 hexagon
120mm cannon	3000kg	6 hexagon

This should give you something to work with when trying to get a feel how "big" something is.

Other - The basic Accuracy of a *vehicle* weapon will be half its damage dice (rounding nearest). The basic Accuracy of a *handheld*, pintle or tripod mounted weapon is a quarter of its damage dice (rounding nearest), and the basic Accuracy of a thrown weapon is zero.

The following table lists all the *basic* weapon design modifiers, followed by an explanation or clarification of them, along with examples. A "basic" weapon is something similar to a gun or sword, where the mechanism of damage is fairly straightforward and obvious. The advanced or special case modifiers will come later.

Technological Era	Damage for 1 hexagon
Primitive (and all melee wpns)	+12 lethal
Basic	+18 lethal
Industrial	+24 lethal
Atomic	+30 lethal
Post-Atomic	+36 lethal
Advanced	+42 lethal
Early part of an Era	-2 penalty
Middle part of an Era	no adjustment
Late part of an Era	+2 bonus
Easy technology	+3 bonus
Average technology	+0 bonus
Hard technology	-3 penalty

Modifiers	Amount
Weapon of .5 millihex	-33 penalty
Weapon of 1 millihex	-30 penalty
Weapon of 2 millihex	-27 penalty
Weapon of 4 millihex	-24 penalty
Weapon of 8 millihex	-21 penalty
Weapon of 16 millihex	-18 penalty
Weapon of 32 millihex	-15 penalty
Weapon of 64 millihex	-12 penalty
Weapon of 125 millihex	-9 penalty
Weapon of 250 millihex	-6 penalty
Weapon of 500 millihex	-3 penalty
Each doubling of space	+3 bonus
Each 25% extra space (max +50%)	+1 bonus
Each 25% less space (max -25%)	-1 penalty
Autofire (Industrial Era or better)	-3 penalty
Autoburst (Atomic Era or better)	-2 penalty
Can use shotgun damage	-3 penalty
Takes several actions to reload	+1 bonus
Takes fifteen seconds to reload	+2 bonus
Takes a minute to reload	+3 bonus
Unreliable (jam on roll ≤7)	+3 bonus
Very unreliable (jam on roll ≤11)	+6 bonus
Detrimental side effect	+2 bonus
Beneficial side effect	-2 penalty
Post-Atomic Era special effect	-6 penalty
Advanced Era special effect	-12 penalty
Bulky ammo (x1/2 capacity)	+1 bonus
Compact ammo (x2 capacity)	-2 penalty
One-use weapon	+6 bonus
Explosive damage (lethal)	-6 penalty
Explosive damage (half-lethal)	-3 penalty
Shaped charge damage	+3 bonus
Handheld (or shoulder-fired)	+3 bonus
Bipod/tripod mounted weapon	+2 bonus
Manually aimed weapon	+1 bonus
Turreted or remote weapon	+0 bonus
Placed weapon	+6 bonus
Strength-based wpn.(special)	-9 penalty
Thrown weapon	-12 penalty

Accuracy modifiers	Amount
Shoulder-fired ranged weapon	+1 Acc
Basic Era or earlier (minimum of 0)	-2 Acc

BASIC WEAPONS - The basic design rules cover only the *function* of the weapon. The monetary cost of the weapon and ammunition for it is in the advanced rules (page 2.39). If you need to determine the armor and Hits of a weapon, you would go to the **Gadgets** chapter and use the rules covering gizmo armor and Hits.

Damage from weapons is assumed to be lethal unless otherwise specified. Half-lethal weapons generally do +1 damage, and non-lethal ones do +2 damage. Each +1d of damage in a weapon represents somewhere between two- and two-hundred-fifty percent more penetrating power, and each +1 is perhaps thirty to thirty-five percent more than the previous value. So, realistically speaking, the difference between a normal weapon and a "magnum" or upgraded version of that weapon is probably no more than a +1 difference.

Something that we are going to mention now and several times later in the text is the nature of modifiers. A weapon modifier that says "+3" or "-3" *does not* make a weapon inherently better or worse. *What it means is that the weapon does more or less damage than an otherwise identical weapon with or without that characteristic*. For instance, if you have a pair of 4 kilogram rifles, and one is a robust single shot elephant rifle, and the other is an autofire assault rifle, you would *expect* the assault rifle to have a lower damage. And in **Stuff!**, autofire capability reduces the damage of a weapon compared to similarly sized weapons without autofire capability.

Explanations of the various modifiers on the previous page follow:

Tech Era - The base damage done by a weapon that takes up 1 hexagon (500kg) at that tech era. Weapons from early or late parts of an era get a -2 penalty or +2 bonus to this damage. A gamemaster can decide to subdivide this further into -1 or +1 increments if desired.

EXAMPLE: An Atomic Era (the overall era in which you are reading this) weapon has a base damage of +30 for one hexagon of weapon. A weapon from the *Late* Atomic Era (which is where we are now) would have a base damage of +32 instead.

Note: Self-contained bullets will usually be considered a Middle to Late Industrial Era item, so "modern" firearms date from that period and later.

While melee weapons or ranged weapons based on muscle power can be at any tech era, for *design* purposes they are *always* considered Primimtive Era weapons (a base of +12 lethal damage). A mass swung by muscles doesn't get any more sophisticated...

Easy Technology (+3) - The "easy technology" modifier represents a weapon technology that is readily accessible and understandable. It can be modified and adapted without requiring more than a tradesman's level of expertise. If it is something that poorly equipped rebels can make out of locally available materials, count it as "easy technology". For Earth's history, most explosives, unguided rockets, melee weapons and archaic ranged weapons like bows, crossbows, etc. are all going to get this modifier.

"Average"(+0) technologies usually represent gunpowder weapons, things that require some sort of technical infrastructure, like iron working, or the ability to make moving parts at fine tolerances, like the action of a flintlock or the cycling bolt of an assault rifle. Conventional firearms are "average technology".

"Hard"(-3) technologies are mostly going to be used in a fantasy or science fiction campaign, and are ways for a gamemaster to tweak certain weapon types to get the level of damage they feel appropriate for the tech era and nature of the gameworld. It represents both the efficiency of the weapon and to some degree the difficulty in making it.

EXAMPLE: If a role-playing campaign was set in a world without significant quantities of iron and tin, then gunpowder weapons would have to be made out of something else, like copper. Copper is not as strong as iron (and is heavier), so making it an "hard" technology (-3) instead of an "average" one (+0) would mean that a copper weapon would have to be heavier than an iron one to do the same damage.

If a weapon uses multiple technologies in its consutruction or means of doing damage, use the average, rounding towards zero.

EXAMPLE: A weapon that uses both "easy" (+3) and "average" (+0) technologies would average to +1 damage. A weapon using "average" (+0) and "hard" (-3) technologies would average to -1 damage.

Note: *Suggested* tech types for the weapons common to many role-playing settings:

Weapon type	Technology type
Melee weapons	Easy(+3)
Grenades/explosive shells	Easy(+3)
Bows & crossbows	Easy(+3)
Repeating crossbows	Easy/Average(+1)
Gunpowder firearms	Average(+0)
Stunners	Average/Hard(-1)
Lasers	Average/Hard(-1)
Gauss weapons	Average/Hard(-1)
Particle beams	Hard(-3)

Size - Each time you double or halve the size of the weapon from the default of 1 hexagon, you gain or lose +3 on the base damage.

EXAMPLE: A 2 hexagon weapon from the Atomic Era does a base damage of +33, while a .5 hexagon weapon does a base damage of +27.

You *can* use the **EABA Universal Chart** (**EABA**, page 3.4) for doubling or fractional amounts. Weapons whose size does not *exactly* match a table entry can be up to 50% larger or 25% smaller, for a bonus or penalty on damage. If you need to go more than this, you should be using the next higher or lower table entry. The small table on page 2.3 should give you an idea of about what a certain class of weapon weighs. If you are trying to recreate an *actual* weapon, start with its *unloaded* weight.

Note: In weapon examples like the one below, design modifiers from the advanced design rules will be in *italics*.

EXAMPLE: Let's say you want a weapon with an empty mass of 1.5 kilograms (or 3 millihexes in volume). There is no "3 millihex" entry, but you could use the "2 millihex" numbers and then apply the "+25% size" modifier twice to get a 3 millihex weapon. This would give you a 1.5 kilogram weapon and it would have +2 on damage over the 2 millihex numbers. Or, you could use the "4 millihex" numbers and apply the "-25% size" modifier once. This would *also* give you a 3 millihex weapon, but it would do -1 on damage compared to the 4 millihex numbers. If you work it out, you'll see the damage is the same in either case.

Keep in mind that for very large weapons you are only buying the *weapon*, not any support services or structures to house it in or on. A battleship turret may be armored, but that armor would be part of the *vehicle* mass, not the *weapon* mass.

Autofire(-3) - The weapon *may* use standard **EABA** autofire rules (**EABA**, page 5.6). A weapon capable of autofire can usually fire single shots as well, especially if it is a handheld weapon. Damage is the same, regardless of the mode used. Note that weapons do not do less damage just because they are autofire. What the -3 damage modifier means is that an autofire weapon doing the same damage as a regular one has to be more heavily built to withstand the extra stresses, either mechanically, electrically or in terms of its ability to dissipate waste heat. A weapon may be autofire or autoburst at only a third the normal damage penalty, rounding down, *if* it is counted as Unreliable (or a level *more* unreliable) when used in autofire or autoburst mode (see **EABA**, page 7.3).

EXAMPLE: A weapon that is unreliable *only* in autofire mode would have a -1 damage penalty (normally -3), and a weapon that is unreliable *only* in autoburst mode has no damage penalty at all (normally -2). This doesn't make an unreliable autoburst mode "free". Autoburst capability *will* make a weapon cost more in Credits.

Degtyarev Pechotnyi	
Late Industrial Era	+26
Average technology	+0
20 millihex	-17
Several actions to load	+1
Autofire	-3
Unreliable	+3
Reduced range	*+1*
Bipod mounted	+2
Modifier total	+13
Final damage	4d+1

Most hand-held autofire or autoburst weapons will take the unreliable autofire option as a weight-saving measure. Weapons firing explosive rounds are less concerned with weight and more with safety, and do not usually take the option (and imagine the problems with unjamming an artillery piece!). If a weapon has global levels of unreliability, it will automatically apply to autofire mode as well, and an unreliable autofire mode cannot be taken unless it is *more* unreliable than normal fire.

EXAMPLE: A weapon that is "unreliable"(+3) and "autofire"(-3) is unreliable in normal fire *and* in autofire modes. It could, however, have "very unreliable autofire"(-1). This means it is Unreliable in normal use and Very Unreliable in autofire use.

Autofire weapons firing explosives, shaped charges or any sort of bulky package take a -9 penalty *instead of* a -3 penalty (-6 for autoburst).

You *may* take the autofire modifier more than once. Extra uses of autofire or autoburst are at a -1 penalty each instead of the normal penalty, but reliability adjustments only apply to the *first* modifier (second and further autofire or autoburst modifiers are always at least a -1 penalty). Each extra level of autofire or autoburst just increases the number of hits on a successful roll by one, and one additional hit for each amount the roll is made by. A rotary cannon or other very high rate of fire weapon might have this modifier several times. Remember that each extra time you take this modifier results in ten extra shots being fired each time you pull the trigger.

EXAMPLE: A weapon that has the autofire modifier three times (-5 damage) would get three hits on a successful "to hit" roll, and three *extra* hits for each two points the roll was made by. Each time the trigger is pulled, this weapon fires thirty shots from its supply of ammunition. If this weapon were unreliable only in autofire mode, only the first -3 penalty is altered by the reliability option (to -1), and the other -2 are counted normally, for a total damage modifier of -3 instead of -5.

Autoburst(-2) - A weapon that can only fire short bursts instead of sustained autofire only takes a -2 penalty (or -6 for lightweight or bulky packages). This is handled the same as regular autofire, but will limit the maximum number of hits to three. This lesser modifier can also be applied to weapons with a slow rate of autofire, like the autocannons mounted on many light armored vehicles. Lesser autofire weapons only shoot three shots per major action instead of the normal ten.

Shotgun(-3) - The weapon may use its normal designed damage, *or* adjust this to do multiple hits at less damage, using normal **EABA** shotgun rules (**EABA**, page 5.6). To be able to fire multiple small projectiles, shotguns typically have larger barrels and correspondingly larger mechanical assemblies, making them heavier than conventional weapons doing the same damage. Shotgun rules may also apply to things like continuous beam lasers, where they do several hits before the target can possibly move out of the way. Conventional weapons which fire extremely rapid bursts should probably use a multiple autofire or autoburst modifier. The damage a weapon has *after* this modifier is applied represents that of a single large slug. See the **EABA** rules (page 5.6) for rules on shotshells.

Reloading(variable) - The default reloading time for a weapon is an action, depending on your Agility or skill with the weapon (you could always blow the roll). This is the default, for something like a clip-fed weapon where you can pop the old one out and put a new one in (provided you had a replacement clip already in hand). A weapon that takes several actions to reload might be a revolver that cannot use speed loaders (load one bullet at a time), a belt-fed machinegun, or a weapon large enough that you simply can't move ammunition into the gun in one action (like an artillery piece or mobile rocket launcher). This modifier means the reloading time is a major action per shot for multiple shot weapons, or at least two actions for a weapon that only holds one shot. Weapons that take a minute or more to reload a shot are typically siege weapons, very large cannons or archaic muzzle-loading weapons. To be most accurate, the bonus you get for a particular reloading time is one-quarter the Time level needed to reload (so the +2 modifier is actually sixteen seconds).

Note! - Reloading time *assumes* you have what you need to do the reloading with. If an artillery piece is manually loaded and has 100 kilogram shells, the reloading time *assumes* there are enough people there to manhandle the shells into the weapon. Keep this in mind. As a rule of thumb, reloading archaic weapons takes the listed time if you have 1 person for each full 2d+0 in the tech era and size of the weapon. For instance, an archaic weapon whose size and tech era alone gave 10d+0 damage would require a five-person crew to reload in its listed time.

The reloading modifier may also be used for weapon preparation time *before* use, even if the weapon cannot normally be reloaded. For instance, if a disposable man-portable rocket launcher requires several actions to prepare it for firing, it *can* use the "reloading" modifier for the *pre*-fire sequence, even though it cannot be reloaded and thus has no *post*-firing delay. Weapons may have both a pre-loading *and* re-loading modifier.

Unreliable(+3) - A weapon which has a chance of malfunction *even in ideal conditions* can take this modifier. Ones that are *very* likely to have problems can take the more severe form at +6 (for detail, see **EABA**, page 7.3). These modifiers would typically be used on archaic weapons, or on very cheap weapons, on the the early models of a new design, or on poorly designed autofire weapons. An autofire weapon that is just a little too light to reliably handle the stress might take the less severe modifier as well, especially at Industrial Era levels of technology or if the weapon is cutting edge (built just a little ahead of its time). If a weapon has a global "unreliable" modifier, this supercedes something like "reliable autofire". It is unreliable in *all* conditions.

SMAW	
Atomic Era	+30
Easy technology	+3
16 millihex	-18
Several actions to load	+1
Operational side effect	+1
Shaped charge x 3	+9
Bulky ammo x 125	+7
Shoulder-fired	+3
Slow weapon x 3	+3
Modifier total	+39
Final damage	13d+0

A weapon that is only unreliable in certain modes of use or in certain operational conditions only gets a +1 bonus instead of +3. See the **Autofire** modifier for an example (only unreliable in autofire mode).

EXAMPLE: A flintlock pistol that is just normally "unreliable", but is "very unreliable" when in wet conditions would get an +4 damage instead of the +6 it would get for being "very unreliable" all the time. A flintlock rifle that reliably fires when kept in good order, but "very unreliable" in wet conditions would be a +2 damage instead of +6 damage.

Note! - *Do not apply this modifier gratuitously as a easy way to get extra damage!* Taking a "gun is very unreliable underwater"(+2) bonus is only going to be significant if adventurers are underwater a lot... *All* weapons are going to have conditions that make them unreliable to some extent. This modifier is only for those conditions that are going to be *commonly* encountered.

For reference, if the user has a 4d+2 skill roll, the chance of an Unreliable weapon misfiring is about one percent, and the chance for a Very Unreliable weapon to misfire is about ten percent. The real-world chance of misfire for a modern weapon in good order is no more than a half of a percent.

Side effects(±2) - Side effects are things above and beyond what would normally be expected from a weapon at that level of technology or which gives a penalty/advantage in the **EABA** system. For instance, a pistol might have recoil, but this is not a *detrimental* side effect unless it is so severe that you *can't* fire more than once a turn. Similarly, a laser has *no* recoil, which is a *beneficial* side effect for maintaining your aim. Armor-piercing ammunition is usually *not* a special effect. Ammunition is *not* something inherent to the weapon. A rifle can fire regular ammunition *or* armor-piercing ammunition. Both do the same damage. The *weapon* hasn't changed, the *ammunition* has.

On the other hand, an advanced energy weapon *might* be inherently armor-piercing, or the *only* ammunition available to a weapon might be armor-piercing, and this *could* be a beneficial side effect inherent to the weapon.

Side effects(+2) that cause damage to the firer (or those near them) as part of normal weapon operation are normally half-lethal damage of half the weapon's normal damage. A weapon *can* have more than one side effect, but they should not be related to each other if each one is to be worth a separate bonus.

Things that are a beneficial or detrimental side effect related to the weapon's *operation* are only worth half (a +1 or -1) and this is purely optional. For instance, if a class of weapon can *only* be used in vacuum, this does not affect normal **EABA** combat rules, so it would only be a detrimental side effect worth +1. A rocket with backblast that only causes side effect damage if used in a vehicle or enclosed space would be a +1, or an unbalanced melee weapon would be a +1. Operating limits may be *part of* a +2 or -2 side effect, but will *not* add to it.

Possible **side effect**	**Beneficial**	**Detrimental**
Gunpowder	none	may have severe recoil
Rockets	none	backblast
Laser	no recoil	blocked by smoke
Particle beam	armor-piercing	none
Gauss weapon	none	none
Stunner (electrical)	none	non-lethal, easily blocked

ADVANCED TOPIC: EXCESSIVE RECOIL

Weapons with recoil typically just cause the shooter to lose any aiming bonuses or cause consecutive shot autofire penalties. If a recoiling weapon fired from one hand has a damage of *more than* the firer's Strength plus 1d, the excess is taken by the firer as half-lethal damage to the firing arm. For a weapon fired from both hands (but *not* braced on the shoulder), the limit is the firer's Strength, plus 2d. For a shoulder-fired or bipod mounted weapon, the safe amount of recoil is the firer's Strength, plus 4d. Subtract 1d from the safe limit if the weapon if the weapon is autofire or uses shotgun damage (2d if both!). In the case of pistols, padded gloves or hand armor can absorb up to 0d+1 of the damage (the shock still travels up the arm). For shoulder-fired weapons, torso armor of up to 1d+0 can apply against this damage. Weapons using the "recoil compensation" modifier (page 2.28) increase the damage threshold for safe weapon operation.

EXAMPLE: A person with a Strength of 2d+0 can safely fire one-handed a recoiling pistol of up to 3d+0 damage (3d+1 with a padded glove). They could safely fire a recoiling rifle of up to 6d+0 damage (7d+0 with shoulder padding). Or, they could safely fire a recoiling *autofire* rifle of up to 5d+0 damage (6d+0 with shoulder padding). If they fired a 5d+0 pistol one-handed while wearing padded gloves, they would take 1d+2 half-lethal damage (1d+1 non-lethal and 0d+1 lethal hits). People *have* actually been hit in the face by their own recoiling pistols...

Special effect(special) - This is something that is above and beyond accepted science, some wierd effect that *might* be possible once understanding of the universe has progressed beyond where it is now. That is, we can't tell you what the effects are because they are impossible according to current theory. An example in the **EABA** rules is "disruptors", weapons whose energy beam only interacts with a specific atomic or molecular signature, and thus ignores any barrier not made of that substance. Obviously, this is an *extremely* powerful modifier for a weapon. A special effect for Post-Atomic Era weapons is a -2d modifier, and a -4d modifier for Advanced Era weapons. Normally, effective countermeasures for a special effect will be developed within a fraction of a tech era, so if a particular special effect first becomes available in the middle of the Post-Atomic Era, the first countermeasure will be available by the late part of the era. Usually, neither the weapon with the special effect nor the countermeasure will be all that common, and both are usually restricted military tech in terms of weapon or armor cost.

A special effect can also be some neat but highly impractical or space-intensive function given to a weapon, like a high-tech quarterstaff that collapses to the size of roll of quarters with the push of a button, or an energy blade that disappears into its hilt when turned off. The penalty for this is whatever the gamemaster says it is. Since a ±3 change in damage is a change in energy of a factor of about a two-and-a-half, that can be a guide for other changes a special effect might have.

Compact/Bulky ammo(special) - Ammunition normally takes up the same space as the weapon for 200 shots. Each time you halve this, you get a +1 bonus to damage, and each time you double it, you take a -2 penalty to damage. Numbers in parentheses on the following table apply to *normal* weapons (200 shots equals size of weapon).

Weapon volume x1	Damage
shots x 250 (50k shots)	-16 penalty
shots x 125 (25k shots)	-14 penalty
shots x 64 (12.5k shots)	-12 penalty
shots x 32 (6400 shots)	-10 penalty
shots x 16 (3200 shots)	-8 penalty
shots x 8 (1600 shots)	-6 penalty
shots x 4 (800 shots)	-4 penalty
shots x 2 (400 shots)	-2 penalty
shots x 1 (200 shots)	+0 bonus
shots x 1/2 (100 shots)	+1 bonus
shots x 1/4 (50 shots)	+2 bonus
shots x 1/8 (25 shots)	+3 bonus
shots x 1/16 (12 shots)	+4 bonus
shots x 1/32 (6 shots)	+5 bonus
shots x 1/64 (3 shots)	+6 bonus
shots x 1/125 (2 shots)	+7 bonus
shots x 1/250 (1 shot)	+8 bonus

Bulky or compact ammunition affects the cost of ammunition, but *not* the cost of the weapon. Normally, ammo equal to the weight of a weapon will have a certain cost. The same applies here, but you are getting fewer or more shots for the same amount of money. The size of the ammunition also matters if it has an explosive payload. The bigger each shot is, the more explosives you can pack in.

Compact ammo might be used once or twice for certain modern weapons, or used several times for science-fiction weapons whose power packs hold a seemingly endless number of shots. Bulky ammo might be used once or twice for pistol cartridges, shotguns or for some archaic weapons that have inefficient ammunition types.

EXAMPLE: An Advanced Era weapon could lose 4d (-12 on the table) and still do the damage of an Atomic Era weapon of similar size and mass. But if the Atomic Era weapon has a clip holding 20 shots, the Advanced Era equivalent would hold 1250 shots!

Note - Most *reloadable* shoulder fired rockets will have this modifier at the "3 shots" level, which gives +6 damage, the same as for a *disposable* weapon (page 2.10).

In **Stuff!**, the ammunition for a weapon increases in mass as the weapon does. Bigger weapons fire bigger bullets. *But what if they don't?* The ammo weight rules work okay for weapons *in the same size range*. But, if you have a 4 millihex machine pistol that fires the exact same ammunition as a 2 millihex pistol, then their ammo *should* weigh the same, a twenty shot magazine for the machine pistol being the same size as a twenty shot magazine for the pistol. *What to do?*

If you are designing a family of weapons using the same ammo in different size ranges, but they have the same ammunition capacity for their weight (pistols to pistols, rifles to rifles), apply the "compact" ammunition modifier once for each change in weapon size. So, if your submachinegun is twice the size of a pistol, then the ammo would need to be half the size.

EXAMPLE: A 4 millihex machine pistol would get +3 in damage compared to a 2 millihex pistol, but would take a -2 penalty for compact ammo for a net result of +1 damage, quite reasonable when you figure the machine pistol probably has a longer barrel and sturdier construction. The design result is that weapons of the same type larger than the basic item are +1 damage for each larger size or -2 damage for each smaller size category, while ammo weight stays the same.

What does it all mean? This modifier tweaking is something you can usually ignore unless you are trying to make a weapon match a particular real-world weapon, or if you are designing a broad family of weapons to use the same ammunition and thus have similar final damage. If you *are* trying to model or recreate real-world weapons, there are detailed notes at the end of the advanced design section.

ADVANCED TOPIC: AMMO CAPACITY

Weapons of the same type from different tech eras may have different ammunition efficiency. You *may* apply the "bulky" or "compact" ammunition modifiers as needed to get that extra damage you need at more primitive tech eras, or to get the extra shots you want at more advanced eras.

The actual mass of things like ammunition is very hard to accurately generalize in as broad a system as **Stuff!** For instance, the bullets in a policeman's pistol do *less* damage than those in a soldier's rifle, but may weigh *more*. The pistol fires a large but slow lead bullet, while the rifle fires a small bullet, but at much higher velocity and penetrating power. The weight of the lead is why the pistol bullet is heavier. **Stuff!** does not have the detail to take things like this into account, and just assumes that bigger weapons have bigger ammunition. You would have to use **BTRC's** older weapon design book, **3G³**, in order to accurately design hand-held weapons down to the bullet level.

One-use weapon(+6) - This modifier is meant for disposable weapons, use once and throw it away. A grenade is a perfect example. A weapon which holds more than one shot but is still a one-use weapon (like a disposable pistol) might use "several actions to reload" or "bulky ammunition" modifier, not the "one-use weapon" modifier, which is meant for things like rocket launchers or other single shot devices that *include their ammunition mass in the designed size and mass*. This modifier is *more* effective than taking the "bulky ammo" modifier, since the weight of the one shot is included with the weapon rather than added to it.

Explosive damage(-6) - The weapon does damage as an *explosion* of the listed dice. A lethal explosion typically involves fragmentation or flames. Half-lethal or non-lethal explosion damage is only a -3 penalty, and is more representative of regular explosives, or "stun grenades".

EXAMPLE: An normal Atomic Era fragmentation grenade would be about this:

Atomic Era weapon	+30
Easy technology	+3
1 millihex weapon(.5kg)	-30
Lethal explosion	-6
Single use	+6
Thrown/placed weapon	+6
Modifier total	+9
Total	3d+0 lethal explosion

If it were a stun grenade (half-lethal damage), it would be a 4d+0 explosion instead.

A weapon can either *be* explosive, or *use* explosives. These are *very* different. If a weapon *is* explosive, like a land mine or disposable rocket or grenade, you use the -6 modifier on the weapon. And even for reloadable rockets, this works for many designs. But to be accurate, if the weapon *fires* explosives, like an artillery piece, grenade launcher or reloadable rocket, you apply the -6 modifier to the damage you would get from the size of *one* unit of ammunition. A unit of ammunition would usually be an "easy technology"(+3), "one use"(+6) device and be "explosive"(-6), for a final damage that is around +3 more than the base for its size. This is a case where having bulky ammunition is a *benefit*, since it means explosive payloads can be larger.

EXAMPLE: An 8 millihex one-shot rocket launcher would apply the -6 modifier to the *weapon* to figure explosive damage. It *is* an explosive weapon. On the other hand, an artillery piece *fires* explosive weapons. A 4 hex artillery piece normally holds 200 shots in a space equal to that of the weapon, or 20 millihexes per shell. *One* shell is a modifier of -14:

16 millihex weapon(.5kg)	-18
25% extra size	+1
Easy technology	+3
Lethal explosion	-6
Single use	+6
Modifier total	-14

If this were an Atomic Era shell (base damage of +30), then the artillery *shell* (-14 modifier) would have an explosive damage of +16 (or 5d+1).

If a weapon uses explosive ammunition, it can *usually* still fire other kinds. A tank can fire shells filled with explosives, *or* penetrating rounds. Note that the damage of an explosive warhead is *not* affected by the range to the target, because with an explosive warhead, range to the target is always zero (from the explosive, that is). However, the range at which the weapon would start to lose dice (see page 2.18) will be the weapon's *absolute* maximum range (explosive shells do the same damage at all ranges, but have a maximum range they can reach).

An explosion that is a *secondary* effect of the weapon would be a +3 *bonus* to the main effect, but a -18 penalty to the explosion part (see the "shaped charge" modifier).

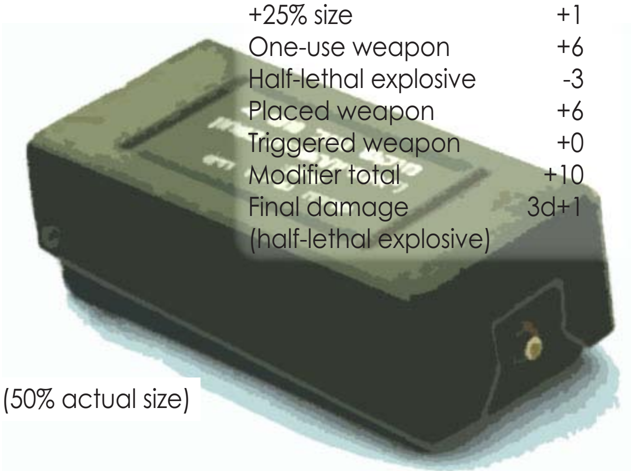
EXAMPLE: A weapon that is an anti-tank warhead will use an explosive charge to generate an intense armor penetrating effect. The effect on the target will be a lot more dice than the explosive effect on things in the immediate area.

A dual-use explosive charge like this will count the *largest* damage for any other effect that is based on the final weapon damage.

Note - Explosions are an area effect, but if the explosive actually hits its intended target, the effect *on the target* is +1d over the normal damage.

Shaped charge(+3) - A shaped charge is a special type of explosive warhead exceptionally good at penetrating armor. They first become possible early in the Atomic Era. In addition to the damage bonus, it is counted as an armor-piercing attack, and is considered to already have the "half-lethal explosion" modifier. The "shaped charge" modifier is usually taken on things like anti-tank rockets. A weapon that is a shaped charge must have a damage of at least +18 *before* applying this modifier in order to qualify. Ammunition, thrown or placed weapons that use shaped charges must also have a damage of at least +18 *before* applying this modifier in order to qualify.

NO4 Anti-personnel mine	
Atomic Era	+30
Easy technology	+3
.5 millihex	-33
+25% size	+1
One-use weapon	+6
Half-lethal explosive	-3
Placed weapon	+6
Triggered weapon	+0
Modifier total	+10
Final damage	3d+1
(half-lethal explosive)	



(50% actual size)

Note! - For a gameworld, you can always *say* a weapon is a shaped charge, even if less than 6d+0, but it has no special effect. So, you *could* say a big pistol gets its punch from tiny shaped charge bullets, but it would *not* count as extra damage nor have a secondary explosion.

A shaped charge counts as armor-piercing against armor of the same era or before, and also count as a half-lethal explosion, at -18 less than the adjusted attack itself.

EXAMPLE: An +24 attack becomes a +27 shaped charge (which is *lethal* damage), and also acts as a +9 *half-lethal* explosion.

Shaped charges will count as a "weapon enhancement" for determining weapon cost (page 2.39). The shaped charge modifier *may* be taken more than once. Larger shaped charges are more effective than smaller ones, and large enough weapons can have "stacked" shaped charges, where the first one starts punching a hole and the second one follows through with the knockout. The shaped charge modifier may be taken a maximum of once for a 1 millihex weapon (or 1 millihex unit of ammunition), and once more for each two rows of weapon size past this (4 millihex, 16 millihex, 64 millihex, etc.). *Each* extra modifier is a weapon enhancement for cost purposes, and will make the final weapon (or its ammunition) +1 cost. Multiple shaped charges simply count the *final* damage for determining the -18 penalty for any secondary explosion effects.

EXAMPLE: A weapon that is an +33 shaped charge because it took the modifier three times will also act as a +15 half-lethal explosion (+33 with a -18 penalty).

Note! - Explosions and shaped charges will blur the line between "weapon" and "ammunition". Is the grenade launcher the weapon, or is it the grenade? We'll deal with this in the ammunition cost section (page 2.39), but you would generally deal with it like the explosives example on page 2.10.

Hand-held(+3) - Ranged weapons that are designed for personal use are generally lighter than their vehicle-mounted counterparts, so they have higher damage for the same mass. Hand-held weapons get the largest bonus. Bipod or tripod weapons are not as good as shoulder-fired weapons, but still get a bonus. Weapons mounted on a vehicle or stationary ones which require an operator for all aspects of targeting get a small bonus, and weapons which *require* vehicle controls, a turret mount or otherwise require a functioning vehicle to operate are the default (no bonus). The main concept is that a non-vehicle weapon will be limited by human hand-eye coordination, which puts an upper limit on its Accuracy. You won't be shooting down air-to-air missiles with a weapon that is *manually* aimed...

EXAMPLE: A rifle, pistol, shoulder fired grenade launcher or rocket gets a +3 bonus. A tripod-mounted machinegun gets a +2 bonus. A ball-mount or pintle-mount machinegun on a tank gets a +1 bonus, as would an archaic field piece, but a coaxial turret-mounted machinegun gets no bonus. However, the turret-mounted weapon can have a higher aimed Accuracy than any of the other weapons, giving it a longer useful range.

Note! - If it is light enough (say anywhere in the -1d encumbrance penalty range), a bipod or tripod mounted weapon can be carried and fired from the hip. It would have an Accuracy of 0 if used like this.

Placed weapon(+6) - A placed weapon would be like a grenade or satchel charge. There is no real "weapon", just an poorly aimable means of doing damage and a means of triggering it. *This modifier cannot be used in conjunction with the "hand-held" modifier*. If you are throwing or placing it, this assumes you are already holding it in your hands. A thrown or placed weapon has an indeterminate upper size, depending on the campaign, but it should normally be around the normal lifting capacity of a normal person. For gameworlds where an **EABA** Strength of 2d+0 is the human norm, this would mean a maximum size of 100 millihexes (50 kilograms).

EXAMPLE: A satchel charge would be an easy technology(+3), half-lethal explosive(-3), one-use (+6), placed weapon(+6), for a total +12 modifier. So, an 8 millihex(-21) Atomic Era(+30) satchel charge would end up at +21, for a 7d+0 half-lethal explosion.

Strength-based(-9) - A Strength-based weapon is something like a knife, sword or axe. The final damage of the weapon is its *addition* to *punch* damage for melee purposes. The base modifier assumes the weapon can be used (or loaded) with one hand. The modifier is only -6 if it is a two-handed weapon.

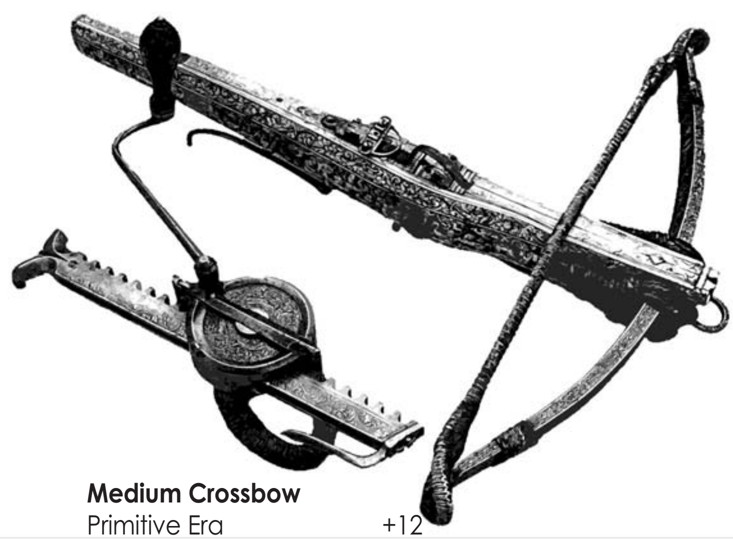
EXAMPLE: A melee weapon with a designed damage of 1d+0 does punch+1d lethal damage.

Strength-based weapons that do half-lethal damage get a +1 modifier to damage, and non-lethal ones get a +2 modifier to their damage. A normal ranged weapon that does not do lethal damage can also use these half-lethal or non-lethal modifiers.

*An extremely important note for any Strength-based weapon is that **all** modifiers on damage except tech era are divided by three, rounding down. This **includes** the Strength-based weapon modifier.* For instance, a +3 modifier becomes a +1, or a -6 modifier becomes a -2. Modifiers of less than +3 or -3, or any fractional amounts are not counted, unless there are enough of them to accumulate to +3 or -3, in which case they become a +1 or -1.

EXAMPLE: A 50% to weapon size is normally a +2. This would have no effect for a Strength-based weapon, since it is less than +3. However, if the weapon design also had a +1 modifier like half-lethal damage, the two together would add to +3, which *would* become a +1.

Thrown weapon(-12) - A thrown weapon is any projectile whose damage is directly or indirectly based on muscle power. This could be a thrown knife, spear or axe, but could also be a crossbow, bow or hand-cranked catapult. Grenades or other thrown weapons with *inherent* damage use the "placed weapon" modifier. A thrown weapon also gets the +1 for half-lethal damage and +2 for non-lethal damage, though few thrown weapons would ever be less than half-lethal damage. Since thrown weapons are Strength-based, all modifiers for them are divided by three as well.



Medium Crossbow	
Primitive Era	+12
Easy technology	+1
8 millihex	-7
Bulky ammo (shotsx 1/8)	+1
One minute to reload	+1
Thrown weapon	-4
Basic Era bonus	+1
Shoulder-fired	+1
Modifier total	+6
Final damage	2d+0

(remember that modifiers are one-third normal value)

A melee weapon which can also be thrown (or vice versa) would just be designed with the same physical parameters for both aspects. It just might end up with different damage in the different ways it is used. Since the adjusted difference between the thrown and Strength-based is 1 point, a thrown version of a weapon normally does 1 point less damage than it does when normally wielded.

Strength-based or thrown weapons *always* start with Primitive Era damage, though their materials technology may be of any era and this will affect their Armor, Hits and cost. A weapon like a bow, crossbow or siege engine *can* be designed as a thrown weapon, but in practical terms many would be better designed as normal weapons with longer reloading time, possibly bulky ammunition, and a detrimental side effect on operation that limits their use to those with sufficient Strength to cock the weapon. This would be Strength minus 1d for weapons cocked by arm strength, and Strength for those where you can put your whole body into it. A weapon using stored mechanical energy and the "thrown weapon" modifier can only use Primitive Era damage as its base. However, as a special case, you get +3 to damage for each tech era past Primitive (+1 after dividing by three), or +1 to damage for each fraction of an era past Primitive (which may include fractions that round to +0 after dividing by three). This represents lighter or more advanced materials and technologies, like compound bows.

EXAMPLE: A Basic Era crossbow would be made out of wood and metal, while an Atomic Era cross-bow could be made of carbon fiber and various synthetics. While the ergonomics of how a crossbow works mean the two crossbows are about the same size, the more efficient Atomic Era model will do +2 damage compared to a Basic Era model of the same size (and be considerably harder to cock).

A medium crossbow might start off as a Primitive Era weapon (+12), 8 millihex (-7), easy technology (+1), thrown weapon (-4), shoulder-fired (+1), for a damage of 1d+0. The Basic Era model would do 1d+1 damage, and the Atomic Era one would do 2d+0. Modifiers such as reloading time and bulky ammunition could combine to give more bonuses to damage. For instance, If you made the ammunition bulkier than normal (quarrels take up more space than bullets) and said the crossbow took extra time to reload, you could easily get +2 on the damages previously figured (see example to the left).

For weapons which would require the efforts of more than one person to cock, you would take the *average* Strength of those involved, and add +3 to their effective Strength each time you double the number of people involved. Extra mechanical leverage (like winches) is usually reflected in an increased reloading time modifier.

EXAMPLE: Eight 2d+0 individuals using a winch that takes a minute to crank could ready (in one minute) a "thrown" weapon with a modifier of +18 (or +6 after dividing by 3). This is +6 for their Strength, +9 for three doublings, and +3 for reloading time.

You normally design such a weapon by getting the size and tech era damage, then determinine the "minimum crew" (see the reloading notes on page 2.6) then figure out how long it takes that number of people to reload it and seeing if you want or need to add extra people.

EXAMPLE: A 16 hexagon Primitive Era trebuchet has a raw damage of +24 (+12 for era, +12 for size). So, it has a *minimum* crew of 4 (1 per 2d or +6). If the crew had Strengths of 2d+0, you would start off with +12 "cranking strength" (+6 base, +6 for two doublings). You can see that for any sort of final damage, it would take forever for four people to reload it and crank it into position (you would need a +12 from reloading time). Four people *could* do it, but you would want more.

ACCURACY MODIFIERS - Vehicle-mounted or emplaced weapons have a default Accuracy of half their damage *dice* (rounding nearest), while hand-held weapons have a default Accuracy of one-quarter their damage (rounding nearest).

Ranged weapons that are fired using two hands *and* braced on or over the shoulder (*or* using a bipod/tripod) get +1 Accuracy at no extra cost. All ranged weapons from the Basic Era or earlier get -2 to Accuracy (but may also get the "shoulder fired" bonus). Accuracy for weapons cannot be less than zero (they can't be *less* accurate when aimed).

EXAMPLE: A Basic Era rifle with a damage of 3d+0 would have an Accuracy of 0 (a base of 1, +1 for being shoulder-fired, and -2 for being Basic Era or earlier. This Accuracy *can* be bought up at an extra cost in Credits.

To buy extra Accuracy for a weapon (up to the limits for its tech era) can be done in two ways. One is in the **Weapon Cost** section (page 2.39), and is simply an "increased ability" for each +1 Accuracy. The other way is to use part of an "autonomous weapon" modifier (page 2.21) as an Accuracy bonus instead of a skill bonus.

LET'S SEE IF IT WORKS - That's all you need to design a vast array of conventional weapons. Can you really design up a practical weapon in a minute or less? Let's make a light machinegun that an Atomic Era soldier can carry around, something like the M-60 used by the United States.

Atomic Era weapon	+30
Average technology	+0
16 millihex weapon(8kg)	-18
Extra 25% size(+2kg)	+1
Autofire(reliable)	-3
Takes fifteen seconds to reload	+2
Bipod-mounted weapon	+2
Modifier total	+14
Total	4d+2 lethal damage

That's the weapon! It's 10 kilograms empty (a basic M-60 weighs about 11 kilograms empty). A 200 shot belt of ammunition has the same weight as the weapon (another 10 kilograms), and its base Accuracy is a quarter of its 4d+2 damage (round nearest), plus 1 because you need both hands and a shoulder to fire it, for total Accuracy of 2.

What about an archaic cannon? Something like you might find on a 17th century battlefield:

Basic Era weapon	+18
Late part of an era	+2
Average technology	+0
1 hexagon weapon(500kg)	+0
Takes a minute to reload	+3
Unreliable in wet conditions	+1
Manually aimed weapon	+1
Modifier total	+25
Total	8d+1 lethal damage

That's your cannon. It's 500 kilograms for *just* the cannon (a gun carriage is an advanced modifier (page 2.28)). Since 200 shots of ammunition has the same weight as the weapon (500 kilograms), we can figure about 2.5 kilograms per shot, which would make this cannon about what would be called a "six-pounder". Its Accuracy is a quarter of its 8d+0 damage (rounding nearest), or 2, minus 2 for being a Basic Era weapon (primitive aiming ability), for a total Accuracy of 0.

What about a melee weapon? Something like a nice longsword?

Primitive Era weapon	+12
Easy technology	+1
4 millihex weapon(2.0kg)	-8
Reduced 25% size(-.5kg)	ø
Strength-based weapon	-3
Modifier total	+2
Total	punch+2 lethal damage

There you go! Note how all the modifiers (aside from era damage) are divided by three. Melee weapons are always counted as Primitive Era for figuring the damage they do, but the materials they are made from may affect their armor, hits and cost. Handheld weapons have a base Accuracy of 0, so you get a weapon that does punch damage +2 in lethal damage for 1.5 kilograms.

Here is a fairly detailed basic design that you can reference back to later. This design project is the 40mm Mk19 autofire grenade launcher as used by the United States military.

Atomic Era damage	+30
Average technology	+0
Weapon of 125 millihex(62.5kg)	-9
Autofire(explosive weapon)	-9
Takes fifteen seconds to reload	+2
Explosive damage(lethal)	-6
Tripod mounted weapon	+2
Modifier total	+10
Final damage	3d+1 lethal explosive

This weapon has an empty mass of about 63 kilograms, and has ammunition of the default weight, so a belt of 200 grenades will also mass about 63 kilograms (.31 kilograms each). To compare, the actual weapon has a mass of either 43 or 54 kilograms, depending on which tripod you use, and the grenades weigh about .35 kilograms each. You could also design it around the grenade rather than the launcher:

Atomic Era damage	+30
Easy technology	+3
Weapon of .5 millihex(.25kg)	-33
50% extra space(+.13kg)	+2
One-use weapon	+6
Side effect	+1
Explosive damage(lethal)	-6
Placed weapon	+6
Modifier total	+9
Final damage	3d+0 lethal explosive

This gives a grenade that weighs about .38 kilograms. The operational side effect is that while it is a placed weapon, it *requires* the launcher to place it (you *can't* throw it manually). The launcher is designed much the same as before, but the costs of weapon and ammunition will be different.

This is an example of using the rules to design the same weapon two different ways, depending on the level of detail you want.

ADVANCED WEAPONS - Now that we've run through the simple stuff, there are extra modifiers to cover all the permuations and special cases. Like what if you want an autonomous ground-to-air rocket launcher with proximity-fuzed warheads and a minimum arming distance? *Yep, you can do that*.

Modifier	Damage
Fixed mount weapon	+0 bonus
60° arc weapon	-3 penalty
180° arc weapon	-6 penalty
360° turret weapon	-9 penalty
Nuke damage	+60 bonus
Indirect fire weapon	-3 penalty
Submunitions	-3 penalty
Extended range	-3 penalty
Reduced range	+1 bonus
Bracketed range	-1 penalty
Placed weapon	+6 bonus
Proximity fuzed	-3 penalty
Triggered weapon	+0 bonus
Untested technology	-3 penalty
Autonomous weapon	-3 penalty
Guided weapons	-3 penalty
Specialized targeting	+3 bonus
Slow weapon	+1 bonus
Powered melee weapon	special
Duration effect	-3 penalty
Declining duration effect	-2 penalty
Continuous beam	-3 penalty
Line area	-3 penalty
Cone area (narrow)	-6 penalty
Cone area (wide)	-9 penalty
Radius area	-3 penalty
Non-damage effect	+6 bonus
Stopping power	-1 penalty
Penetrating power	+1 bonus
Battering damage	-1 penalty
Adjustable damage	-1 penalty
Combined weapon	+1 bonus
Recoil compensation	-1 penalty
Self-charging	-3 penalty
Gun shield	-1 penalty
Gun carriage	-3 penalty
Dismountable weapon	-1 penalty
Generic gizmos	-1 penalty
Generic bonus	+1 bonus
Generic penalty	-1 penalty

Advanced modifiers separate casual users of **Stuff!** from the übergeek weapon-porn users. These modifiers are also going to be needed to recreate sophisticated real-world weapons, or tweak designs to match the known idiosyncracies of weapons or those from various SF or fantasy worlds.

Note that many of the modifiers will have the same sort of limits as explosive ammunition. That is, if the modifier is part of the *projectile* rather than part of the *weapon*, then you figure the damage of the projectile and apply the damage modifier to the *projectile* damage. For quick and dirty designs, it doesn't matter. If you want to go into more detail, it *will* affect the damage, as well as the cost of the ammunition and the weapon.

EXAMPLE: A radar-controlled gun that fires normal ammunition will be more expensive than a normal gun which fires radar-controlled projectiles. Conversely, ammunition for the first weapon is far cheaper than ammunition for the second weapon.

These modifiers can reflect the economic or political or science realities of a gameworld. For instance, if you already have flak guns, but you can't afford to retrofit them to radar controlled units, you get radar controlled projectiles instead. If you have the money, but your science doesn't allow miniaturized components for radar controlled flak shells, then you retrofit the weapons.

Weapon arc(special) - Vehicle mounted weapons have a default "0° arc". This would be like the broadsides of an old sailing ship, or the main cannon on the old Swedish S-tank. The vehicle must be moved to aim the weapon, though *some* fine aiming of several degrees to either side is usually possible at the weapon itself. In game terms, it can fire only down a specific row of hexagons, with a little leeway at longer ranges (a 15° arc of fire is about 1 meter wide per 4 meters of range). Most archaic artillery would be counted as fixed arc, but will have the "gun carriage" modifier, which allows them to be manually aimed in any direction (but this takes more time than a turret would).

Weapons with larger arcs of fire require more machinery to make this possible, so they do less damage for a given mass. That is, a 500 kilogram gun will do more damage than a gun and turret that together weigh 500 kilograms. For purposes of extra ammunition storage, ignore the "weapon arc" and "gun carriage" modifiers. *The mobility of the turret does not affect the size of the ammo.* Each -3 of turret penalty halves the size of the weapon for ammo storage purposes.

EXAMPLE: An Atomic Era weapon of 1 hexagon (+30) in a 360° turret (-9 penalty) will do a damage of 7d+0. The size of *just the weapon* is half the total size for each -3 penalty, so the weapon is one-eighth of a hexagon, and external ammunition storage would be based on this weapon size of one-eighth hexagon, *not* the overall one hexagon turret size.

Nuke damage(+60) - At the Atomic Era and later, *explosive* weapons can do damage based on fission, fusion or other advanced principles. Just add +60 to the effect. The cost would be like you took the "increased ability" cost modifier twenty times (once per +3 in the effect), or a cost multiple on the weapon of about x1000. Nuclear weapons are usually going to be single use devices. If a *reusable* weapon fires nucelar devices, the cost multiplier applies to the ammunition instead.

EXAMPLE: An Atomic Era "backpack nuke" would be a 100 millihex "one use" weapon with half-lethal explosive damage, the "nuke" modifier and the "placed weapon" modifier. Assuming no other modifiers on damage, this would give it a half-lethal explosive damage of 30d+0, which is roughly 40 kilotons of yield. The cost of the weapon would be about 600,000 Credits if you assume it is a "placed" weapon and not a "handheld" one.

Historically, the minimum size for a nuclear device is about 1 hexagon at Early Atomic Era and perhaps a quarter this for each fraction of an era afterwards.

Note - Technically, this would mean the 1 millihex "atomic hand grenade" is not possible until the Late Post-Atomic Era. It would be about a 28d+0 explosion, so throw it *really* hard.

Indirect fire(-3) - An indirect fire weapon is one that can shoot over or otherwise go around obstacles that block direct sight of a target. A mortar, long range rocket launcher or artillery piece is an example. In practical terms, an indirect weapon just falls on its target from a height. And while this by itself could be anywhere from painful to fatal, indirect fire weapons usually rely on some sort of explosive warhead or area effect to do their damage. Aside from being able to shoot over hills and the like, indirect fire weapons can aim at *areas* rather than *things* (for a substantial targeting bonus for the size of the area). The tradeoff is that you only have a random chance of hitting a *specific* target in that area, depending on the warhead of the weapon.

Indirect fire weapons may also be guided weapons, like terminal homing rounds that seek a target on their way down, and are often "slow" weapons that may take several seconds to a minute or more to reach their maximum range.

Indirect fire weapons are usually fired in quantity or in barrages, so that enough payloads are delivered that every hexagon in the target area is hit at least once. *On average, anyway*. There will always be areas hit harder than others.

Area(radius)	to hit	to hit one spot
1m	-1	3 shots
2m	-2	9 shots
4m	-4	30 shots
8m	-6	100 shots
16m	-8	400 shots
32m	-10	1600 shots
64m	-12	6400 shots
125m	-14	25k shots
250m	-16	100k shots
500m	-18	400k shots

The "to hit" number is the decrease to difficulty to put a shot *somewhere* on a target that size. The "to hit one spot" is about the number of *hits* you need to get on that area to have a fifty percent chance of a shot landing in a *particular* hexagon. If you have an attack that fills a certain radius with a useful effect (like an explosion), you can shift the "to hit one spot" row upward by the number of rows in your radius of effect.

EXAMPLE: If you're laying an artillery barrage into an area of 250 meter radius, and each artillery shell has a useful effect out to a distance of at least 8 meters, then you can shift the number of shots you need to fire to hit a particular target by 4 rows (8 meters is on the fourth row). So, in order to have a fifty percent chance of getting a specific hex in the 8 meter blast radius of one of your shells, you need to hit the area with at least 400 shells. Since a 250 meter radius target is -16 difficulty to be hit, you can probably lay a good percentage of your shots into this area from maximum range.

Submunitions(-3) - The weapon is big enough to have a payload that can be separated into smaller, independent weapons. Artillery shells that dispense cluster bombs would be an example. The main weapon or projectile is bought as having all the modifiers of the smaller ones, then apply -3 *each time* you double the number of effects.

EXAMPLE: A mine-laying artillery shell is bought as an +24(8d+0) lethal explosion that is triggered by stepping on it. Then the submunition modifier is taken five times. This doubles the number of attacks five times (to thirty-two), but drops the damage of each one by -15, down to +9(3d+0).

Submunitions can be dispensed more or less within reason, like in a line, a circular or elliptical area, and so on, but there will always be some random variation in the distribution, and the main weapon's to hit roll will determine how close the submunitions are distributed to their intended target. As a rough density guide, use "Size" on the **EABA Universal Chart** to represent the diameter of the area, and then double the *level*. Subtract from this a "Size" level equal to the number of sub-munitions, a Size level appropriate to the target size and a movement level to represent how much terrain is being covered. This number or better has to be rolled on 3d+0 to encounter a submunition in that area on a turn of movement, or on the turn they are placed. *This sounds like a pain in the neck to figure out, but it isn't that bad...*

EXAMPLE: If you drop 125 anti-vehicle mines over an area 250 meters in diameter, it would be something like this: An area 250 meters in diameter is a "Size" of 14, which is doubled to 28. A "Size" of 125 submunitions is a level of 12, which subtracts from 28, leaving 16. We'll say the size of the vehicle these are made for is 6 meters, which is a Size level of 3. This subtracts from 16, leaving a 13. So, each turn a vehicle that size drives through the mined area, it has to roll a 13 or more (on 3d+0) to be hit (or a 12 or less to be safe). The number would be reduced by the movement level used, since if you are covering more area, you have a better chance of hitting one or seeing it too late to get out of the way. A larger vehicle would be easier to hit, a smaller one harder. Similarly, if the submunitions were something like little shaped charges on parachutes, the chance of one randomly landing on the top of your vehicle if you are there when they are dropped would also be a 13 or better.

The math isn't perfect, but it's close enough for gaming purposes...

Extended range(special) - As a broad and not entirely accurate generalization, weapons will lose 1d of damage at a range of their damage level plus 10, and 1d more each 2 range levels thereafter. Just look at the **EABA Universal Chart** (**EABA**, page 3.4), find the damage of the weapon based *solely* on its size, tech era and type, add 10 and see what the corresponding range is.

EXAMPLE: A 2d+0 pistol bullet (damage level of 6) will go to 1d+0 damage at a range of 90 meters (distance level of 16), and then to 0d damage at a range of 175 meters (distance level of 18).

This isn't entirely accurate. A 1d+0 pistol bullet (damage level of 3) will still bore a hole in your skull at a range of 32 meters (distance level of 13), but a 4d+0 rifle bullet (damage level of 12) will lose 1d of damage long before a range of 700 meters (distance level of 22). In water, they would both lose damage far faster, and in a vacuum, neither would lose damage at all. Neither would the drop of damage with range apply to things like explosive warheads, though the "base" damage of the weapon could be used to determine its maximum range (see **Explosive Damage**, **EABA** page 5.7).

For **Stuff!** purposes, the damage level used to determine this range is the damage you get for the size of the weapon, the tech era and whether it is handheld, etc., with *no other modifiers applied*. Otherwise every time you tacked on a modifier you would have to change the range of the weapon.

EXAMPLE: An Atomic Era rifle (base damage of +30) of 8 millihexes (-21 penalty) that was handheld (+3 bonus) will have a damage level of 12 (4d+0 damage) for all rules relating to range vs. damage. It does not count whether it is autofire, has bulky ammunition or is unreliable or anything except tech era, size and weapon type.

The extended range modifier is there so that weapons of *extraordinary* range can be designed (like for starships). This modifier *may* be taken more than once. Each time it is taken, the range at which the *first* damage loss occurs is increased by 4, and the increments for *further* loss are increased by 1 each *two* times you take this modifier. *Huh?* See the following table for an illustration of both the extended and reduced range modifiers.

Design modifier	Range before -1d damage	Range per extra -1d damage
+6	Damage level - 14	+1 range level
+5	Damage level - 10	+1 range level
+4	Damage level - 6	+1 range level
+3	Damage level - 2	+1 range level
+2	Damage level + 2	+1 range level
+1	Damage level + 6	+2 range levels
+0	Damage level + 10	+2 range levels
-3	Damage level + 14	+2 range levels
-6	Damage level + 18	+3 range levels
-9	Damage level + 22	+3 range levels
-12	Damage level + 26	+4 range levels
-15	Damage level + 30	+4 range levels
-18	Damage level + 34	+5 range levels

EXAMPLE: You have a weapon with a damage of 8d+0 (damage level of 24), but you are also mounting it in a spaceship to fire at absurdly distant targets. You apply "extended range" four times. This reduces the weapon's damage to 4d+0 but adds 16 to the range at which it starts to lose damage (instead of damage level + 10, it is now damage level + 26). In this case, the weapon would not lose the first 1d of damage until a range level of 50. That is, you took "extended range" four times for a -12 modifier on damage. So, see the -12 row on the table above and add +26 to the base damage level of 24 to get the range where you lose damage). Further, instead of damage dropping by -1d each 2 range levels, it drops off each 4 range levels (+2 for having the modifier four times). This means the weapon has the following damage profile:

Damage	Out to:
4d+0	11,000 kilometers (range of 50)
3d+0	45,000 kilometers (range of 54)
2d+0	180,000 kilometers (range of 58)
1d+0	700,000 kilometers (range of 62)

Don't worry about trying to manually figure out absurdly long ranges. There is an extended version of the **EABA Universal Chart** in the back of these rules for just that purpose.

Reduced range operates in exactly the reverse manner, except that if the modifier is taken more than twice, the maximum range becomes *shorter* than the damage level of the weapon, and it loses 1d for *each* range band after the first time you take it. Reduced range cannot be taken more than six times (+6 damage), and taking it at this level usually reduces the range of the weapon to zero, This is the same as the "placed weapon" modifier. A placed weapon from the basic design rules is simply a weapon with six levels of reduced range.

Reduced range mainly exists so that extremely powerful weapons can have realistic ranges for their tech era, or so that short range, high power weapons can be developed. One level of reduced range gives pretty good results for lightweight, high velocity bullets, like many modern assault rifles or small caliber personal defense weapons. In addition, thrown weapons are assumed to already have three levels of reduced range and six levels of slow weapon (page 2.23), and cannot use either of these modifiers.

EXAMPLE: If the "reduced range" modifier were taken four times on the 8d+0 weapon from the previous example, the weapon would go to 9d+1 (damage level of 28), but the range at which it starts to lose damage is a range level of 18 (see the +4 row on the table and add the base damage level of 24). Plus, it would lose 1d from damage *each* range band past this. The damage profile would look like this:

Damage	Out to:
9d+1	175 meters (range of 18)
8d+1	250 meters (range of 19)
7d+1	350 meters (range of 20)
6d+1	500 meters (range of 21)
5d+1	700 meters (range of 22)
etc.	

Note - If you're worrying that the examples above are off by one meter, you're taking this way too seriously.

Reduced range also works for most large-bore and archaic weapons. Modern artillery is unlikely to have a maximum range of more than 45 kilometers (range of 34), archaic naval cannon no more than 16 kilometers (range of 31) and most siege engines could not range past 500 meters (range of 21). Reduced range, bulky ammunition, slow weapon (page 2.23) and battering damage (page 2.27) give best results for primitive siege weapons.

EXAMPLE: If you did real-world ballistic tests and converted the results into **EABA** terms, you would get the following results. Remember, the damage for range purposes is based on the weapon size, tech era and type, so it will not be the same as the actual damage. The first number is the real-world result, the second is the **Stuff!** result. Range is in meters, with the range level in parenthesis after it, like 90m(16) would indicate that a range of 90 meters is a range level of 16.

Range	9mm (level 6)	5.56mm (level 12)	with red. range x 1
0m(0)	2d+1/2d+1	4d+1/4d+1	4d+1/4d+1
11m(10)	2d+1/2d+1	4d+1/4d+1	4d+1/4d+1
23m(12)	2d+0/2d+1	4d+0/4d+1	4d+0/4d+1
45m(14)	2d+0/2d+1	4d+0/4d+1	4d+0/4d+1
90m(16)	1d+2/1d+1	4d+0/4d+1	4d+0/4d+1
175m(18)	1d+0/0d+1	3d+2/4d+1	3d+2/3d+1
350m(20)	0d+2/0d+0	3d+0/4d+1	3d+0/2d+1
700m(22)	0d+1/0d+0	2d+0/3d+1	2d+0/1d+1

You can see that for such a simple drop-off rule (damage level + 10), it does a passable job for the 9mm round. However, the 5.56mm round (second column) is another matter. The normal **Stuff!** rule allows the round to keep damage way past its real world numbers. However, if we gave the 5.56mm round one level of reduced range, it would look more like the third column, and while it is not perfect, it is a *much* closer match.

Note - Little tweaks like this are really more detail than you need for ninety-nine percent of all role-playing uses. That's why this is part of the *advanced* design rules. Dig rules like this out only when it is absolutely necessary or you have nothing better to do...

When extended or reduced range is applied to weapons with explosive or shaped charge damage, it acts differently. For *extended* range, it *does* drop the weapon damage, but the weapon does this damage at *all* ranges where it would normally do at least 1d+0 in damage. For *reduced* range, the base damage is increased, but the absolute maximum range of the weapon is the last range band where it does *full* damage, *unless* the means of doing explosive damage would reasonably drop with range. For instance, a flamethrower might splatter less at long range than short range.

EXAMPLE: If the weapon was an explosive-tipped missle and we used the extended range example, it would mean the missile does *full* damage (4d+0) out to 700,000 kilometers. If we used the reduced range example, it would mean the missile has a *maximum* range of 175 meters (the furthest range where it does maximum damage).

This can be used to represent a powerful short range weapon, like a portable anti-tank rocket. If a weapon has a maximum range of zero, it means it is a placed weapon like a satchel charge or mine, a dropped weapon like a bomb or a thrown like a grenade. Its range is however far you can throw it, roll it down a hill, drop it from a height, or set it so that someone stumbles over it (like a mine).

Note! - A weapon that fires a projectile with a long enough range can loft things into orbit. *How do you design this?* Fairly easily, as it turns out. First, *just* the tech era and size of the weapon need to have a certain damage for orbital/escape velocity:

Gravity	Orbital v.	Escape v.
.15g (Moon)	7d+0	8d+0
.25g	8d+0	9d+0
.40g (Mars)	10d+0	11d+0
.60g	11d+0	14d+0
.80g	16d+0	17d+0
1.0g (Earth)	19d+0	20d+0
1.20g	22d+0	23d+0
1.40g	25d+0	26d+0

Yes, a high-powered rifle ***can*** *put bullets into lunar orbit*. Then, the weapon needs to have a minimum range before it starts losing damage of at least the orbit you want to reach (at least range 40 for escape velocity). Last, you tailor the size of your payload based on the size of the launcher (default shot is 1/200th weapon size). Maybe make it a non-aimable vehicle weapon, give it an extended reload time and you're done!

EXAMPLE: A Jules Verne style cannon capable of shooting a shell full of passengers to the Moon (discounting the fact that the acceleration would turn them into strawberry jam) would need to do at least 20d+0 damage for its size and tech era, which would be a 4,000 hexagon weapon, which would fire a default shell of about 20 hexagons in volume, more than enough to carry a few people and supplies.

Bracketed range(-1) - Bracketed range is a specialized case usually applied to explosive weapons. The designer sets a minimum weapon range. The weapon does no *explosive* damage within this range. For instance, if you had a plane dropping nuclear bombs, you would want the bombs to have a safe arming distance so they wouldn't blow up the plane dropping them. Just because a weapon does no explosive damage doesn't mean it does *no* damage. *A person getting hit by an unarmed anti-tank missile is still going to be in serious trouble!* If this is the case, subtract 6d from the damage to represent the impact damage of the unarmed weapon and make it half-lethal instead of lethal effect. If a weapon has any sort of proximity, autonomous or guided weapon modifier, it may have bracketed range at *no* penalty to damage. A weapon with bracketed range and an explosive effect can usually be set to automatically explode once it reaches a given distance or a certain time delay. This could be a manually set fuze prior to the Middle Atomic Era, or a computer-programmed time delay at the Middle Atomic Era and later.

Proximity fuze(-3) - This applies only to area effects like explosions or radius effects, which can harm a target even if a direct hit is not scored. Proximity fuzes become possible in the Atomic Era. The user sets a *maximum* distance at which the explosive warhead will detonate. This becomes the target size for purposes of aiming modifiers, *not* the actual size of the target. Any hit that misses by this amount or less triggers the explosion at the range appropriate to the degree of the miss.

EXAMPLE: If you had a 7d+0 explosion, it would do 3d+0 to anything within 4-7 meters (see **EABA**, page 5.7). Seven meters is about the size of a truck or tank, which would be a called shot difficulty of -4 (four points easier to hit). Any shot with the weapon that misses by four points or less means that the explosion still goes off, but the target will be in the 3d+0 damage range, not the 7d+0 of a direct hit.

Proximity fuzes are best when the size of an explosion or area effect is large compared to the size of the intended target. A seven meter explosion doesn't need a proximity fuze if targeting a three hundred meter battleship. Similarly, if the weapon will eventually hit *something*, a proximity fuze may not be necessary. Artillery shells go off when they hit the ground, and if the target is nearby, it gets some of the effect. You don't need to proximity fuze the warhead. On the other hand, if you are trying to affect an airplane surrounded by a whole lot of nothing, proximity fuzes might be a good idea.

Triggered weapon(+0) - Many placed weapons can be triggered, and this has no extra space or cost. For a placed weapon that can be triggered by being run over or stepped on (but which has no proximity fuze), the trigger has a skill roll of 2d+0. This roll is made vs. a difficulty of 3 for a "perfect" target, and the difficulty is modified by anything outside that range. If a triggered weapon is ranged, and aimed at a particular spot, it also uses the 2d+0 skill roll to hit, if it triggers. For weight ranges, something will trigger fairly reliably if it is within a factor of three of the "perfect" weight (about five weight levels).

EXAMPLE: An anti-personnel mine is meant to be triggered by a normal person (80 kilograms, a weight level of 8). An 80 kilogram person stepping on the mine means it rolls 2d+0 and tries to get 3 or better. A 100 kilogram person on a 200 kilogram motorcycle would be a total weight level of 14, 6 levels off the "perfect" weight, so the mine would have to roll 9 or more on 2d+0 to trigger if run over by the motorcycle. If it fails the roll, its trigger thinks the target is outside the right weight range and doesn't fire. Similarly, an 80 kilogram person that steps on an anti-vehicle mine meant for a multi-ton vehicle is quite unlikely to trigger it.

Remember that explosives do +1d damage if they are in contact with a target, so a land mine would usually have +1d effect on what triggered it. If a triggered weapon like a land mine takes an "enhanced capability" on its cost, each level will increase the spread over which it can trigger. For instance, one level of enhanced capability would mean target numbers are increased by 1 for each 2 levels of weight difference instead of for *each* level.

EXAMPLE: An United States M-19 anti-tank mine (approximately 12.5 kilograms) designed as an Atomic Era weapon would be:

Atomic Era	+30
Easy technology	+3
Weapon of 16 millihex	-18
50% extra space	+2
One use weapon	+6
Shaped charge x 2	+6
Placed weapon	+6
Triggered weappon	+0
Modifier total	+33
Total	11d+2 lethal
	(plus 6d+2 half-lethal explosion)

This weapon has *zero* range. It is not even proximity fuzed. You have to run over it to set it off.

Untested technology(-3) - This is really a catch-all modifier. It represents a culture trying to use a particular means to do damage for the first time. It's another way of looking at the "hard technology" modifier from the basic design section (page 2.4). For instance, the first cannon shot large metal *arrows* instead of cannonballs. This was not a very effective use of the technology, and they quickly stopped doing it. However, for the subset of an era where the tech is first turned into a weapon, this modifier may apply. Once a "battle proven" weapon has been developed, subsequent designs will no longer have this penalty. A modern example might be point defense laser weapons. We have nothing but prototypes, and none have been tested under actual combat conditions. They would take this penalty. Maybe by later in the Atomic Era we will have the bugs worked out.

Autonomous weapon(-3) - An autonomous weapon is much like a placed weapon, but with range or some degree of brains. They are only possible at the middle of the Industrial Era or later. Instead of a fixed 2d+0 skill roll, they get 1d+0 at Industrial Era, and +1d each era after that (or +1 for a fraction of an era). Note that an autonomous weapon almost requires some form of electronics, which is why they are not available in the *early* part of the Industrial Era.

An autonomous weapon uses its skill roll to "see" the target each round, and cannot be fired until it makes its first roll (the "lock on"). If an autonomous weapon is in any way aimed by a person (like a shoulder-fired rocket), it can't be fired until the *person* makes their first roll to acquire the target. If it loses target lock on one turn and does not regain it on the next roll, it misses. It veers off, crashes into the gorund, self-destructs, just goes straight ahead or otherwise becomes uncontrolled. Autonomous and user-guided weapons use their skill roll against a range of one turn's worth of movement *on the turn it would hit the target* (also see the "slow weapon" modifier, page 2.23). If it had lock-on on the previous turn, it may use its Accuracy bonus, and get +1 per round of successful "aiming" (up to +3), just as for any other aimed weapon.

Note! - Yes, this *does* mean that faster weapons are going to be harder to hit with (because they have a longer range from one turn's worth of movement). They have less time to "think" about how they are going to adjust their course, but on the other hand, the target has less time to spot or react to it.

Guided weapon(-3) - The autonomous weapon modifier can also be used for user-guided weapons. The difference is that a guided weapon's skill roll is +1 at Industrial Era and +1 to that for each era after that, but that skill roll *adds to the user's ability*. The bonus to user skill may not exceed the user's natural limits with that skill.

EXAMPLE: If a user has a skill roll with "guided rockets" of +1d, and the maximum possible skill bonus for their Agility is +2d, then a guided anti-tank rocket will never give *this person* more than a +1d bonus to their existing skill (a *total* skill bonus of +2d).

This skill roll is used for targeting just as a person would use the weapon, but with certain preset conditions. For instance, an user-guided air-defense system would not shoot ground targets, or might only shoot at air targets that are not equipped with a radio transponder broadcasting a specific "I'm friendly, don't shoot me!" signal.

A robot or other construct with indepdent decision making capability would still take this modifier, as it mainly represents the ability to finely aim the weapon. The actual "brains" are a minor part of the weapon's size, but the one most important for the number of skill dice available. An autonomous weapon in something like a self-aware robot could either fire using the robot's skill and a great deal of flexibility, or act autonomously at its inherent skill, but only according to its pre-set parameters. *Just because you've taken out the main AI doesn't mean the automated security lasers have gone dead...*

A placed weapon that is autonomous is one with a triggering condition appropriate to the tech era. Middle Industrial Era and earlier are going to be mechanical triggers or time fuzes. A clockwork automatic fuze could be quite sophisticated, acting in different ways at different times of day or changing the weight or number of triggering incidents before it does particular actions. Only in the Late Industrial Era and later will things like electronic or magnetic sensors become available. Placed weapons require that the target come to the weapon, rather than the other way around, and are always specified as to a time or time range, or a target type.

Both the autonomous and guided weapon modifiers may be taken up to twice. You simply take up more space in the weapon for the guidance mechanisms. Similarly, it can be taken in fractional amounts for a lesser or pro-rated bonus (round all fractions towards the lower skill bonus).

EXAMPLE: A Post-Atomic Era user-guided weapon gives a +1d skill bonus (+1 at Industrial Era, +1 more at Atomic Era, +1 more at Post-Atomic Era). This modifier also drops weapon damage by 1d. So, you could easily say that each +1 skill bonus is worth a -1 penalty to damage.

A full +1d of guided weapon or +2d of an autonomous weapon bonus maybe given up to give the weapon a +1d "larger than life" bonus. That is, the weapon (for autonomous weapons) or the user (for guided weapons) can keep the "best four" die in a roll rather than the "best three". This really only becomes a factor for Post-Atomic Era weapons, but it can make them devastatingly effective. This "larger than life" bonus can be taken twice for Advanced Era weapons.

EXAMPLE: A Post-Atomic Era guided weapon can have up to a +2d skill bonus if the modifier is taken twice. This could be a +1d skill bonus *and* the ability for the user to keep the "best four". An Advanced Era autonomous weapon could have have up to an 8d+0 skill roll. This could be converted into a 6d+0 skill roll for the weapon *and* the ability for it to keep the "best four".

Up to now we have been assuming that an autonomous or guided weapon is something like a rocket, where the user or guidance system has to constantly track its target. A guided weapon can also represent a targeting aid mounted *on* a conventional weapon. This simply provides a bonus to the user's skill to hit under a particular set of circumstances or against a particular target type. A guided weapon bonus may be applied to weapon Accuracy instead of user skill on a 1 for 2 basis. That is, 1 point of skill or 1d of autonomous weapon bonus can become +2 to weapon Accuracy. This is part of the design process and may not be changed later. Any skill bonus of more than +1 may also be split between skill bonus and Accuracy. Remember that weapon Accuracy only applies if you take a major action to aim.

Note - This ability to gain Accuracy *does* overlap somewhat with the concept of weapon gizmos (page 2.29). It works best for high-tech weapons that have phenomenal accuracy due to weapon improvements we haven't thought of yet, while gizmos are things we have or have at least thought about.

EXAMPLE: A range-finding telescopic sight with ballistic compensation might be a +2 guided weapon bonus (Atomic Era). The designer decides to split this between a +1 to user skill and +2 to weapon Accuracy. *It would still only count as one weapon enhancement for figuring the weapon's cost.* This sight gives the user a +1 to their weapon skill roll in *all* cases, and if they aim, they get their weapon's Accuracy, which is increased by 2 over the basic weapon because of this sight.

ADVANCED TOPIC: ADVANCED TARGETING

EABA is a role-playing system that uses a "people" scale, not a "vehicle" scale. For roleplaying, a hand-held weapon Accuracy of up to 7 gives good results, allowing a good shot with a good weapon to hit a person-sized target out to several hundred meters, further if the weapon is braced. By the Early Atomic Era, useful technological targeting aids become possible, allowing direct fire to ranges far beyond those possible for an unaided human. These aids will take two forms. The first is an *extremely high* Accuracy stat. This represents a very precise aiming system, but the weapon still requires a major action to aim in order to gain this Accuracy.

	Accuracy limit	
Tech Era	**mounted wpn.**	**handheld wpn.**
Early Primitive	3	2
Primitive	4	2
Late Primitive	5	3
Early Basic	6	3
Basic	7	4
Late Basic	8	4
Early Industrial	10	5
Industrial	11	6
Late Industrial	13	7
Early Atomic	15	8
Atomic	18	9
Late Atomic	21	11
Early Post-Atomic	25	13
Post-Atomic	29	15
Late Post-Atomic	34	17
Early Advanced	40	20
Advanced	47	24
Late Advanced	55	28

The second is one or more levels of the Trait **Larger than Life** (**EABA**, page 2.14), only usable for that particular weapon. Post-Atomic Era weapons can have one level, and Advanced Era weapons can have two. The full benefit of technology is only available for vehicular weapons, but Accuracy of half the maximum can be used for hand-held weapons to reflect advanced sighting aids.

Specialized targeting(+3) - User-guided or autonomous weapons *must* have a "target type". Heat-seeking anti-aircraft missiles would be an example. Generally, the "target type" is the environment in which the target typically resides. These environments would normally be "surface", "air", "underwater" and "vacuum". The default for an autonomous weapon is to be able to go after *any* target in that environment. A weapon with "specialized targeting" has to further narrow its target type to a specific characteristic within that environment. For instance, "radar homing anti-aircraft" or "acoustic homing torpedo". It cannot engage *any* target outside this type.

Note! - In a real-world design sense, *all* guided or autonomous weapons will have specialized targeting. We have yet to come up with an anti-aircraft missile that can switch between heat seeking, radar homing and optical pattern matching, depending on the type of airborne target. If you want to shoot down *everything* airborne, you mount a targeting sight to an auto-cannon and put a person behind the trigger...

Slow weapon(+1 or more) - Most weapons are assumed to hit their target the instant they are fired. For most role-playing situations, this is going to work just fine. However, for some weapons it is possible there could be a significant delay between firing the weapon and when it gets there. This modifier is usually only used on guided or autonomous weapons that are designed to "reach out and touch someone". So, no, you can't make a "slow" land mine just to get extra damage, nor do you usually apply it to guns, but you *might* say a bow or crossbow has "slow" ammo. Any direct fire target outside a second's flight time gets double its movement modifier for each second of distance.

Note - For **EABA** combat purposes (assuming human reaction times), a weapon with one or two levels of "slow weapon" cannot be deliberately dodged (it is too fast to see and/or get out of the way of). Weapons with three levels *can* be dodged, and each level after that would be a +1 to dodging ability (slow things are easier to dodge). Most muscle-powered ranged weapons like bows and crossbows will have three levels of "slow weapon", since they can be dodged. Remember that since these are Strength-based weapons, three levels of slow weapon is only +1 to damage. Thrown *melee weapons* are assumed to already have six levels of slow weapon *and* three levels of reduced range and cannot take either of these modifiers.

The first time you take the "slow weapon" modifier, its speed per turn becomes 1000 meters per second. Each extra time you take the modifier, weapon speed is halved.

Modifier	Damage
1000 meters per turn(36)	+1 bonus
500 meters per turn(32)	+2 bonus
250 meters per turn(28)	+3 bonus
125 meters per turn(24)	+4 bonus
64 meters per turn(20)	+5 bonus
32 meters per turn(16)	+6 bonus
16 meters per turn(12)	+7 bonus
8 meters per turn(8)	+8 bonus
4 meters per turn	+9 bonus
2 meters per turn	+10 bonus
1 meter per turn	+11 bonus

The number in parentheses is the range level of the *maximum* range a ballistic object like a cannon ball would fly if it had that velocity (ignoring drag effects). This lets you get maximum accurate use from the reduced range modifier.

EXAMPLE: You design up a medeival siege weapon. You're not aiming it at anything faster than a castle, so you want the weapon to be slow as possible and still have suitable range. You look up a range level of 20, and see that this is 350 meters, sufficient for your purposes. So, you give your siege weapon a +5 "slow weapon" bonus, and then figure a reduced range modifier that gives you sufficient damage at a range level of 20 (350 meters).

You can use this in conjunction with "reduced range" and "bracketed range" modifiers to get just about any speed and range parameters want. However, if a weapon is supposed to reach its maximum range in one turn, it usually will *not* have the "slow weapon" modifier.

EXAMPLE: You design up a weapon that has a maximum effective range of 40 meters, and it gets to 40 meters on the turn it is fired. Unless the nature of the weapon is that it is "dodgeable", you cannot take *any* "slow weapon" modifier. That is, you cannot play "Timmy powergamer" and get a free +2 to damage by saying it has a "slow weapon" bonus which is undodgeable but is also irrelevant considering the weapon's maximum range of 40 meters.

EXAMPLE: Let's say you wanted to design an Atomic Era laser-homing missile designed for use against ground targets. You want it to have a minimum arming distance of 50 meters, a range of 2 kilometers and a top speed of 500 meters per turn. And we'll say the missile is fired from a disposable cannister just to make things easy. The laser illuminator that is used to "paint" the target is a separate item and would be designed elsewhere in **Stuff!**.

Atomic Era damage	+30
Weapon of 125 millihex	-9
One use weapon	+6
Shaped charge x 4	+12
Side effect (backblast)	+1
Reduced range (dmg. level + 2)	+2
Bracketed range (40 meters)	-0
Guided weapon	-6
Specialized targeting	+3
Slow weapon (500 meters/turn)	+2
Tripod mounted weapon	+2
Modifier total	+43
Total	14d+1

The base damage for the weapon is +23(or 7d+2), for tech era, size, and tripod mounted, so with the reduced range modifier it has a normal range before it starts losing damage of 23 (damage level) plus 2 equals distance 25 (2 kilometers). And since this is an explosive warhead, this 2 kilometer range becomes the absolute maximum range.

Artillery pieces are another use for this modifier. They may be firing at targets kilometers away, and rather than aiming at a *thing* (which can move out of the way), they aim at an *area*, and hope that targets are in that area by the time the shells land.

Powered melee weapon(special) - A melee weapon is always designed as Primitive Era for damage purposes, but this does not mean technology can't be used to enhance it. An electrified police baton would be an example. A powered melee weapon would use the "combined weapon" modifier (+1 bonus, page 2.27) and would consist of a normal melee weapon and a technologically appropriate weapon with the "thrown/placed weapon" modifier (+6 bonus) and a "beneficial side effect" (-2 penalty) that if the main weapon hits, the other weapon does as well. The net effect is to have two melee weapons, but one has to have a power supply or ammunition in order to function. If you are not using **EABA**, this modifier could be used for a "flaming sword" or other magical item. If you *are* using **EABA**, weapons with paranormal effects are best bought as enchanted items.

ADVANCED TOPIC: ENERGY BLADES

A melee weapon that has a "laser blade" or other form of damage that requires continuous power would be a ranged weapon with the "reduced range"(+6), "detrimental special effect (requires a melee skill roll/short blade length)"(+2), and "continuous beam"(-3) modifiers. The damage done by such a blade would be independent of the Strength of the user, since it is not relying on moving mass to get its penetration.

Duration effect(-3) - A duration effect is one that continues after the firer has finished their action or moved on to other targets. A flamethrower would be an example of a duration effect. Each time the modifier is taken, the duration is increased by 2 levels (doubling it). The first doubling goes from a duration of an "instant" to 2 seconds (the turn the weapon is fired, and the turn after that). The target takes damage at the same point in each turn of the original amount (which may be re-rolled if the gamemaster allows). At the end of the duration, the damage stops. This modifier is not appropriate for all types of attacks or tech eras, so it should be used carefully.

Declining duration effect(-2) - Similar to a duration effect, but the damage is reduced by the elapsed duration, with a maximum duration based on the number of levels bought.

EXAMPLE: A "declining duration" taken twice would give a total duration of 4 seconds. The original attack would do normal damage. At second 2 (time level of 2), damage would be the original damage minus 0d+2. At second 3 (time level of 3), damage would be the original damage minus 1d+0, and on the last second the damage would be the original damage minus 1d+1.

Continuous beam(-3) - Effects like continuous laser beams can be handled as an autofire attack, a shotgun attack, or use this modifier. A continuous beam modifier means that as long as the weapon is "on", anything crossing its path is *automatically* hit. This is like an autofire attack, but each extra hit adds +1d damage to the first hit. That is, you only get one hit, but the damage it does is increased on a better to hit roll. In game terms, continuous beams can be used to deny an area to anyone not willing to be hit, or to automatically hit something that passes through that area between one firing action and the next. Ten "shots" for the weapon counts as a continuous beam for one second.

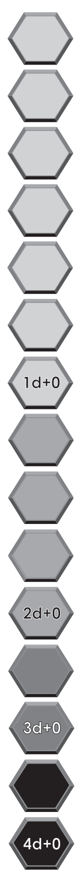
Note - If you don't want a continuous beam to *automatically* hit anything that crosses the area, use a skill roll to initially aim the beam, and count only range and target size for determining if there is a hit. Since this is a passive effect, there is no multiple action penalty by the shooter if multiple targets cross the beam.

Line area(-3) - A line area is an area one hexagon wide that extends from the tip of the weapon. A weapon with line area is assumed to automatically have the maximum level of the "reduced range" modifier, for which it *does not* get the damage bonus.

EXAMPLE: A weapon with line area and a damage for its size of 4d+0 (damage level of 12) would do 4d+0 at the tip of the weapon, and lose 1d of damage at each range band past zero.

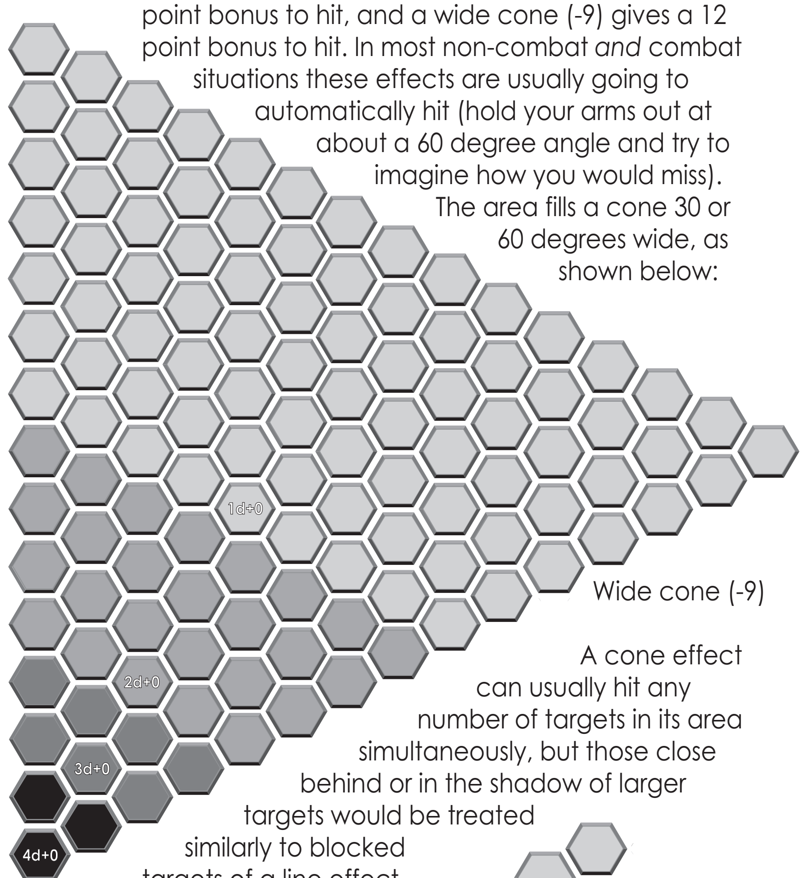
This *can* be bought up with the "extended range" modifier as needed. In combat terms, a line area automatically hits anything that its line crosses, but targeting a specific item on that line is not automatic. If your shot with a regular weapon would miss by more than a meter, the fact that your "bullet" is a meter wide won't help. Practically speaking, it is a permanent 2 point bonus to hit. If a line effect intersects a target, it usually stops at that point, or if it can go through or around the target, it loses 2d+0 of damage *plus* the size level of the target.

EXAMPLE: A 3d+0 flamethrower blasts some unlucky soul, but 1d+0 of the jellied fuel laps around him or splatters and continues on downrange. A flamethrower burst hitting a car (say a size level of 2) would stop 2d+2 of the burst from continuing on (2d+0 base, +2 for the car's size level).



Line area (-3)

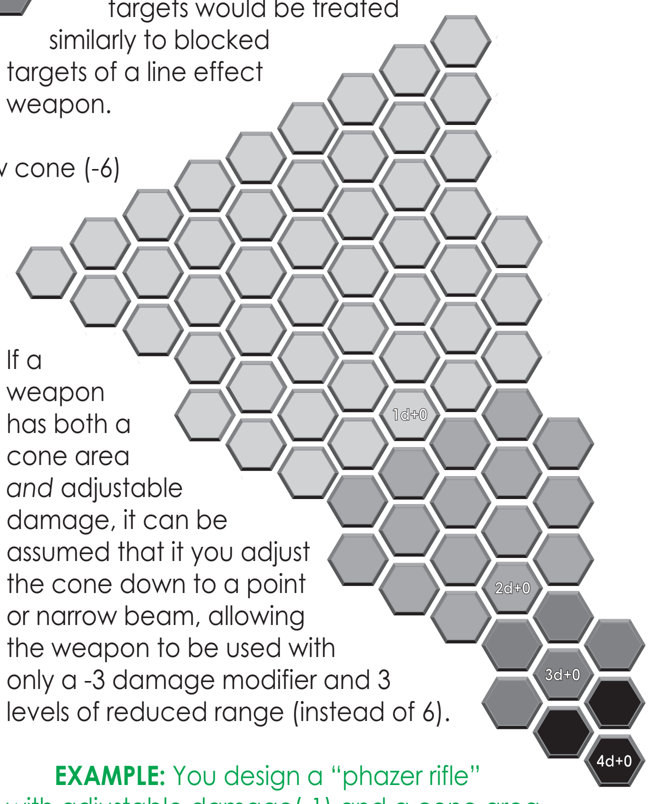
Cone area(-6) - This is handled exactly the same way as a line area, but it is a lot easier to hit with. A narrow cone (-6) counts as a permanent 6 point bonus to hit, and a wide cone (-9) gives a 12 point bonus to hit. In most non-combat *and* combat situations these effects are usually going to automatically hit (hold your arms out at about a 60 degree angle and try to imagine how you would miss). The area fills a cone 30 or 60 degrees wide, as shown below:



Wide cone (-9)

A cone effect can usually hit any number of targets in its area simultaneously, but those close behind or in the shadow of larger targets would be treated similarly to blocked targets of a line effect weapon.

Narrow cone (-6)



If a weapon has both a cone area *and* adjustable damage, it can be assumed that it you adjust the cone down to a point or narrow beam, allowing the weapon to be used with only a -3 damage modifier and 3 levels of reduced range (instead of 6).

EXAMPLE: You design a "phazer rifle" with adjustable damage(-1) and a cone area (-6), with a final damage of 6d+0. You can use the rifle as a 6d+0 cone area attack, or narrow the beam to a 7d+0 normal attack with a longer range.

Radius area(-3) - A radius area fills an area a certain number of hexagons across, including in the vertical dimension. If the effect happens in mid-air, the effect is a sphere. The base radius is enough to fill one hexagon, and for each extra -3, the radius doubles, first to one meter radius, then two, then four, and so on. A one meter radius fills the center hexagon and all the surrounding hexagons.

Anything in the area of effect is automatically hit with the weapon's effect, and the radius means that the user can target either an individual, or any area that would include them.

EXAMPLE: *Centering* a radius effect attack on a person would be done by targeting the person. Just trying to hit the person would be done by targeting an area that would include them.

To get the bonus, simply take the *diameter* and find it on the size column of the **EABA Universal Chart** (**EABA**, page 3.4). This level is the weapon's bonus to hit.

EXAMPLE: An attack with a diameter of 8 meters is a size level of 4, so the weapon gets a 4 point bonus to hit.

Non-damage effect(+6) - Sometimes a weapon doesn't do damage. This is another case where **EABA** players might be looking for a tech solution for a paranormal problem. For instance, an illumination flare might use the "non-damage" modifier, but the nature of the campaign might be such that they *should* be using a paranormal focus with the "acts as an Attribute" modifier.

The "non-damage effect" usually means that the weapon acts as an Attribute on the target or anything in an area of effect. An entanglement weapon like a net gun might act as Strength or penalty to Health which competes against the target to slow or prevent their movement, while an illumination flare might act as an Awareness that anyone in its area could use to see things with, or a smoke cloud an Awareness that subtracts from that of anyone in the area. A tranquilizer gun might be bought as non-lethal damage, but it might also be bought as an Agility that subtracts from the target for a given duration.

If you are trying to stay completely within a tech-based framework, use this modifier and take care with the nature of the effect you are trying to generate.

Stopping power(-1) - This is one of the nebulous terms that various experts will argue about until they are blue in the face. In **Stuff!** terms, it means the weapon has a greater capacity for injury than for armor penetration. You apply -1 to damage, but damage that *penetrates armor* is increased by +2. So, against unarmored or lightly armored targets, you get a net +1 to damage.

EXAMPLE: A fan of the venerable .45 ACP and firm believer in its "stopping power" designs up a pistol with 2d+1 damage. If the "stopping power" modifier is applied, damage drops to 2d+0, but if the weapon hits an unarmored target, you add +2, making it 2d+2. If the target had 2d+0 armor, the normal 2d+1 pistol would do 0d+1 damage, but the 2d+0 "stopping power" version would do nothing.

Penetrating power(+1) - The weapon has a better ability to penetrate armor than it does to damage tissue. A small diameter, high velocity round might have this characteristic. It adds +1 to the damage of the weapon for penetrating any armor, but damage after any armor is penetrated is reduced by -2. However, if anything penetrates armor, damage is always at least 1 point.

EXAMPLE: A fan of the new 4.6mm personal defense round and firm believer in its "penetrating power" designs up a pistol with 2d+1 damage. With the "penetrating power" modifier, it has 2d+2 damage. But against an unarmored target, it only does 2d+0 damage, less than the version without this modifier. If the target had 2d+1 armor, the normal 2d+1 pistol would do no damage, but the "penetrating power" version would do 1 point.

Penetrating and stopping power on damage are indicated by a superscripted ^{p} or ^{s} after the damage, while battering power (see next page) uses a superscripted ^{b}. For instance, a 2d+1 weapon with "penetrating power" would be listed as a damage of $2d+1^p$, and one with "stopping power" would be listed as $2d+1^s$. For stopping, penetrating and battering power modifiers, armor only applies to materials that the weapon is not considered armor-piercing against. For instance, heavy clothing may be 0d+1 armor, but it is not an appropriate armor against bullets or the blunt trauma of catapult stones. If a weapon would normally ignore the level of armor it hits, it does not trigger any armor-specific effects.

Battering power(-1 per +3) - Very large bore weapons firing solid shot often have this modifier, as would catapults and similar archaic weapons. Modern weapons with a more scientifically tailored ability to penetrate armor generally do not have this modifier, but might have "stopping power" instead. Battering power can also be used for high-tech stunners, where if they penetrate armor at all, they do a lot of non-lethal damage. The modifier is a -1 to damage for each full +3 the weapon has from its size, tech era and type (no other modifiers apply). However, if the weapon penetrates armor, it gets +2 damage for each die of final weapon damage. In addition, battering power increases a vehicle's Damage Limit by 1 for each 2d of damage striking the vehicle, so a 6d+0 battering weapon increases a vehicle's Damage Limit by 3 for hits by that weapon. Even at maximum useful range, a hit against a lightly armored target by one of these weapons is likely to be devastating.

EXAMPLE: An archaic 32-pounder cannon might have a damage from tech era, size and type of +30(10d+0). With the battering modifier, this gets a -10 modifier and drops to +20(6d+2). If a 10d+0 weapon were fired at a stone wall with an armor of 6d+0, it would get 4d+0 damage through. If a 6d+2 battering weapon were fired at the same stone wall, it would get 0d+2 through, but get +12 for a battering weapon (+2 for each 1d+0 of *final* weapon damage), for a total effect of 4d+2.

With other modifiers like reloading time applied, the battering modifier can make archaic weapons even more effective against poorly armored targets. In addition, even if you apply decreased damage with range, battering weapons still do significant damage at maximum range.

EXAMPLE: If the 32-pounder was at maximum range and only did 0d+2 penetrating damage, if it hit an unarmored person, it would still get +12 and end up doing 4d+2 damage (it is a 32 pound cannonball falling from the sky, after all!).

For penetration, stopping power and battering, the ammo the weapon uses is usually the source. If the tiny, fast projectile of the 4.6mm personal defense round is the source of the "penetrating power", then *any* weapon firing that round has that characteristic. However, a weapon that has neither characteristic can usually buy special ammunition (at extra cost) that gives either characteristic. For instance, buying special hollow-point rounds that have better "knockdown" ability.

Adjustable damage(-1) - The weapon has a function or mechanism that allows you dial in the damage you want, anywhere from 0d+1 up to the normal damage of the weapon, and usually up to +1d more, *if the weapon is assumed to be a level more unreliable for those shots*. An example would be a binary propellant weapon. A weapon with adjustable damage and continuous beam would be something like a variable power laser cutter. Adjustable damage is usually the same type of damage the weapon normally does (lethal, half-lethal, non-lethal). The modifier can be used to allow normal damage attacks with a different type of damage, like a weapon that fires either 2d+1 lethal blaster bolts *or* 2d+1 stunning blaster bolts. If the adjustable damage modifier is taken twice, the weapon can fire any type of damage at any level within its design parameters.

A weapon which uses energy or metered chemicals of some kind to get adjustable damage will get varying numbers of shots, depending on the damage done. A +1d over the designed amount halves the number of shots, and a -1d doubles them. You can only do +1d once, but you can take the -1d as many times as you have dice.

EXAMPLE: A 5d+0 adjustable laser rifle with 40 shots can fire 20 unreliable shots at 6d+0, or 80 normal reliability shots at 4d+0 or 160 at 3d+0, and so on.

Combined weapon(+1) - Sometimes you want two weapons in a single carried item. The advantage is that certain parts can be shared. For instance, a rifle/shotgun combination has one shoulder stock, not two. A combined weapon is designed as two *separate* weapons that add to a final size and weight, and then the damage of each weapon is increased by +1. The smaller of the weapons must be at least ten percent of the size of the larger one. You only get the damage bonus once.

Melee or thrown and ranged weapons *may* use the "combined weapon" modifier. For instance, a pistol that is also a throwing axe. This is a case where the "handheld" and "thrown" modifiers co-exist, but only because the weapons were designed separately.

Recoil compensation(-1) - A weapon can have a "beneficial side effect" (for -2) of *no* recoil, which negates *all* recoil penalties. This is not appropriate for some technologies, but recoil can be *reduced*. This can be taken up to twice, and each time increases the maximum damage the weapon can do without causing recoil injuries to the firer by 1d.

EXAMPLE: You can safely fire a pistol (one handed) with a damage up to your Strength plus 1d. With this modifier, that number is increased to your Strength, plus 2d. This represents padded grips, large muzzle brakes, countermasses or other means of taming the recoil force.

Self-charging(-3) - The weapon incorporates some technology that allows it to recover lost shots. This could be things like an on-board reactor, solar panels, induction grids and so on. For the listed modifier the weapon recharges +1 damage (0d+1) of one shot per ten seconds (a time level of 7), or +6 damage (2d+0) per minute (a time level of 12).

EXAMPLE: A self-charging laser rifle that held a hundred 4d+0 shots could recharge them all in 200 minutes (400d of total damage divided by 2d+0 recharged per minute).

Each extra time you take the modifier, you increase the rate of charge. If the weapon is only *partially* self-recharging or requires certain outside conditions to recharge, the rate of recharge is doubled (tripled if *both* apply). An example of this might be a solar-charged weapon. *No sunshine, no recharge!* Or, a gauss weapon that turns raw ferrious metal into magnetically accelerated projectiles. If you don't have a source of metal, there is no recharging. This modifier is also useful for self-charging "magical" weapons.

EXAMPLE: If our self-charging laser rifle used a solar panel (which requires sufficient sunlight to operate), then it would recharge 1 shot per minute instead of 1 shot per two minutes, but only in full sunshine.

Gun shield(-1) - A gun shield is a lightly armored plate or piece that is permanently mounted to the weapon. It provides the same armor the weapon has to the firer, in the front arc. If the weapon is handheld, it only provides the protection to one body part, but it will protect the whole body from weapon side effects coming from that arc.

EXAMPLE: The Panzershreck (a WWII German shoulder-fired anti-tank rocket) has a detrimental side effect that its rocket causes damage to *anything* near the firer. This is worth a +2 on the damage. It also has a gun shield, which protects the *firer* from this damage, for a -1 on the damage, for a total of +1 damage from the combination.

Gun carriage(-3) - Non-portable weapons that are not in a vehicle can still be towable by common means at the designed tech era. That is, an archaic cannon can be towed by horses, or a modern artillery piece by a truck. The equipment or supplies needed to do the towing (harnesses, horses, truck, etc.) are *not* included. Gun carriage weapons usually have a fixed arc of fire (you have to manually move the carriage to change the arc). Like a turret, the mass of the weapon in the gun carriage is smaller, which will affect ammunition size.

Dismountable(-1) - A dismountable weapon is one that is normally not man-portable, but which can be broken down into smaller bits. For instance, a mortar might be broken down into its barrel and baseplate, each of which is carried separately. The weapon cannot be fired unless it is assembled, and cannot be easily carried unless it is disassembled. The extra mass required to make the weapon usable yet portable results in a lower damage compared to weapons of the same type that cannot be split up for easier transport. If the penalty is taken once, the weapon can be broken down into two pieces. Each time the modifier is taken, the weapon gets twice the number of pieces.

The default time to assemble the weapon is one minute (a time level of 12), and is an Average(7) task to complete. The assembly time can be doubled to counter the damage penalty for extra pieces, but the weapon must always be at least -1 to normal damage if this modifier is taken at all.

EXAMPLE: A pack howitzer might be four pieces (-2 to damage), but if it takes two minutes to assemble instead of one, it only takes -1 to damage instead.

Generic gizmos(-1) - There are various types of sighting aids and weapon enhancements available at just about every tech era. Many of them are technically possible at *several* eras, but were either impractically bulky or expensive. These add-ons do not make a weapon do less damage, they just make the weapon bulkier than a version of the weapon without them. If added to a weapon *after* it is designed, they simply add about 25% to the weapon's *empty* weight.

The way we will handle this in **Stuff!** is to assign a point cost and a minimum tech era for these add-ons. The point cost for a gizmo goes down by 1 for each *fraction* of a tech era past its introduction, with a minimum point cost listed in parentheses.

EXAMPLE: Telescopic sights can only be reduced to a certain size and still be useful. Their point cost is 5(3), so they start off at 5 points, but no matter how advanced, they will always use at least 3 points.

The "generic gizmos" modifier is good for twelve points worth of gizmos, minus 1 for each full -3 in penalties for the size of the weapon.

EXAMPLE: A 2 millihex weapon has a -27 to damage, so it can only have 12 - 9 = 3 points worth of gizmos with this modifier. If the 3 points of gizmos were added to an *existing* 2 millihex weapon, it would become a 2.5 millihex weapon (25% bigger).

Gizmo	Tech Era	Points
Telescopic sight	Early Industrial	5(3)
Rangefinder	Middle Industrial	6(2)
Night vision sight	Early Atomic	5(2)
Tactical light	Early Atomic	3(1)
Weapon camera	Early Atomic	5(1)
Laser sight	Middle Atomic	3(1)
Reflex sight	Middle Atomic	3(1)
IFF system	Middle Atomic	5(1)
Heads-up interface	Middle Atomic	5(1)
Thermal sight	Middle Atomic	5(2)
Biometric ID	Late Atomic	3(1)
Data integration	Late Atomic	3(1)
Target tracking	Early Post-Atomic	5(1)

In general, each *point* of "generic gizmos" will count as a "weapon enhancement" in terms of modifying the actual cost of the weapon. This would be the base cost of the weapon for its size, type and tech era of the gizmo, *before* any other modifiers. A telescopic sight doesn't care if it is on an expensive weapon or a cheap one, but an Atomic Era model may be more expensive than an Industrlal Era one.

Note - Many of these gizmos can actually be designed *as* gizmos (using that chapter), but may not have specific combat effects listed.

Telescopic sight: Gives a +1 to weapon Accuracy and usually negates 4 points of range difficulty for making sight Awareness rolls against a specific target. A gamemaster *may* require an Awareness roll before a called shot can be made.

Rangefinder: Gives a +1 to weapon Accuracy and allows triggered or proximity-fuzed devices to be set to explode at a certain range rather than when first encountering a target. At Early Atomic and previous eras, this range setting must be done manually (like setting a timer or fuze), while at Middle Atomic Era and later, triggered or proximity-fuzed devices can be programmed by the weapon.

Night vision sight: Negates any penalties for darkness for targets in the narrow arc in front of the weapon and usually negates 4 points of range difficulty for making sight Awareness rolls against a specific target. This does not provide as wide a range of vision as night vision goggles, but night vision *goggles* cannot use the range negation of a normal telescopic sight. Night vision sights do not work in *complete* darkness without a special tactical light. Night vision sights cannot normally be used during the day. A unit that is 1 point larger than normal has both night and day modes.

EXAMPLE: An Early Atomic Era sight with both normal *and* night vision capabilities would cost 6 points. At the maximum level of technology, it would take 3 points (instead of 2).

Tactical light: A basic visible-wavelength light whose beam is centered where the weapon is being aimed. Allows use at night with no penalty on Awareness to spot things out to a range level of one-third the weapon's era and size, plus 8. Remember that this light extends to the end of the range band.

EXAMPLE: A Middle Atomic Era (+30) pistol (2 millihex, -27 penalty) with a tactical light would suffer no vision penalties when shooting at a target at up to (30 - 27) / 3 + 8, equals a range level of 9 (10 meters). Mounted on a 2 hexagon tank cannon (+3 bonus), the useful range would be (30 + 3) / 3 + 8, equals a range level of 19 (349 meters).

This is just a way to quantify the idea that "bigger weapons can mount bigger lights".

Of course, a tactical light makes the user of the weapon incredibly easy to spot as well. At levels of technology where night vision equipment is available, a tactical light can be in a wavelength that can only be seen with vision-enhancement devices. Since vision enhancement is being used, the power and size of a dedicated non-visible tactical light can be reduced, making it 1 point smaller than normal. Any tactical light can have a switchable filter for non-visible wavelengths at no additional point cost.

Weapon camera: A device that takes a photograph whenever the weapon is fired (film at Early Atomic, digital at Middle Atomic and later). This can be used for documentation or record-keeping. The output from the camera is not immediately useful to the user of the weapon (see Heads-up interface).

Laser sight: Projects a tiny dot wherever the weapon is aimed. It is not normally visible in daylight, and provides no useful target illumination at night. The main effect is that in low to moderate light conditions, it allows the first aiming action to be a minor action instead of a major action, thus allowing Accuracy to be used on the same turn the weapon is brought to bear. A laser sight also allows aiming as a normal major action in situation where it would normally be impossible (like firing from the hip).

Note - In an era of thumbnail-sized laser pointers it is hard to imagine that the original laser sights were glass tube, helium-neon lasers running off a several *thousand* volt power supply, and were about the size of a one liter bottle of soda.

Reflex sight: This is a projected reticle system, where aiming crosshairs "float" above the weapon, allowing faster target acquisition. It allows the first aiming action to be done as a minor action rather than a major action. This is similar to the effect of a laser sight, but a reflex sight must be aimed normally (you can't do it from the hip), but on the other hand, a reflex sight works in all lighting condtions.

IFF system: **I**dentification, **F**riend or **F**oe. Designed to prevent "friendly fire" accidents. It requires a "friend" transponder on friendly targets, and the effect is to prevent the weapon from firing or locking on when it is pointed at a friendly target. If necessary, it can also be reversed to *only* allow fire against targets with such transponders.

Heads-up interface: Provides output from any weapon-mounted gizmo (cameras, night vision, rangefinders, etc.) to a remote display device, such as a helmet-mounted viewer or vehicle console. It automatically includes a visible-wavelength weapon camera. It allows the user of the remote display to see what the weapon is seeing. For instance, it allows a handheld weapon to be aimed and fired around corners without actually exposing more than the weapon itself. At gamemaster discretion, this may take extra time or not allow full use of Accuracy. In a vehicle, a heads-up display can be slaved to the weapon for reverse effect. The weapon aims where the user is looking.

Note - The size of any display for the output of the heads-up interface is a separate item.

Thermal sight: Like a night vision sight, except that it operates off heat emitted by the target and the environment, allowing it to be used in total darkness and through some types of obscurement. Targets that are the same temperature as the background temperature are extremely difficult to spot. Thermal sights may be used in any level of lighting and need no special additions for operating in daylight or complete darkness.

Biometric ID: The weapon has the ability to recognize authorized users. It will not operate for anyone who is lacking the proper code. This coding can either be personal or device-based. A personal coding might be something like a fingerprint, retinal or DNA scanner, while a device-based coding might be a physical key, combination pad, coded ring or some other device or information that can be passed from one individual to another. The difficulty of defeating such an ID with proper tools is Challenging(9) and takes about ten seconds (time level of 7). Defeating the protection without the proper tools can be difficult to impossible.

Data integration: All gizmo output from the weapon, as well as things like energy reserves, shots remaining and other weapon data are available in forms that can be readily analyzed by computer or transmitted across local radio-spectrum networks. Information shared by more than one weapon provides +1 Accuracy to *each* weapon in the network, and +1 each time the number of weapons is doubled. The total Accuracy bonus is limited to +1 at Atomic Era but increases by +1 for each era after that. Remember that you only get Accuracy bonuses if time is spent to aim the weapon.

EXAMPLE: A squad of Post-Atomic Era soldiers with data integrated weapons could have a +2 Accuracy bonus if at least four weapons were available to each other across he network.

Data integrated weapons may also have slaved fire control, allowing a commander to fire (and for vehicle-mounted weapons, aim) several weapons at once. An armed robot would have data integration and a heads-up display (for the person controlling the robot).

Target tracking: A weapon with target tracking can have a target designated by the user. Once this is done, if the target moves out of the sights, the weapon will indicate (to the best of its knowledge) where the target is actually at, using other weapon gizmos and extrapolation and even tactical databases to make a "best guess". It helps to negate being surprised and reduces any penalties for shooting at targets hiding behind cover (if that target had been acquired first). Practically speaking, it will act as a -4 to the difficulty of Awareness tasks to re-acquire a target that left a shooters line of sight, but the bonus drops by 1 per time level.

The following is an example of how you might use the "generic gizmos" modifier.

EXAMPLE: You are designing a cutting edge (Late Atomic Era) SWAT team who have tricked-out assault rifles (say 8 millihex weapons). You get 12 points of gizmos, minus the penalty for weapon size (-7), for 5 points of gizmos. The weapon designer decides this isn't going to be enough, and takes the modifier twice, which gets them 10 points of gizmos, at the cost of -2 to weapon damage.

For 10 points, our designer gets a tactical light (1 point at this level of tech), laser sight (2 points), heads-up interface (4 points) and data integration (3 points), for a total of 10 points.

What does this get us? The user of the weapon can fire it in the dark using the tactical light, though this does expose them. If the user was wearing night vision goggles, the tactical light could be in a non-visible wavelength and still be useful. The laser sight allows quick aiming, the heads-up display allows aiming around corners without exposing yourself, and the data integration provides an overall +1 Accuracy bonus, as well as allowing any team member to see through the gun camera of any other team member. This could include such esoteric uses as using someone else's gun camera to get a view to aim your weapon if your gun camera was not useful (like shooting at something on the other side of smoke screen that *you* cannot see the other side of, but which a fellow team member can).

Now, each -1 from gizmos represents about 25% of the mass of the weapon, so taking the modifier twice on an 8 millihex weapon means that you have about 4 millihexes of gizmos for cost purposes. If we zip ahead to the weapon cost section (page 2.39), we'll see that 4 millihexes of Late Atomic Era weapon has a cost level of -7 (90 Credits). The "enhanced weapon" modifier is +1 to cost. Since we have 10 points of gizmos, we apply this 10 times (+10), for an adjusted cost of +3, or a gizmo cost of 2,800 Credits. So in addition to the cost of the weapon, we have about 3,000 Credits worth of gear attached to it. This cost is for *just* the gizmos, and the multipliers do not apply to the weapon as a whole. The gizmos don't care if the weapon is autofire, unreliable, etc.

Generic bonus/penalty(±1) - A +1 or -1 to damage represents about a thirty-five percent change in the penetrating power of a weapon. If you are using **Stuff!**to design weapons for a fantasy or SF world, it usually doesn't matter, the rounding takes care of itself, and everything is consistent compared to everything else. However, if you are designing for a historical setting or a modern one where every last real-world tidbit of information is known, the choose-the-pizza-toppings **Stuff!** design approach may not be as perfect as you need. Your weapon designs in **Stuff!** might be just a point of damage off in either direction, or a weapon is just *that* close in the real world to being at the damage threshold you want. Sometimes you can fudge this by using the stopping power or penetrating power (page 2.26) modifiers, but sometimes you really just need another +1 or -1 to make everything *seem* right. Like if you really feel the weapon is more advanced than the middle of a tech era, but not quite advanced enough to be late in a tech era.

If it is needed to get a real world weapon to meet your expectations of what it should do, go ahead, give it the modifier.

EXAMPLE: The modern 5.56mm round will be mentioned later as falling through the cracks, being on the edge or between several categories. Normally, to get results that match real-world data, you end up with a weapon doing 3d+2 damage, but it is listed as being a 4d+1 weapon. It gets a +1 for penetrating power, and then we toss in a generic +1 to represent the sum of the other factors. So, this round would do 4d+1 for getting through armor, but anything that got through armor would be reduced by -2 (a hit to an unarmored person would do 3d+2).

We might also have gone from 3d+2 damage to 4d+1 by using the penetrating power modifier and adding one level of reduced range. Or, if we are doing a gameworld where all the advanced modifiers don't matter and you don't have to match a lot of real-world hardware, you just keep the 3d+2 damage, because all other weapons in that size range will be scaled the same way and it will all balance out.

LET'S SEE IF IT WORKS - This covers just about every conceivable technology-based weapon you can come up with. We *did* warn you about diving into the advanced modifiers section... If you think you're ready, we'll do a few advanced examples.

Stinger - This is a shoulder-fired heat-seeking anti-aircraft missile with a proximity fuzed high explosive warhead. Many of the modifiers apply only to the missile. These are marked with an "*".

Atomic Era weapon	+30
16 millihex weapon(8kg)	-18
Bulky ammo x 250	+8
Operational side effect(backblast)	+1
Increased range	-3
Explosive damage(lethal)*	-3
Easy technology*	+3
Autonomous weapon*	-6
Specialized targeting*	+3
Slow weapon(500m/sec)*	+2
Shoulder-fired weapon	+3
Modifier total	+20
Total	5d+0 lethal explosion(see text)

The weapon is 8 kilograms empty (an empty Stinger launcher actually weighs in at about 6 kilograms). The tech era, size and shoulder-fired give a default damage of +15 (or 5d+0), for a normal range before losing damage of 25 (2 kilometers). The *actual* range of a Stinger is listed as 8 kilometers (range level of 29), so we add one level of increased range. This gives the weapon with an explosive warhead a range of 8 kilometers. Normal ammo mass for 200 shots is 8 kilograms (the weight of the weapon). The Stinger gets 1/250 this, or .8 shots for 8 kilograms (10 kilograms per shot), compared to an actual weight of about 10 kilograms for the missile. It has an operational side effect of backblast, so it can't be fired from enclosed areas (if it were, the firer would take half-lethal damage of half the weapon's damage). The warhead is a fragmentation charge, so we count this as lethal explosive. Since this is a reloadable weapon using explosive missiles, we base explosion damage on the *missile* size. *Hold on to that thought.*

The weapon is "autonomous"(-3), which for the Atomic Era is a 2d+0 skill roll. We take this twice, for a 4d+0 skill roll and -6 in damage. This is partially offset by having "specialized targeting" (passive heat-seeker)(+3). A Stinger has a top speed slow enough that it takes several seconds to reach maximum range, so we give it the "slow weapon" modifier twice (+2) for a top speed of 500 meters per second (about mach 1.6, compared to an actual speed of mach 2.2). We give it bracketed range for free (with the "autonomous weapon" modifier). This is just a minimum arming distance to prevent misfires from blowing up the firer.

All of these modifiers are in the *missile*, so they *will* affect the final explosion damage (all that stuff takes up room that would otherwise be packed with explosives). So, you have Atomic Era (+30), 20 millihex missile (-17), "easy technology"(+3), "one use"(+6), "explosive"(-6), "autonomous"(-6), "specialized targeting"(+3), and "slow weapon" (+2), for a total lethal explosive damage of 5d+0.

So, how would you use this weapon? Hold on, we're not quite there yet. We need to figure out how much Accuracy we're going to need. We didn't buy any extra Accuracy for the weapon, so it has an Accuracy of a quarter its damage, or 1, +1 for being shoulder fired, which makes a base Accuracy of 2. At first thought, this is not good enough for something that has to initially acquire distant targets, and make its final approach roll from a range of 500 meters (difficulty of 21). However, remember that it probably gets an an inherent bonus of -3 to difficulty for target size. This is offset by the fact that targets may have a +12 or so to difficulty (at 450kph) because of their movement (it is supposed to shoot down jets, after all). So, when we add everything up for an Accuracy of 2 and a range of 500 meters or so, we're looking at a difficulty of:

Factor	**Difficulty**
Range(500 meters)	21
Accuracy	-2
Maximum aiming bonus(time level of 3)	-3
Target size(estimated)	-3
Target movement(estimated)	+12
Final difficulty	25

It's clear we need to tweak the design in order to allow the firer to get an initial lock-on, and for the missile to have a chance of hitting a fast-moving target. We buy +5 Accuracy by increasing the missile's cost by +5 (about x5.6 normal cost). This gives us an Accuracy of 7, which if aimed for a time level of 6 (8 seconds) would change the previously calculated difficulty from 25 to 17, which is difficult, but doable. And this is for a side shot on a target moving at 450kph(280mph), where the target gets its full movement. A tail shot would have the relative movement modifier reduced, making it an easier task, as would being able to engage a target at an initial range of less than 500 meters. If we use the notes on advanced targeting (page 2.22), the maximum Accuracy a handheld weapon can have in the Atomic Era is 9, so the Accuracy could be further improved if needed.

Okay, so how do we use it? First, spot your target. This would be an Awareness roll based on current conditions. Second, aim until the firer successfully "hits", at which point you fire the missile. If the target is within 500 meters, then it hits on the turn it was fired. Third, wait. Each turn after it is fired, the missile gets a 4d+0 "Awareness roll" against the range, modified by the Accuracy bonus at the time it was fired and target size. If it fails, it loses lock-on and misses. If it makes the roll, it gets +1 Accuracy. When it gets within 1 second of the target, it rolls to hit, based on all the previous factors (movement, size, etc.). If it makes its to hit roll, it scores a direct hit and does full 5d+0 damage as an explosion. If it misses, it zips past and is unlikely to re-acquire the target. If it stays in flight for more than 8 kilometers (its maximum range), it runs out of fuel and crashes.

What can a target do? If they are within 1 second's flight time when the weapon is fired, not much. All the modifiers in their favor were part of the initial lock-on roll, and if this is made, then they are hit. Outside this range, they can attempt to make the missile's Awareness roll harder, but manuevering and speed has no effect unless it puts the vehicle that is someplace harder to see. On the turn the missile would hit, the pilot can attempt to "dodge", or engage in evasive maneuvers. This allows them to give their Dodge bonus to the vehicle, which might make a difference, but would also hinder any vehicle skill rolls they have to make because they are flying close to the ground or around obstacles.

Coastal defense gun - A large cannon in a fixed emplacement, designed to make life difficult for enemy ships passing by by firing high explosive shells at them.

Industrial Era weapon	+24
Late part of an era	+2
64 hex weapon(32 ton)	+18
Takes fifteen seconds to reload	+2
Bulky ammunition(x2)	+1
Reduced range(5 times)	+5
180° arc weapon	-6
Modifier total	+46
Total	7d+0 lethal explosion(see text)

The basic range of the weapon is its damage level for tech era (+26), size (+18) and turreted weapon (+0), plus 10, for a range level of 54, or 45,000 kilometers. This is a wee *bit* further than the 50 kilometers of range these weapons *actually* had. We use the "reduced range" modifier five times, which drops the range to (damage level - 10), for a range level of 34, or 45 kilometers, not far from the mark. Since it has reduced range *and* explosive damage, absolute maximum range is 45 kilometers, but it does *full* damage out to that range.

Like the Stinger, explosives are in the projectile, but in this case it is a lot simpler. We ignore the 180° weapon arc for determining actual weapon size. This means the actual gun is only 16 hexagons, the rest being the machinery and empty space needed to traverse it 180 degrees. Since we have bulky ammunition(x2), 100 shells take up 16 hexagons, so each one is 160 millihexes, which is a -8 penalty. So, explosive damage is Industrial Era (+24), "late era" (+2), "easy technology"(+3), 160 millihex shell (-8), "one use"(+6), and "explosive(lethal)"(-6), for a lethal explosive damage of 7d+0. In **EABA** terms, this is about the same as 8 kilograms of Industrial Era explosives. If this weapon fired regular steel (non-explosive) shells, you would ignore this, and simply use the weapon modifiers, which would give 15d+1 damage, though this might not be effective against vehicles with a low Damage Limit.

We could also design it with "slow weapon", "indirect fire", or add a "gun shield". These would allow us to have the gun in a pit, shielded from direct targeting, or exposed but slightly protected, and the "slow weapon" would reflect the time it takes shells to reach full range and make it harder to hit moving targets. If we added more levels of "bulky ammunition", then the shells would be bigger, and would do more regular or explosive damage. We could also make this a weapon with battering damage, using very heavy solid shot to wreak significant structural damage on lightly armored ships.

Flamethrower - A backpack device consisting of one or more pressure tanks and liquid fuel tanks.

Atomic Era weapon	+30
Early part of an Era	-2
32 millihex weapon(16kg)	-15
Easy technology	+3
Reduced range(4 times)	+4
Takes a minute to reload	+3
Unreliable	+3
Explosive damage(lethal)	-6
Declining duration effect	-8
Continuous beam	-3
Shoulder-fired weapon	+3
Modifier total	+12
Total	4d+0 lethal explosion

The first practical flamethrowers were built for World War 1, though flame-spewing weapons go back as far as Greek fire does. There are a number of backpack flamethrower variants, and this design is fairly representative. It is Early Atomic Era (1940's vintage). It is 16 kilograms empty, and it has a damage for range purposes of Atomic Era (+30), 32 millihex weapon (-15) and shoulder fired(+3), equals a damage level of 18, for normal range before losing damage of 28 (5.6 kilometers). This *far* beyond flamethrower range, so we use the reduced range modifier four times. This drops the maximum full damage range to (damage level - 6), or a range of 12 (23 meters), and it loses 1d of damage at each range level past that. The further you are from the target, the greater the amount of fuel that has burned off by the time the blast gets there, so this is a special case where explosive damage continues past a normal range limit.

Normally, this weapon holds 200 shots in 16 kilograms, but remember that the continuous beam effect counts as 10 shots *per use*. So, 10 bursts of flaming napalm counts as 100 shots of ammunition. Using normal ammunition size, 100 shots takes up 8 kilograms. Flamethrowers are not the easiest things to reload. The fuel tanks must be refilled, and pressure tanks charged. It isn't a fast process. Last, flamethrowers can be balky beasts, so we apply a global level of unreliability.

The weapon acts as a lethal explosion (flaming gasoline), each "shot" a continuous but declining damage effect of up to 16 seconds (time level of 8). The flames eventually go out. The continuous beam modifier represents the stream of flaming fuel. Anything crossing the stream will be hit. The weapon can fire ten blasts before running out of fuel.

MAGICAL WEAPONS - In a world where magic exists, weapons can be based on magical rather than technological principles. The design process is the same, except that you have to set a "Magic Era" for the weapons, and determine which magical technologies are "easy", "average" or "hard". This represents the degree of finesse and power magical adepts can accomplish with magical foci. Magical weapons can have special modifiers on their damage and related properties:

Modifier	Damage
Fatigues user by 0d+1	+1 bonus
Fatigues user by 0d+2	+2 bonus
Fatigues user by 1d+0	+3 bonus
Fatigues user by 1d+1	+4 bonus
Fatigues user by 1d+2	+5 bonus
Fatigues user by 2d+0	+6 bonus

A fatiguing weapon means that it saps some of the stamina or vitality from the person using it instead of (or in addition to) using a clip, charges or some other means of magical energy storage. This damage is taken as non-lethal Hits in **EABA** that would be recovered like any other non-lethal damage.

EXAMPLE: The 2 millihex wand of firebolts (Industrial Magic Era) might look like this:

Industrial Era magic	+24
Easy technology	+3
Weapon of 2 millihex	-24
Fatigues user by 1d+0	+3
Handheld weapon(pistol)	+3
Modifier total	+9
Final damage	3d+0 lethal

If the magical weapon has a "clip" or some other form of magical energy storage, the fatigue cost would have to be spent to recharge *one* shot's worth of energy.

EXAMPLE: A more practical version of the firebolt wand would bump the damage up a little bit, and include a clip or other form of energy storage (a magical powerstone), which means it can take a while to reload, since this would normally occur between combats.

Industrial Era damage	+24
Easy technology	+3
Weapon of 2 millihex	-24
Takes several actions to reload	+1
Fatigues user by 1d+0	+3
Handheld weapon(pistol)	+3
Modifier total	+10
Final damage	3d+1 lethal

If this held 20 shots, it would have a mass of 1.1 kilograms (.1 kilogram for the magical power gem). It would take several actions to reload each shot, and each shot does 1d+0 non-lethal damage in fatiguing hits during the recharge process.

Apply any appropriate gameworld cost for magical power gems on a per kilogram basis, and add this to the base weapon cost.

EXAMPLE: If magical power gems cost 10,000 Credits per kilogram, then the second firebolt wand would cost 1,000 Credits more than normal because of the .1 kilogram power gem.

If a gameworld simply needs the occasional magical cannon, use these rules. But if magic and magical devices are varied and pervasive, then use the paranormal power focus or gadget rules (**EABA**, page 6.24) for maximum consistency. **Stuff!** is really just meant for the mundane world. Also, building magical weapons to do effects other than mundane damage should be handled using the paranormal powers section of the **EABA** rules.

REVERSE ENGINEEERING - This is the part where we go into the details of turning real-world weapons into their **Stuff!** parameters, either to use these parameters either as a multi-system archive for other game systems, or just for your own various **EABA** campaigns.

Increments - **Stuff!** works in certain increments of size and mass. Specifically, for an empty weapon of any kind, there is a minimum 25% change from one size to the next larger or smaller one. So, if you are designing modern rifles, they are going to have an empty size that might not exactly match real-world figures. For instance, around the 8 millihex point, you can only have *empty* weapons that are 5.0kg(+25%), 4.0kg(normal), and 3.0kg(-25%). If your empty real-world weapon masses 3.5kg or 4.5kg, you're out of luck. You can't even interpolate, since the 25% size increments are ±1 damage. What you *can* do is look at everything else that might be somewhere in between, and apply them as a sum, a generic bonus/penalty modifier of ±1 damage.

EXAMPLE: If you have a real-world weapon with an empty mass of 3.5kg, it is going to have slightly more damage than a 3.0kg weapon, and less than a 4.0kg weapon. If the weapon is also beyond the middle of a tech era, but not advanced enough to be at the end of one, then the two modifiers can combine to be a generic +1 damage bonus.

Ammunition - If you are trying to match real-world ammo to **Stuff!** design numbers (especially using the pdf calculator), try to match the figures in the table on the next page.

Most calibers in existence when this was first published (circa 2006CE) will be considered Middle Atomic Era, but you can usually give a bonus or penalties for something you want to come into existence ten years from now (Late Atomic Era) or for a pulp campaign in the 1930's (Late Industrial Era). The 1930's (Late Industrial Era) would be at -4 damage compared to modern (Middle Atomic Era) weapons of the same size, but consider that most weapons *weren't* the same size back then, and if they were, they were less powerful than modern equivalents. The classic Thompson submachine gun of the Roaring Twenties as a **Stuff!** design is a Late Industrial Era 10 millihex weapon with a 2.5 millihex clip (a 6.3 kilogram submachine gun!), the typical .38 caliber revolver a policeman or FBI agent would carry only had an **EABA** damage of 1d+0, and the Colt 1911 .45 ACP service pistol would have been only 1d+1 when it was introduced.

Those damages are based *not* on the **Stuff!** parameters, but the *actual* ballistics of the rounds compared to the **EABA** damage scale.

For weapons with a very long service life, the differences in power can be significant, and have to be dealt with somehow. If you had the choice between firing a modern high power load through a recently made .45 ACP pistol, or a model built in 1911CE, you would probably choose the former, no matter how well maintained the older model was. The table lists rounds for the middle of an era. If the round historically existed early in the era, the name is followed by a superscripted minus sign, like ".45ACP^{-}".

One way to model older weapons is to apply the modern damage if new ammo is fired through an older weapon, but you add some level of unreliability to compensate for it. The value of this unreliability is halved.

EXAMPLE: If you have a hot 2d+1 load for a new .45 ACP pistol, and you fire it through an older .45 ACP pistol meant for a 1d+1 round, then just give the older pistol a full level of unreliability(+6, halved to +3) to make up the difference.

In such cases, a malfunction that fails the Hard(11) skill roll is just a misfeed or jam. One that fails an Average(7) skill roll usually means you overstressed and broke something, doing 1 Hit of damage to the weapon and rendering it non-functional until it is repaired. The other thing that should be done for weapons with a long service life is that the design for the weapon should be based on a tech era somewhere in the middle of the range in which it is used, rounding towards the more primitive models.

EXAMPLE: We'll use the .45 ACP, since it has had such a long service life. It started about the Late Industrial Era, and will probably see use through the Late Atomic Era. So, all designs to use that round should probably be Early Atomic Era. This does not say that you *can't* have a 21st century .45 ACP pistol with Late Atomic Era damage numbers. What it *does* say that a manufacturer of ammunition that is physically compatible across weapons throughout the tech era range is unlikely to court lawsuits by selling rounds that will make a gun blow up in your hands, and that manufacturers of weapons will not be enthusiastic about making weapons whose ammunition will blow up other weapons made by that same company. Realistically speaking, what would happen is that the new and improved 21st century round, even if is in the same caliber and size range as the .45 ACP, is a *different* round that is *not* physically compatible with older weapons.

The Damage listed on the table is the optimum you should try for if recreating a real-world weapon. This damage is the *penetration* ability of a typical real-world weapon firing that round. This can vary a point in either direction. A weapon with a short barrel firing a rifle round might be -1 or even -2 to damage, while a carbine or submachinegun firing a pistol round might be +1 damage, +2 if firing the maximum safe load rather than a regular power commercial load. These damage modifiers often factor in automatically as the weapon is made heavier or lighter. A bulk rating of "+" or "-" signifies the average weapon will have one or more levels of altered ammunition weight, while a penetration rating of "p","s" or "b" means penetrating, stopping or battering power. A "ø" means none are likely as a default.

None of the modifiers listed on the table have been applied. What you can do is apply them as needed, if needed, to get the right historical parameters for your weapon.

EXAMPLE: A modern .45 ACP pistol has an empty mass of about 1 kilogram and a loaded mass of about 1.2 kilograms with a 8 round clip (7 plus 1 in the chamber), with each bullet being a size of about .04 millihexes. For reference, the original Late Industrial Era model had a loaded mass closer to 1.4 kilograms. If you design this pistol at Early Atomic Era, you get a weapon with a damage of 2d+0 and whose only modifier is two levels of bulky ammo(+2), which is about as simple and perfect as you could want (select tech era, select size, select ammo, you're done!). But, not willing to leave good enough alone, the designer decides to give it a generic +1 to damage to place it exactly in the middle of its tech range, making damage 2d+1, which is slightly high.

Stuff! ammunition(Middle Atomic Era)

Round	Damage	Size	Bulk	Penetration	Other possible characteristics
.25 ACP^{-}	1d+0	.008 millihex	-	p	
9mm short^{-}	1d+1	.020 millihex	+	ø	
.22 rimfire^{-}	1d+1	.006 millihex	-	p	
.45 ACP^{-}	2d+0	.040 millihex	+	s	
9mm^{-}	2d+1	.025 millihex	+	ø	
10mm	2d+2	.030 millihex	ø	ø	
.357 magnum^{-}	2d+2	.030 millihex	ø	ø	
4.6mm HK	2d+2	.010 millihex	-	p	Reduced range(+1)
.224 BOZ	3d+0	.015 millihex	ø	p	Reduced range(+1)
5.7mm FN	3d+0	.012 millihex	ø	p	Reduced range(+1)
.44 magnum	3d+0	.040 millihex	+	s	
12ga shotgun^{-}	3d+1	.100 millihex	+	s	Reduced range(+1), shotgun damage(-3)
5.56mm NATO	4d+1	.025 millihex	ø	p	Reduced range(+1)
5.8mm PRC	4d+1	.025 millihex	ø	p	Reduced range(+1)
4.73mm/c	4d+1	.010 millihex	-	p	Reduced range(+1), unreliable(+3)
7.62mm NATO	4d+2	.050 millihex	ø	p	Reduced range(+1)
.338 magnum	5d+0	.060 millihex	ø	ø	Reduced range(+1)
12.7mm MG^{-}	6d+1	.225 millihex	+	s	Reduced range(+2)
14.5mm MG^{-}	6d+2	.400 millihex	ø	s	Reduced range(+2)
15.2mm AMR	7d+0	.300 millihex	+	p	Reduced range(+1), armor-piercing ammunition
20mm cannon^{-}	7d+0	.500 millihex	ø	s	Reduced range(+2)

Stuff! ammunition(Middle Industrial Era)

Round	Damage	Size	Bulk	Penetration	Other possible characteristics
10mm pistol^{-} (.39")	1d+2	.012 millihex	+	ø	Reload in a minute(+1d), unrel. in some cond.(+1)
12mm pistol^{-} (.48")	2d+0	.020 millihex	+	ø	Reload in a minute(+1d), unrel. in some cond.(+1)
14mm pistol^{-} (.55")	2d+1	.040 millihex	+	s	Reload in a minute(+1d), unrel. in some cond.(+1)
12mm rifle^{-} (.48")	3d+1	.030 millihex	ø	ø	Reload in a minute(+1d), unrel. in some cond.(+1)
14mm rifle^{-} (.55")	3d+2	.045 millihex	ø	ø	Reload in a minute(+1d), unrel. in some cond.(+1)
1pdr^{-} (50mm)	5d+2	1 millihex	+	b	Reduced range(+1), reload in a minute(+3)
3pdr^{-} (70mm)	6d+2	3 millihex	+	b	Reduced range(+2), reload in a minute(+3)
6pdr^{-} (94mm)	7d+0	6 millihex	+	b	Reduced range(+2), reload in a minute(+3)
12pdr^{-} (117mm)	7d+2	13 millihex	+	b	Reduced range(+2), reload in a minute(+3)
24pdr^{-} (144mm)	8d+1	28 millihex	+	b	Reduced range(+3), reload in a minute(+3)
32pdr^{-} (163mm)	9d+1	37 millihex	+	b	Reduced range(+3), reload in a minute(+3)
42pdr^{-} (174mm)	10d+0	48 millihex	+	b	Reduced range(+3), reload in a minute(+3)
68pdr^{-} (203mm)	10d+2	75 millihex	+	b	Reduced range(+3), reload in a minute(+3)

So, to tweak the damage back down and simultaneously satisfy everyone who feels that it has better stopping power than the 9mm, we apply the stopping power(-1) modifier, which drops the damage to 2d+0^S, and everyone is happy.

EXAMPLE: The same designer decides to make the maximum power .45 ACP available at Middle Atomic Era. Looking at a custom handloading manual, they find a safe load for modern weapons in good condition that translates out to a normal **EABA** penetration of 2d+1. They apply the same parameters as the previous example and get a damage of 2d+2, which is a little high. So, they apply the stopping power modifier again, which gives them a final damage of 2d+1^S, and all is well.

You don't have to match these numbers exactly, but as you tweak ammunition size and weight for a design, if you are doing a historical design, these are the numbers to get close to. Archaic weapons, especially the cannon shells, are subject to a lot of variation. Cannons firing the same weight shell came in a wide variety of lengths, weights and safe powder charges. A cannon firing a 68 pound shell from a fortified position on land would be a far different weapon than one mounted on the deck of a man o'war.

Can you break Stuff! - If by "break", you mean "can I make fearsomely powerful weapons that put anything ever historically used to shame?", then yes, you can. Whether or not the weapon is in any sense practical for a regular civilian or soldier to carry or use is another matter. Someone has actually constructed a pistol to fire the 12.7mm MG cartridge. Yes, it is fearsomely powerful. No, it is not even remotely practical. Custom-made weapons can do or be just about anything, and they will cost like one-of-a-kind items, which they often are. Commercially produced items have to fill a market niche or meet a military need. A soldier might be expected to carry 200+ rounds of ammunition on their person. If your ultra-powerful assault rifle has ammo too heavy to lug around in large quantities, it's not going to get used very much.

For custom designs, anything goes. For stuff that is going to be used by lots of marginally trained people in the real world, it has to fill a need. And if past history of military procurement is any guide, a bad design with political connections has a better chance of getting into service than a great design with no power brokers behind it. So, in the end, the answer is "yes, you can make a weapon far more efficient and powerful than any currently adopted by a major army", but there are probably real-world considerations outside the scope of **Stuff!** to explain why it hasn't been done yet.

Historical parameters - If you are not recreating existing weapons, but trying to keep your designs accurate in a historical sense, here are guidelines as to when particular weapon technologies were first used. They may not have been in common use until decades later, or may have been abandoned for centuries until they became practical (like for revolvers), but for gadgeteers and inventors, the technologies were at least known of.

Weapon or characteristic	Date	Era
Bows	≈7000BCE	Early Primitive
Catapults	≈400BCE	Primitive
Trebuchets	≈300BCE	Primitive
Crossbows	≈250CE	Primitive
Muzzle loading firearms	≈1324CE	Early Basic
Matchlocks	≈1410CE	Basic
Time-based fuzing	≈1450CE	Basic
Grenades	≈1450CE	Basic
Rifled barrels	≈1498CE	Basic
Wheellocks	≈1517CE	Basic
Flintlocks	≈1610CE	Late Basic
Revolvers	≈1620CE	Late Basic
Breech-loading firearms	≈1765CE	Early Industrial
Percussion caps	≈1805CE	Early Industrial
Cartridge load firearms	≈1830CE	Industrial
Caseless ammunition	≈1848CE	Industrial
Impact fuzing	≈1860CE	Industrial
Land mines	≈1862CE	Industrial
Autofire(cranked)	≈1862CE	Industrial
Clip-fed weapons	≈1862CE	Industrial
Autofire(reciprocating)	≈1883CE	Late Industrial
Silencers	≈1909CE	Late Industrial
Shaped charges	≈1935CE	Early Atomic
Radar-based aiming	≈1943CE	Early Atomic
User-guided weapons	≈1943CE	Early Atomic
Proximity fuzing	≈1943CE	Early Atomic
Bullpup configuration	≈1949CE	Early Atomic
Heat-seeking missiles	≈1956CE	Early Atomic

EABA

3G³ conversion - The older **3G³** product from **BTRC** has a much more detailed (and complex) set of weapon design rules. The damage scale from that system converts to **EABA** and **Stuff!** as follows.

A **3G³** DV of 12 is an **EABA** damage of 1d+0. Each time the **3G³** DV is multiplied by x1.5 (round up), **EABA** damage goes up by +1d. A DV of half the way between two full dice amounts is a +1, and two-thirds the way is +2, round up.

DV	EABA	Example	Armor
0	0d+0		
4	0d+1		gambeson
8	0d+2		hardened leather
12	1d+0	.32 ACP	flak jack., chain mail
14	1d+1		chain + gambeson
16	1d+2	.22 long rifle	
18	2d+0	.45 ACP	plate armor
21	2d+1	9mm	Level II bulletproof
24	2d+2	.357 magnum	
27	3d+0	.44 magnum	Level II+ bulletproof
32	3d+1		
37	3d+2	.30 carbine	
41	4d+0		Level III bulletproof
48	4d+1	5.56mm	
55	4d+2	7.62mm	Level IV bulletproof
61	5d+0		
72	5d+1		
82	5d+2	.460 magnum	
92	6d+0		
107	6d+1	12.7mm	
122	6d+2	14.5mm	
137	7d+0		
160	7d+1	20mm cannon	
183	7d+2		
206	8d+0	30mm cannon	
308	9d+0		
462	10d+0	60mm cannon	
692	11d+0	75mm cannon	
1038	12d+0	light anti-tank rocket	
1557	13d+0	90mm cannon	
2336	14d+0	120mm cannon	
3504	15d+0		
5256	16d+0	heavy anti-tank rocket	

The examples assume weapons are from the Middle Atomic Era. The archaic armors are not proof against modern weapons and most would lose 1d of protection against them. For instance, 2d+0 plate would only be 1d+0 vs. a 9mm bullet.

WEAPON COST - Now that you've designed it, you've got to pay for it. Weapons will have a cost based on their tech era and size, modified by the capabilities. Normally, the weapon cost is assumed to be a "loaded" weapon. **Stuff!** uses the same basic idea as the **EABA** vehicle rules. Equipment is the same cost as **EABA's** vehicle gizmos, which is expanded on below. Entries in italics are optional. Size in millihexes *may* be fractional.

Final size (do *not* count consumables)	**Level**
Cost per each millihex *or*	-18
Cost per hexagon	2

Modifiers	**Levels**
Primitive Era	+0
Late Primitive/Early Basic Era	*+1*
Basic Era	+2
Late Basic/Early Industrial Era	*+3*
Industrial Era	+4
Late Industrial/Early Atomic Era	*+5*
Atomic Era	+6
Late Atomic/Early Post-Atomic Era	*+7*
Post-Atomic Era	+8
Late Post-Atomic/Early Advanced Era	*+9*
Advanced Era	+10
Late Advanced Era	*+11*
Weapon	+2
Melee weapon	+4
Easy technology	-1
Average technology	+0
Hard technology	+1
Placed, tripod or vehicle weapon	+0
Thrown or Strength-based weapon	+2
Handheld(both hands, bipod or shoulder fired)	+2
Handheld(one hand/not shoulder fired)	+4
Limited production(military only)	+4
Slightly limited production	+2
Mass market production	-1
Increased range	+1
Reduced range	-1
Increased capability	+1
Decreased capability	-1
Beneficial side effect	+2
Operational	+1
Detrimental side effect	-2
Operational	-1
Special effect	+1
Disposable	-7
Obsolescent	-2
New tech(just made available)	+2
Experimental(fractional era ahead)	+4
Prototype only	+7

The "base cost" of a weapon is usually that for its size, tech era and the type of weapon. To figure out the level of cost for a given weapon size, just apply the difference in millihexes or hexagons.

EXAMPLE: The difference between 1 meter and 20 meters on the **EABA Universal Chart** is closest to 9 levels. Since a 1 millihex weapon has a base cost of -18, a 20 millihex weapon has a base cost of -9.

At gamemaster discretion, ammunition cost may also apply "production" modifiers to base weapon cost (e.g. military weapons may have more expensive ammunition).

Weapon(+2/+4) - This is a generic penalty for an item that is a weapon. Use the +2 modifier, and if it is a melee weapon, use the +4 modifier. *Simple enough*. Note that the melee weapon modifier is meant for weapons which are labor-intensive to make, like swords. If it does not require skilled labor or special tooling to make, use the +2 modifier.

Technology(+1 to -1) - Use the modifier for the *most* expensive technology in the weapon. An "easy" explosive in an "average" guided rocket is an "average" weapon. This is the same as an increased or decreased capability.

Placed, tripod, vehicle(+0) - Most weapons that fall into these categories have a cost adjustment of +0 levels. Placed weapons will also likely have the "disposable" modifier.

Melee or Strength-based(+2) - Weapons doing damage only through the strength of the user have the listed cost adjustment. Make sure this modifier was also used in the *design* process. Crossbows and bows count as melee weapons for cost purposes.

Handheld(+2/+4) - If the weapon is normally fired with *both* hands or is shoulder-fired (like a rifle or rocket launcher), use the first modifier. However, if it is designed to be fired from one hand (like a pistol), use the second modifier. If its ergonomics allow effective use in one hand, use the second modifier for figuring the cost. A pistol that will break your wrist unless you use both hands is *still* a pistol. On the other hand, most submachineguns are clearly designed to be fired with both hands, even though they still use pistol ammunition. Don't ask us why pistols cost twice as much, they just do.

Limited production(+4) - This usually applies to military/paramilitary weapons. If it is *definitely* military hardware, it is +4 levels in cost. Anything at the cutting edge of weapon development often takes this modifier. "Hard" weapon technologies are often limited production.

Slightly limited production(+2) - Weapons which have *some* restrictions, but which are obtainable by police or *sometimes* by civilians are +2 to normal cost. Mature but not universal technoloigies usually count. Whether autofire weapons fall into the latter category depends on the politics of that area of the game world. "Average" weapon technologies are usually slightly limited production, as are tools that can also be used as weapons (utility knives, etc.), or "military weapons" that use a technology of limited availability (like Damascus steel).

Mass market production(-1) - These weapons are ones which have been produced in such quantity or for such a long period that there is a market glut. The Soviet AK-47 might be an example. These weapons are -1 to normal cost. The "mass market production" modifier can also apply at designer's option (and with gamemaster approval) to weapons whose nature is so simple or easily duplicated that it really should be cheaper than any other weapon of similar size or capability.

Increased/decreased range(±1) - If it has increased range, apply a +1 modifier per level. If it has reduced range, apply a -1 modifier per level.

Increased capability(+1) - A catch-all modifier. The main use is increased Accuracy that is inherent to the weapon (as opposed to add-on gizmos). Each +1 Accuracy is an "increased capability" that is specific to that weapon. A weapon can have gizmos that affect accuracy and inherent capabilities that enhance it.

EXAMPLE: A disposable guided rocket might have extra Accuracy built into the rocket (non-transferable), but might also have a detachable telescopic sight (also improves Accuracy) that *can* be transferred from weapon to weapon.

Other weapon options may mention that they are increased capabilities as well, and the gamemaster can define any modifier they want as an "increased capability", depending on the nature of the gameworld. Tech-specific special effects are generally considered an increased capability. Special ammo types might be an "increased capability" for ammo cost purposes.

EXAMPLE: An amount of ammunition that masses the same as the weapon normally costs seven levels less than the weapon cost. If you had armor-piercing ammunition, you would use six levels less than the weapon cost instead.

Decreased capability(-1) - Another catch-all. Most things that decrease the utility of the weapon will take the -1 modifier.

Things that count as an increased/decreased capability are below, and a designer can always say that a particular characteristic is one or the other as needed. If a characteristic says it is per point or level, then the cost for the capability applies per point or level. Otherwise the cost is simply paid once. In addition, some of these costs may have or imply other costs. For instance, guided explosive weapons are likely to have the +4 "military weapon" cost multiplier in addition to any extra capability multipliers.

Characteristic	Capability
Hard technology	incr.(+1 level)
Easy technology	decr.(-1 level)
+1 Accur. (to tech era limit)	incr.(+1 level)
-1 Accur. (down to zero)	decr.(-1 level)
Incr. range level(each)	incr.(+1 level)
Decr. range level(each)	decr.(-1 level)
Autofire or autoburst	incr.(+1 level)
Shotgun damage	incr.(+1 level)
Unreliable or very unreliable	decr.(-1 level)
Shaped charge(per level)	incr.(+1 level)
Nuclear damage	incr.(+20 levels)
Explosive damage	incr.(+1 level)
Broader triggered range	incr.(+1 level)
Proximity fuzed	incr.(+1 level)
Autonomous wpn.(per level)	incr.(+1 level)
Guided wpn.(per level)	incr.(+1 level)
Gizmos(per point)	incr.(+1 level)
Duration effect	incr.(+1 level)
Continuous beam	incr.(+1 level)
Any area effect	incr.(+1 level)
Adjustable damage	incr.(+1 level)
Self-charging	incr.(+1 level)
Non-damage effect	incr.(+1 level)
Slow weapon(per level)	decr.(-1 level)
Specialized targeting	decr.(-1 level)
Half-lethal damage	decr.(-1 level)
Non-lethal damage	decr.(-1 level)

EXAMPLE: You have a 2 millihex Post-Atomic Era pistol with autoburst capability and +1 Accuracy. So, you have the "increased capability" modifier twice, for a cost adjustment of +2 levels for just that part of its description.

Side effect(-2 to +2) - A weapon with the listed side effects has the appropriate modifiers to cost.

Characteristic	Side effect
Excessive recoil	detrim.(-2 levels)
No recoil	benef.(+2 levels)
Backblast	detrim.(-2 levels)
Backbl. in conf. space	detrim. oper.(-1 level)
Armor-piercing	benef.(+2 levels)
Easily blocked/negated	detrim.(-2 levels)

EXAMPLE: You design a high-tech stunner, and it has no recoil, but it is easily blocked by armor, it would have a cost adjustment of zero levels for just that part of its description.

Disposable(-7) - Use the weapon once and throw it away, or the weapon is destroyed by using it (like a grenade). All its parts only have to work once.

Obsolescent(-2) - Normally, a weapon that is obsolete or obsolescent is simply built using a previous tech era's cost, which makes it naturally cheaper. What this modifier means is that there are better weapons of the same type within the *same* tech era, so to get people to buy the inferior weapon, the price has to be decreased.

New tech(+2) - This is the "early adopter" penalty. The weapon is available in small quantities, but demand is high enough to push the price up past normal levels. If the weapon becomes popular, price will quickly drop to normal levels.

Experimental(+4) - This is for any weapon that is slightly ahead of its time. If the gamemaster or gameworld is such that you can create weapons a fraction of a tech era ahead of everyone else, the weapon will take this modifier. Weapons made in quantities of more than ten but less than a hundred will probably have this modifier.

Prototype(+7) - This is the "custom manufacture" penalty. If a weapon is made in quantities of less than ten or is unique, it will have this modifier.

Note - Remember that cost is, in the end, based on supply and demand, *not* a formula. The **Stuff!** cost structure is just a framework to hang things off of. If your gameworld uses historical wages and costs, you'll need to take that into account as well. For instance, the **Sears & Roebuck** 1902 catalog lists Smith & Wesson .38 caliber revolvers for 12 Credits, Winchester repeating rifles for 12 Credits, surplus Civil War muskets for 3 Credits and 10 gauge lever action shotguns for 20 Credits. And dynamite was only about half a Credit per kilogram and could be ordered through the mail...

AMMUNITION COST - **Stuff!** designs weapons as a whole, with no separation of the weapon and ammunition. The default rule is that an ammunition load of 200 shots will mass about the same as the empty weapon, and cost seven levels less. Which cost modifiers you choose to use are a matter of the particular gameworld. A military weapon might have "military" ammunition (like a grenade launcher), or fire the same ammunition as a civilian hunting rifle (like a light machine gun). Similarly, if you have a tricked-out conventional weapon, the ammunition doesn't cost any extra just because you have a thermal night sight mounted on it. Figure the weapon cost using only the ammunition-related enhancements, and base the ammunition cost on this amount.

EXAMPLE: For a pistol that cost 350 Credits, 200 rounds of ammunition will cost about 32 Credits and weigh as much as the empty pistol does.

Combine this with the "bulky" and "compact" ammunition modifiers, and it works fine for ninety percent of weapon designs. Things like armor-piercing bullets, flaming arrows and the like are just a "increased capability" adjustment of +1 on the ammunition cost. However, you *can* run into conceptual problems with some designs. For instance, what if you want to design a reusable rocket launcher that can fire a wide variety of missiles, from unguided kinetic rods to guided, proximity-fuzed high explosive missiles. The *weapon* might just be a metal tube with a trigger assembly. All the extra costs are in the *ammunition*, not on the weapon itself. But, each of these different rockets will make the weapon cost a different amount. *So, how do you figure the weapon cost separately from its ammunition?*

It turns out to be pretty easy. In any case where the line between weapon and ammunition blurs, you figure the cost a little differently. Design the weapon with the *minimum* number of modifiers. That is, only use the modifiers that will be common to *all* the forms of ammunition used. This is usually the size, tech era (include obsolecent through experimental modifiers), type of mount (handheld, vehicle, etc.), and "weapon" modifiers. The cost of *this* weapon is the cost of the "empty" weapon. The cost of the weapon with the extra modifiers is the cost of the "loaded" weapon, and the ammunition cost is the difference between the two. Specifically, the difference between the two is the cost for ammunition that equals the mass of the weapon. Ammunition is assumed to be "disposable" and does not use that modifier.

If you are going to use this ammunition cost rule, use it only as needed. **Stuff!** isn't meant to be a number-crunching system, and we assume you're smart enough to know when to break out the heavy rules and when to just go with the basics.

EABA powercells - Some items in the **EABA** equipment list use generic powercells. This can include weapons if you want. It is worth noting that weapons are likely to require very high pulses of power that a commercial item like a powercell is unlikely to provide. Detailed notes on how to build and use powercells are in the **Vehicles** chapter.

EXAMPLE COSTS - We'll go through some of the design examples earlier in the rules and see how much they cost.

M-60 machinegun (page 2.14) - This is an Atomic Era weapon (+6) with a size of -9 (20 millihexes) and shoulder-fired(+2). This is a "base cost" of -1 (700 Credits). Other modifiers are weapon(+2), handheld (+2), military production (+4), autofire (+1). This is a total cost of +6, or 8,000 Credits. This might be tweaked by other modifiers, but is probably going to end up with a cost of at least +3, or 2,800 Credits.

Modifier	Cost
Weapon size(20 millihex)	-9
Atomic Era weapon	+6
Weapon	+2
Average technology	+0
Shoulder-fired	+2
Military production	+4
Autofire	+1
Total of modifiers	+6
Total cost	8,000 Credits

Default ammunition cost for a load of 200 rounds is the base cost of -1 (size, tech era, weapon type), with a -7 adjustment, or 125 Credits. In this case, we can say the disposable links used as part of the feed mechanism are part of the ammunition cost. If the ammunition was exclusive to this weapon (and vice versa), you would apply all the weapon modifiers to the ammunition cost. So, if for some reason this weapon could only fire a very specific ammunition, and the ammunition for the M-60 couldn't be used in any other weapon, you would have a cost of +6 with a -7 modifier, or 700 Credits for 200 rounds of ammunition. The Stinger missile example on the next page has this problem.

Longsword (page 2.14) - This is a weapon with a size of 3 millihexes. This is a cost level of -15. It is also Basic Era (+2). If we wanted it to have armor as a Primitive Era item, we buy it at Primitive Era cost, but we want *this* weapon to be of medieval quality, so we use a Basic Era cost. Other modifiers are melee weapon (+4), easy technology (-1), Strength-based weapon (+2), military production (+4), for a total cost of -4, or 250 Credits.

Modifier	Cost
Weapon size(3 millihex)	-15
Basic Era weapon	+2
Melee weapon	+4
Easy technology	-1
Strength-based weapon	+2
Military production	+4
Total of modifiers	-4
Total cost	250 Credits

The biggest single factor in the cost is the "military production" modifier. If the gameworld were one where swords were commonly used by people other than soldiers, the ready availability would alter the cost.

Mk19 grenade launcher (page 2.14) - This is a weapon with a size of 125 millihexes. This is a base cost of -4 for size, +6 for Atomic Era, and since grenades are military items, another +4, for a base cost of +6, or 8,000 Credits. Other modifiers are weapon (+2), tripod weapon (+0), autofire (+1) and explosive damage (+1). This is a total level of +10, or 32,000 Credits.

Modifier	Cost
Weapon size(125 millihex)	-4
Atomic Era weapon	+6
Weapon	+2
Average technology	+0
Tripod mounted weapon	+0
Military production	+4
Autofire	+1
Explosive damage	+1
Total of modifiers	+10
Total cost	32,000 Credits

Note that if we bought the *ammunition* as the explosive item, the launcher would have a cost of +9, or 23,000 Credits. Ammunition normally costs the base cost level minus 7, which would be a cost of -1 for 200 rounds, +1 for being explosive, would give a "per grenade" cost of 5 Credits. You could also design up each grenade as an indepdendent weapon and cost it that way.

Stinger missile (page 2.32) - This is a weapon with a size of 16 millihexes. This is a base cost of -10 for the size, +6 for Atomic Era, +4 for requiring dedicated military ammunition, +2 for shoulder-fired, for a total of +2 (2,000 Credits). If we don't design the weapon and ammunition separately, the cost will be higher. We have a 16 millihex weapon and a 20 millihex rocket. The launcher is:

Modifier	Cost
Weapon size(16 millihex)	-10
Atomic Era weapon	+6
Weapon	+2
Average technology	+0
Shoulder-fired weapon	+2
Military production	+4
Total of modifiers	+4
Total cost	4,000 Credits

The ammunition is an entirely separate item, nearly a weapon unto itself. Since ammunition is *inherently* disposable, we *do not* use that cost modifier for the rocket. It looks like this:

Modifier	Cost
Weapon size(20 millihex)	-9
Atomic Era weapon	+6
Weapon	+2
Average technology	+0
Military production	+4
Autonomous weapon x 2	+2
+5 Accuracy	+5
Explosive damage	+1
Operational side effect(backblast)	-1
Operational side effect(needs launcher)	-1
Increased range	+1
Slow weapon x 2	-2
Specialized targeting	-1
Total of modifiers	+7
Total cost	11,000 Credits

This gives a loaded cost of 15,000 Credits. For reference, the government "replacement cost" for a Stinger is 38,000 Credits. Since the original design on page 2.32 seemed a little low in the Accuracy department, we could add up to 2 points of Accuracy (giving it a final Accuracy of 9), which would be two more "increased capability" modifiers on the rocket, increasing its cost to about 23,000 Credits per shot. So, try to hit what you aim at. *Misses are expensive.*

Note - If we had just used straight design rules, all modifiers would have applied to the *weapon*, and it would have had a loaded cost of 23,000 Credits, with a cost per shot of about 11,000 Credits, depending on which modifiers you applied.

Coastal defense gun (page 2.34) - This is a weapon with a size of 64 hexes. This is a "base cost" of +14, with +5 for Late Industrial Era, or 700,000 Credits. While this is a military item, the manufacture of the ammunition is not that complex or legally difficult (it's a big chunk of iron), so we do not apply the military production modifier for purposes of ammunition cost. Other modifiers are weapon (+2), vehicle weapon (+0), military production (+4), reduced range (-5). This is a total level of +20, for a final cost of 1,000,000 Credits.

Modifier	Cost
Weapon size(64 hexagon)	+14
Late Industrial Era weapon	+5
Weapon	+2
Average technology	+0
Vehicle weapon	+0
Military production	+4
Reduced range x 5	-5
Total of modifiers	+20
Total cost	1,000,000 Credits

A load of 32 tons of ammunition would only be 100 rounds because the weapon has a level of bulky ammo. This would be a cost of +12 (64,000 Credits), or 640 Credits per shot. You could apply explosive ammunition (+1) to this, for a cost per shot of 900 Credits for explosive rounds. Note that the weapon has a base accuracy of 7, and it could go up to 13 at this tech era, at an increase to cost.

Flamethrower (page 2.34) - This weapon is Early Atomic Era (+5), with a size of 32 millihexes (-8). The explosive nature of the effect is part of the way the weapon delivers its payload, so the cost *is* part of the weapon, not the fuel that is shoots, and so it is also part of the base cost (+1), for a base cost of -2 (500 Credits). It also has the following modifiers, for a final cost of 1,400 Credits.

Modifier	Cost
Weapon size(32 millihex)	-8
Early Atomic Era weapon	+5
Weapon	+2
Easy technology	-1
Shoulder fired weapon	+2
Military production	+4
Explosive damage	+1
Duration effect	+1
Continuous beam	+1
Unreliable	-1
Reduced range x 5	-5
Total of modifiers	+1
Total cost	1,400 Credits

The "ammunition cost" is -8 for 200 shots (64 Credits). The weapon only carries 100 "shots", so it has a reload cost of about 32 Credits.

WEAPON PARAMETERS - On the following pages are some rough guidelines for designing particular weapons. The idea is that weapons of a certain type, like say flamethrowers, will have common characteristics. Once you figure these out, it is just a matter of taking the tech era and applying the total of the modifiers for that type of weapon to get the final damage, plus the ammunition weight to get the final size.

EXAMPLE: A sword starts with a base damage of +12, and has -10 worth of modifiers. Add the two, and you get 0d+2, so a longsword of the listed size does Punch+2 damage.

EXAMPLE: A generic bolt action military rifle from the Industrial Era has a base damage of +24 for the era, and -12 in modifiers, so a rifle of the listed size and characteristics will have a damage +12 in modifiers, for result of 4d+0. If you gave this rifle one level of bulky ammunition(+1), it would have a damage of 4d+1 instead.

Mostly, shoulder-fired weapons of various types are listed. For melee weapons there may be fractional modifiers in the total (see page 2.10), leaving room for customizing. They round to no effect unless they add up to +1 or -1. Last, modifiers with an "*" might only apply to projectiles rather than overall damage.

For people familiar with weapons, this is not that big a deal, but if you aren't a weapon-phile and just need a tool for quick and dirty weapon design, the guidelines may help you out quite a bit. Remember that not all the modifiers a weapon *may* have are there, just the ones we're saying weapons of that type *do* have.

WEAPON CHECKLIST - We've tried to present things in order, but as you work on doing designs, try to keep the following things in mind.

Weight - If it is a handheld weapon, someone has to carry it. How far do they have to carry it? How long do they have to carry it? If it is an infantry weapon, consider the poor dog soldier is also carrying ammunition, food, a tent, a knife, an entrenching tool, a first aid kit, possibly body armor, blankets or a sleeping bag, etc. If it is a vehicle weapon, weight may not be as important, but space is. There are only so many empty hexagons to go around.

Both of these also relate to ammunition weight. You have to be able to carry enough to fulfill the designed mission of the weapon. If you make an ultra-powerful tank cannon, but the tank runs out of ammunition because the shells were too bulky to carry enough, then the gun could end up being useless when you need it the most.

Mission - What is the main purpose of the weapon? This is not as silly and self-obvious as you might think. A pistol obviously serves a different purpose than an assault rifle, and an assault rifle a different purpose than a heat-seeking missile. Clearly, causing harm is inherent in the nature of a weapon, but you need to figure the people who are supposed to use the weapon, the conditions they are to use it in, and to some extent, the nature of the political situation that allows or requires these weapons. A taser may not be the most effective of weapons, but if the poltical situation makes private ownership of firearms illegal, it may be the best available weapon for an average person. Or, from a military standpoint, a truck driver might need a short-range weapon for self-defense, but does not need the weight or bulk of a heavy rifle. This would be a role for a submachinegun, pistol or as they are called now, "personal defense weapons".

Related to the mission is the cost, which is reflected in the various modifiers. It might not be cost effective to equip and train everyone with a weapon that has 3,000 Credits worth of gizmos strapped to it, but this investment might be worth it for a commando team or SWAT team, and this also falls back onto the weight question. A SWAT team that is five minutes from a source of resupply, on an assignment that is unlikely to take more than an hour, can carry more stuff than a team that has to operate for a week behind enemy lines.

Technology - Exactly what is a reasonable tech era for the weapon? This is not just a matter of what the date is, it also relates somewhat to the mission of the weapon. Civilian weapons are sold in smaller quantities, to a more select audience. New models of pistols, rifles and shotguns come out every year. Military weapons on the other hand, are often used with only minor design changes for decades. The venerable .45 ACP pistol was in service as the US military standard sidearm for something like eighty years! The M-16 assault rifle series is approaching the forty year mark, and the M-14 is a World War II design that is still in service with some units. While older variants may be phased out over time, these weapons will still be a little behind the overall curve, and will have to be supplied with ammunition that is appropriate for the oldest models still in service. Even a brand new design might have been in development and trials for so long that by the time it reaches service, tech has advanced a fraction of an era and left it behind. The current US sidearm, the Beretta 92F, is just a modification of a design dating to 1976CE, which was in turn really just an enhancement of a model dating back to 1951CE.

This creeping obscolescence is not as much a problem when there are centuries between tech eras, but militaries in these eras also tended to be more conservative, and hung onto weapons long past when they should have. For instance, the British were using large-bore muskets in the Revolutionary War, fighting against American rebels armed with small-bore rifles. *And it made a difference.*

Politics - This has been touched on before, but the political situation in the gameworld or any part of it is the single most important factor in terms of weapon cost. A "military" weapon costs four times as much as a normal one. If your government defines all firearms as highly restricted technology, then even if you can get one legally, it is going to cost a lot more than it would in some chaotic war zone where AK-47's are sold at flea markets alongside bootleg DVD's. If swords can only be possessed by nobility, then the number of sword makers will be far smaller and the clientele more wealthy, both factors that will drive up the price.

Balance - If someone can make a weapon that gives them a significant edge, what is there to keep everyone else from copying it? A technology edge, a bigger budget, or something else? Imbalances tend to be self-correcting, often within a timeframe of part of a tech era. Someone comes up with better armor-piercing ammunition, someone else responds by coming up with better armor. These temporary imbalances can be part and parcel of an adventure or a campaign, but keep in mind that they are not forever.

Primitive Era Weapons (+12)[1]

Type	Typical size	Possible Side Effects	Other Modifiers	Total modifier (inc. size)
Knife	.5 millihex(-11)	-	Easy technology(+1) Strength-based(-3)	-13
Short sword	2 millihex(-9)	-	Easy technology(+1) Strength-based(-3)	-11
Sword	3 millihex(-8 1/3)	-	Easy technology(+1) Strength-based(-3)	-10
Two-handed sword	6 millihex(-7 1/3)	-	Easy technology(+1) Strength-based(-2)	-8
Axe	5 millihex(-7 2/3)	-	Easy technology(+1) Strength-based(-3) Unbalanced(+1/3)	-9
Mace	5 millihex(-7 2/3)	-	Easy technology(+1) Strength-based(-3) Half-lethal damage(+1/3) Unbalanced(+1/3)	-9
Polearm	6 millihex(-7 1/3)	-	Easy technology(+1) Strength-based(-2) Unbalanced(+1/3)	-8
Thrown spear	3 millihex(-8 1/3)	-	Easy technology(+1) Thrown weapon(-4)	-11
Thrown axe	2 millihex(-9)	-	Easy technology(+1) Thrown weapon(-4)	-12
Bow[2]	2 millihex(-9)	-	Easy technology(+1) Thrown weapon(-4) Several actions to reload(+1/3) Bulky ammunition(+1)	-11
Crossbow[2]	6 millihex(-7 1/3)	-	Easy technology(+1) Thrown weapon(-4) Several actions to reload(+1/3) Bulky ammunition(+1) Unreliable(+1)	-8
Catapult[2]	2 hexagon(+1)	requires crew of 3	Easy technology(+1) Thrown weapon(-4) Two minutes to reload(+1 1/3) Reduced range(+1) Battering power(-1) Bulky ammunition(+1) Unreliable(+1)	+1
Trebuchet[2]	8 hexagon(+3)	requires crew of 6	Easy technology(+1) Thrown weapon(-4) Eight minutes to reload(+2) Reduced range(+2) Battering power(-1) Bulky ammunition(+1) Unreliable(+1) Indirect fire(-1)	+4

1. Remember that due to division by three, some modifiers (like unbalanced) may round to zero effect unless combined with other modifiers.
2. Remember that Strength-based ranged weapons get +1 damage for each era past Primitive, which will make them harder to reload.

Basic Era Weapons (+18)

Type	Typical size	Possible Side Effects	Other Modifiers	Total modifier (inc. size)
Muzzle loading field artillery	2 hexagon(+3)	Vuln. to weather	Gun carriage(-3) Unreliable(+3) One minute to reload(+3) Reduced range(+3) Battering power(-7)	+2
Matchlock musket	8 millihex(-21)	Vuln. to weather	Handheld(+3) Very unreliable(+6) One minute to reload(+3)	-9
Flintlock rifle	8 millihex(-21)	Vuln. to weather	Late era(+2) Handheld(+3) Unreliable(+4) One minute to reload(+3)	-9

Industrial Era Weapons (+24)

Type	Typical size	Possible Side Effects	Other Modifiers	Total modifier (inc. size)
Bolt-action rifle	8 millihex(-21)	-	Late era(+2) Several actions to reload(+1) Unreliable(+3) Handheld(+3)	-12
Shotgun	8 millihex(-21)	-	Late era(+2) Shotgun(-3) Several actions to reload(+1) Unreliable(+3) Handheld(+3)	-15
Submachinegun	8 millihex(-21)	-	Late era(+2) Reliable autofire(-3) Bulky ammunition(+1) Handheld(+3)	-18
Machinegun	32 millihex(-15)	-	Late era(+2) Unreliable autofire(-1) Ten seconds to reload(+2) Reduced range(+1) Tripod mount(+1)	-10
Field artillery	8 hexagon(+9)	-	Late era(+2) Several actions to reload(+1) Gun carriage & gun shield(-4) Reduced range(+3) Indirect fire(-3) Half-lethal explosive(-3)*	+5
Flamethrower	32 millihex(-15)	-	Late era(+2) Easy technology(+3) Handheld(+3) Reduced range(+3) Continuous beam(-3) Declining duration effect(-8) One minute to reload(+3) Unreliable(+1d) Lethal explosive(-6)	-15
Grenade	1 millihex(-10d)		Late era(+2) Easy technology(+3) Unreliable(+3) Placed(+6) Lethal explosive(-6) One use(+6)	-16

Atomic Era Weapons (+30)

Type	Typical size	Possible Side Effects	Other Modifiers	Total modifier (inc. size)
Rifle	8 millihex(-21)	-	Handheld(+3) Reduced range(+1)	-17
Autorifle	8 millihex(-21)	-	Handheld(+3) Unreliable autofire(-1) Reduced range(+1)	-18
Shotgun	8 millihex(-21)	-	Handheld(+3) Shotgun(-3) Reduced range(+1)	-20
Grenade launcher	4 millihex(-24)	-	Handheld(+3) Reduced range(+1) Bulky ammunition(+6) Several actions to reload(+1) Explosive(-6)*	-13
Grenade	1 millihex(-30)	-	Easy technology(+3) Placed weapon(+6) Lethal explosive damage(-6) One use weapon(+6)	-21
Stun grenade	1 millihex(-30)	-	Easy technology(+3) Placed weapon(+6) Half-lethal explosive damage(-3) One use weapon(+6)	-18
Anti-tank grenade	2 millihex(-27)	-	Easy technology(+3) Placed weapon(+6) Shaped charge(+3) One use(+6) Unreliable(+3)	-2d
Medium mortar	125 millihex(-9)	-	Easy technology(+3) Dismountable(-2) Lethal explosive(-6)* Manually aimed(+1) Bulky ammunition(+4) Reduced range(+2) Indirect fire(-3)	-10
Taser	2 millihex(-27)	+4 damage if armor is penetrated	Handheld(+3) Non-lethal damage(+2) Battering power(-2) Declining duration effect(-6) Reduced range(+3) Bulky ammunition(+3)	-27
Disposable AT rocket	8 millihex(-21)	-	Handheld(+3) Easy technology(+3) One use weapon(+6) Shaped charge x 2(+6) Slow weapon x 3(+3)	+0
Anti-personnel mine	.5 millihex(-33)	-	Easy technology(+3) Lethal explosive damage(-6) Placed weapon(+6) Triggered weapon(+0)	-30

Post-Atomic Era Weapons(+36)

Type	Typical size	Possible Side Effects	Other Modifiers	Total modifier
Binary propellant assault rifle	8 millihex(-21)	-	Handheld(+3) Adjustable damage(-1) Unreliable autofire(-1) Compact ammunition(-2) Reduced range(+2)	-20
Laser rifle	8 millihex(-21)	No recoil Blocked by smoke	Handheld(+3) Average/hard technology(-1) Beneficial side effect(-2) Detrimental side effect(+2) Reduced range(+1)	-18
Laser assault rifle	8 millihex(-21)	No recoil Blocked by smoke	Handheld(+3) Average/hard technology(-1) Unreliable autofire(-1) Beneficial side effect(-2) Detrimental side effect(+2) Reduced range(+1)	-19
Gauss rifle	8 millihex(-21)	-	Handheld(+3) Average/hard technology(-1) Reduced range(+1) Bulky ammunition(+1)	-17
Particle beam rifle	16 millihex(-18)	Vacuum use only Armor-piercing	Handheld(+3) Hard technology(-3) Beneficial side effect(-2) Detrimental side effect(+2) Bulky ammunition(+2)	-16
Sonic stunner rifle	8 millihex(-21)	Atmosphere use only	Handheld(+3) Average technology(+0) Non-lethal damage(+2) Detrimental side effect(+1) Adjustable damage(-1) Cone area(-6) Bulky ammunition(+2)	-22
Hyperv. microsphere	.5 millihex(-33)	Armor-piercing	Handheld(+3) Reduced range(+4) Unreliable autofire(-1) Beneficial side effect(-2) Compact ammunition(-2)	-31

Advanced Era Weapons(+42)

Type	Typical size	Possible Side Effects	Other Modifiers	Total modifier
Disruptor rifle	8 millihex(-21)	-	Handheld(+3) Average technology(+0) Tech era special effect(-12)	-30
Blaster rifle	8 millihex(-21)	-	Handheld(+3) Average technology(+0) Compact ammunition(-2) Reduced range(+4)	-16
Plasma gun	16 millihex(-18)	Excessive recoil Backblast	Handheld(+3) Hard technology(-3) Detrimental side effects(+2) Reduced range(+3) Bulky ammunition(+1) Lethal explosive damage(-6)	-18

DESIGN PAGE 1 - If you are viewing this page as a pdf, it has forms that allow you to do many aspects of weapon design right here on the page, and then print off your finished design. *Cool, eh?*

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Autocalc off	M60 LMG	Mk19 gren.
Reset form	6-pdr	Flamethrower

Insert weapon name				
Middle	Atomic Era	10	d+	0
Average technology		0	d+	0
Weapon of 1 millihex		0	d+	0
No size adjustment		0	d+	0
Normal rate of fire		0	d+	0
Normal damage		0	d+	0
Reload as an action		0	d+	0
Reliable		0	d+	0
No side effects		0	d+	0
No side effects		0	d+	0
No special effect		0	d+	0
Normal ammunition (shots x 1)		0	d+	0
Normal weapon		0	d+	0
Normal damage		0	d+	0
Normal damage		0	d+	0
Handheld (shoulder-fired)		1	d+	0
Normal ranged weapon		0	d+	0

Weapon size	1	hexagon
Ammunition size per shot	0.01	hexagon
Enter shots carried/type	1	clip
Default Accuracy	4	
Enter Accuracy adjustments	0	
Default cost level	8	
Other cost levels (p.2.39)	0	
Approximate historical date	1980CE	

Advanced design modifiers

Fixed mount weapon	0	d+	0
Conventional damage	0	d+	0
Direct fire weapon	0	d+	0
No submunitions	0	d+	0
Normal range (Level+10)	0	d+	0
Normal range	0	d+	0
No proximity fuze	0	d+	0
Non-triggered weapon	0	d+	0
Normal technology	0	d+	0
Non-autonomous weapon	0	d+	0
Unguided weapon	0	d+	0
Normal targeting	0	d+	0
Normal speed weapon	0	d+	0

No duration effect	0	d+	0
Instant effect	0	d+	0
No area effect	0	d+	0
Normal effect	0	d+	0
Non-adjustable damage	0	d+	0
Single weapon	0	d+	0
No recoil compensation	0	d+	0
No self-charging	0	d+	0
No gun shield/carriage	0	d+	0
Not dismountable	0	d+	0
No gizmos	0	d+	0
Subtotal	11	d+	0
Final weapon damage	11	d+	0

Name	Uses	Accuracy	Damage	Shots	Weight	Cost	Armor	Hits
Insert weapon name	insert	4	11d+0	1 clip	0.5(0.0)ton	16KCr	2d+1	11

VEHICLES

"Her broadside walls were shivered, and great slabs and splinters were strewn over the deck of her entire gunroom; her stairways were so bloody and slippery that we had to sift cinders from the ash pans to keep from slipping. When she made fast to the wharf, a number of curious soldiers and civilians crowded aboard, but recoiled when they saw blood and brains bespattered everywhere, whilst arms, legs and several headless trunks were strewn about."

L.S. Flatau, "A Great Naval Battle"

INTRODUCTION - The genesis of **Stuff!** was the short but usable vehicle design rules in **EABA**. The thought was "if we can do basic vehicle design in that short a space, what can we do with a whole book?" This chapter will repeat the **EABA** vehicle rules, and add a *lot* more material to cover all the advanced topics outside the mainstream "get in, turn key, drive" sort of vehicles the main **EABA** rules are meant for.

The rather grim and grisly quote above is a recollection from a battle fought on July 15, 1862 by the Confederate ironclad *Arkansas*. It is meant to remind you that vehicles in roleplaying are an avenue for adventure, and vehicle combat is *not* the best place for adventurers to be, even in a somewhat forgiving system like **EABA**. Keep it in mind in two ways. First, big guns are really, *really* bad for soft, squishy people. Second, you only need to design enough of your vehicle to meet whatever needs it will serve in your adventure. If an adventure takes place on a cruise ship, do you *really* need to design a *entire* cruise ship? *Probably not*.

BASIC VEHICLES - Depending on the gameworld, vehicles can range from a rarity to a central part of daily life. Driving a vehicle is like any other skilled action, changing facing, speeding up, slowing down and so on. The Strength of the engine is like an adventurer's Strength and determines how fast the vehicle can go. If you want to get into a shoving match with a car, you compare your Strength roll to its (hint: you're going to lose). For ninety-nine percent of adventurer or gamemaster needs, you just need to know the following:

How fast will it go?
How big is it?
How tough is it?
How big a gun can I put in it?
How many gizmos are on it?
How much does it cost?
How do I blow it up?

Like weapon design, vehicles will be broken down into basic and advanced sections. The basic section covers your run-of-the-mill car/boat/plane kind of stuff, while the advanced section deals with esoteric stuff like rockets, balloons, starships, etc.

Remember that the idea of **Stuff!** is to let *you* decide the specifics of what you are building. Power plants are "power plants". It can be a steam engine, jet turbine or alchemical reactor, whatever *you* decide is appropriate for the vehicle and the gameworld. You just choose the modifiers on the power plant that best reflect how it works. All that **Stuff!** cares about is how big it is and how fast it makes your vehicle go. The same applies to your weapons, armor and everything else.

If you design up a vehicle and it doesn't seem to meet your idea of what it should be capable of, don't scrap it. First, go to the advanced design section and see if there are any modifiers that might apply. A simple use of something like the advanced "suspension" rules might make your car just that little bit faster. If minor tweaks don't work, then go back and rethink the concept. Maybe you're just trying to do too much, either for the size of the vehicle or the level of technology. Altering one, the other or both might be the change you need.

Power - Whatever makes your vehicle go is going to be referred to as a "powerplant". The actual mechanism is irrelevant at this point, but historically, mechanical power plants only become practical with Industrial Era technology. Everything prior to that is just an application of animal power, wind power or some other natural force.

One hexagon of reliable powerplant generates the listed amount of Strength. Note that this is *total* power plant space. Multiple smaller engines (of the same size) use power for one engine and add +1d each time you double the number. If you have to compare vehicle Strengths, you usually compare power plant Strength, not adjusted Strength.

Technological Era	Power for 1 hexagon
Animal power	+6 Strength
Primitive	+12 Strength
Basic	+18 Strength
Industrial	+24 Strength
Atomic	+30 Strength
Post-Atomic	+36 Strength
Advanced	+42 Strength
Early part of an Era	-2 penalty
Middle part of an Era	no adjustment
Late part of an Era	+2 bonus

Modifiers	Amount
Power plant of .12 hexagon	-9 penalty
Power plant of .25 hexagon	-6 penalty
Power plant of .5 hexagon	-3 penalty
Power plant of 1 hexagon	+0 bonus
Power plant of 2 hexagons	+6 bonus
Power plant of 4 hexagons	+12 bonus
Power plant of 8 hexagons	+18 bonus
Power plant of 16 hexagons	+24 bonus
Power plant of 32 hexagons	+30 bonus
Power plant of 64 hexagons	+36 bonus
Power plant of 125 hexagons	+42 bonus
Power plant of 250 hexagons	+48 bonus
Power plant of 500 hexagons	+54 bonus
Power plant of 1000 hexagons	+60 bonus
Each doubling	+6 bonus
Each 25% extra space (max +50%)	+2 bonus
Each 25% less space (max -25%)	-1 penalty
Touchy (x8 maintenance)	+3 bonus
Durable (x1/8 maintenance)	-3 penalty

Note - One nice thing about **Stuff!** is that any particular gameworld's designs can be tweaked to match the gamemaster or player's expectations. *Want more powerful steampunk vehicles?* Just add +3 or +6 to the listed power plant output. Ditto for any other era, system or subsystem on a vehicle.

Note that the scale is just a little different than that used for weapons, and just slightly different than the ultra-compact rules used in **EABA**. Power plants are -3 to Strength each time size is halved below one hexagon (and extra space modifiers are halved), and +6 to Strength each time it is doubled above one hexagon. We'd like to have made everything exactly the same, but the numbers just didn't work out that way. Strength can and should be changed for early or late portions of an era. For instance, Early Industrial engines would be +22 Strength, while Late Basic engines would be +20 Strength.

Normal powerplants need maintenance each one thousand hours of operation (time level of 44), more often under severe circumstances. Touchy powerplants will need some maintenance at least once each one hundred twenty five hours of operation (6 time levels less). With gamemaster permission, this bonus to power can be taken more than once, cutting operating time between maintenance by a factor of two (2 time levels) for each +3 of Strength after the first (slightly more than a factor of 25% for each +1 Strength). Durable but bulky powerplants require less maintenance, increasing operating time between maintenance by a factor of eight (6 time levels) for the first -1d penalty to Strength and by a factor of two (2 time levels) for each -3 penalty after that.

EXAMPLE: One hexagon of Atomic Era engine has a Strength of +30. A high-performance jet engine that required maintenance each 60 hours (doubly touchy) would have a Strength of +36 (12d+0) instead.

Wind power uses *no* fuel and animal power can get by on forage, but also can get tired or fail. Realistically, animal power should never have an *adjusted* Strength of more than +15 for speed purposes. The way legs work doesn't really allow you to tow a vehicle any faster than this. The top speed for an animal or wind-powered vehicle is in *perfect* conditions. A more reasonable *long-term* average is the speed for the Strength with a further penalty of -6 (down to the minimum table entry).

In addition, in a 1g gravity well, very large creatures lose some of their efficiency because of increased skeletal needs. More details are in the the **Creatures** chapter, but for now assume an animal power plant takes a -1 penalty for each +2 Strength from its size, or +1 per each -4 from its size.

EXAMPLE: A single animal 8 hexagons in size would have an adjusted Strength of +15 (+24, with a -9 penalty from its size). Eight 1 hexagon animals would also have a combined Strength of +15.

On any vehicle with a *mechanical* powerplant (not wind, animal or similar), a fuel tank is part of the space taken up by the powerplant. For free you get five hours of running time at full speed, or ten at half speed or less. More fuel than this takes up the same space as the powerplant for forty hours of fuel at top speed or eighty at half speed or less. This would be figured at the same mass as cargo space. This *does not* cover things like rocket engines, inefficient battery power or super-efficient fusion reactors, just your basic "fill the gas tank" kind of engine that most vehicles are going to have. Anything fancier than that will be in the advanced design section (page 3.15).

EXAMPLE: A .5 hexagon Atomic Era powerplant has a Strength of +27 and will run for five hours at full speed using the fuel included in this size. If you add .5 hexagons of *extra* fuel (the powerplant size), you get an extra forty hours of full power operation.

Once you have the Strength of the vehicle, you adjust this Strength for the vehicle's mass in tons and use the result to figure out the vehicle's top speed, rounding mass to the *nearest* table entry (exactly halfway rounds up). This means you have to figure out the *loaded* vehicle mass *before* you go any further.

Vehicle type	Approx. *loaded* weight
Motorcycle	.2 tons
Compact car	1 ton
Car	1.5 ton
Truck	2 tons
Cargo truck	7 tons
Armored personnel carrier	20 tons
Tank	50 tons
Jet ski	.2 tons
Motorboat	1 ton
Yacht	200 tons
Man o'War	1,000tons
Destroyer	3,000 tons
Cruiser	20,000 tons
Battleship	60,000 tons
Ultralight	.2 tons
Light plane	1.5 tons
Light attack helicopter	5 tons
WWII fighter	6 tons
Modern fighter	15 tons
Large passenger jet	350 tons
Heavy bomber	250 tons

Don't be surprised if you have to go back and refigure things later. You may have over or under-estimated the weight of everything you want to put between the wheels...

Loaded mass	Strength adjustment
.03 ton	+15 bonus
.06 ton	+12 bonus
.12 ton	+9 bonus
.25 ton	+6 bonus
.5 ton	+3 bonus
1 ton	+0 bonus
2 tons	-3 penalty
4 tons	-6 penalty
8 tons	-9 penalty
16 tons	-12 penalty
32 tons	-15 penalty
64 tons	-18 penalty
125 tons	-21 penalty
250 tons	-24 penalty
500 tons	-27 penalty
1000 tons	-30 penalty
2000 tons	-33 penalty
4000 tons	-36 penalty
8000 tons	-39 penalty
16,000 tons	-42 penalty
32,000 tons	-45 penalty
64,000 tons	-48 penalty
Each doubling	-3 penalty
Each 25% extra mass (max +50%)	-1 penalty
Each 25% less mass (max -25%)	+1 bonus
Offroad vehicle	-3 penalty
Flying vehicle	+3 bonus
Upper atmosphere	+9 bonus
Water vehicle(surface)	-9 penalty
Water vehicle(submerged)	-6 penalty

EXAMPLE: One hexagon of Atomic Era engine has a Strength of +30. You put this in a truck that has a loaded mass of 4 tons, for a -6 penalty. This truck has an adjusted Strength of +24 for purposes of determining its performance. Remember that in any sort of shoving or towing match, you use the power-plant Strength *before* it is adjusted for vehicle weight.

We recommend keeping a copy of the **EABA Universal Chart** (**EABA**, page 3.4) handy for easy viewing of doubled amounts of mass, time and size.

There are certain vehicle characteristics you do *not* have to worry about. All vehicles are assumed to be streamlined and have the obvious effects appropriate to their era and function. Boats are watertight, space vehicles are airtight, submarines don't have screen doors, and so on. An "upper atmosphere vehicle" is a flying vehicle designed to operate in a low- or no drag environment (very high altitudes). Any vehicle designed for re-entry will have this modifier.

You use the next table to determine the basic top speed, acceleration and deceleration of your vehicle. You normally round fractional die amounts down, but you *may* use the italicized numbers if you want.

EXAMPLE: Our 4 ton truck has an adjusted Strength of +24 (8d+0). The table shows it has a top speed of 30 meters per turn when fully loaded. If the truck had 2 tons of cargo capacity and was running empty (an empty weight of 2 tons), its top speed then would be closer to that for a Strength of +27 (9d+0), or 40 meters per turn.

A vehicle can't reach its top speed or slow to a stop in one turn. A vehicle's default acceleration and deceleration is based on *half* the power plant Strength (round up), plus the mass modifier, plus or minusany modifier for the type of vehicle (water vehicle, off-road vehicle, etc.), with an *extra* -9 for "surface" vehicles like autos or boats. The result is the Strength row for the meters per turn the vehicle can change its speed. Rockets count as flying vehicles for acceleration/liftoff purposes, *not* as upper atmosphere vehicles.

Air vehicles can take off vertically if acceleration is 4d+2 or more (11 meters). Winged vehicles need a speed of -12 from their top speed in order to take off horizontally, and stub-wing vehicles require a speed -6 from their top speed in order to lift off. This is the "stall speed", and is the minimum controllable speed for a non-VTOL vehicle. Most vehicles can also optimize their speed, gaining or losing one row for acceleration purposes by losing or gaining one row for top speed purposes.

EXAMPLE: Our 4 ton truck has a Strength of +30 and a -6 mass modifier. It will have an acceleration of half its Strength (+15), with a -6 mass penalty and a -9 "surface vehicle" penalty, for an acceleration on the +0 row, or 3 meters per turn.

Air vehicles may not take off *vertically* unless their acceleration is greater than 10 *and* they have paid the extra monetary cost for a VTOL vehicle. Vertical take-off air vehicles can subtract 10 meters from acceleration and accelerate in *any* direction (including straight up) an amount equal to the difference. Most air vehicles can also optimize their speed, gaining or losing ±1 for acceleration purposes by losing or gaining ±1 for top speed purposes. An air vehicle can also give up -1 of top speed to gain an extra +1 of difference for determining stall speed.

EXAMPLE: An airplane with adjusted Strength of +45 has a stall speed based on the +33 row (-12 on top speed), and ends up with acceleration for the +18 row. The designer decides to *gain* +3 speed (to +48) to *lose* -3 on acceleration (to +15 Strength). They then use that +3 on top speed to change its stall speed. The top speed goes back down to the +45 row, but the stall speed goes down -3 to the +30 row. The top speed is +45, the acceleration is +15 and the stall speed is +30.

Strength *remaining*	**Top speed**
-12(-4d+0)	1m/turn (4kph/2mph)
-7(-2d+1)	1.5m/turn (5kph/3mph)
-4(-1d+1)	2m/turn (7kph/4mph)
+0(0d+0)	3m/turn (11kph/7mph)
+3(1d+0)	4m/turn (14kph/9mph)
+6(2d+0)	5m/turn (18kph/11mph)
+8(2d+2)	*6m/turn (22kph/13mph)*
+9(3d+0)	7m/turn (25kph/16mph)
+10(3d+1)	*8m/turn (29kph/18mph)*
+12(4d+0)	9m/turn (32kph/20mph)
+13(4d+1)	*10m/turn (36kph/22mph)*
+14(4d+2)	*11m/turn (40kph/25mph)*
+15(5d+0)	13m/turn (47kph/29mph)
+16(5d+1)	*14m/turn (50kph/31mph)*
+17(5d+2)	*16m/turn (58kph/36mph)*
+18(6d+0)	17m/turn (61kph/38mph)
+19(6d+1)	*19m/turn (68kph/43mph)*
+20(6d+2)	*21m/turn (76kph/47mph)*
+21(7d+0)	23m/turn (83kph/52mph)
+22(7d+1)	*25m/turn (90kph/56mph)*
+23(7d+2)	*28m/turn (101kph/63mph)*
+24(8d+0)	30m/turn (108kph/68mph)
+25(8d+1)	*33m/turn (119kph/74mph)*
+26(8d+2)	*36m/turn (130kph/81mph)*
+27(9d+0)	40m/turn (144kph/90mph)
+28(9d+1)	*44m/turn (158kph/98mph)*
+29(9d+2)	*48m/turn (173kph/107mph)*
+30(10d+0)	53m/turn (191kph/119mph)
+31(10d+1)	*58m/turn (209kph/130mph)*
+32(10d+2)	*64m/turn (230kph/143mph)*
+33(11d+0)	71m/turn (256kph/160mph)
+34(11d+1)	*78m/turn (281kph/174mph)*
+35(11d+2)	*86m/turn (310kph/192mph)*
+36(12d+0)	95m/turn (342kph/214mph)
+37(12d+1)	*105m/turn (378kph/235mph)*
+38(12d+2)	*115m/turn (414kph/257mph)*
+39(13d+0)	126m/turn (454kph/284mph)
+40(13d+1)	*139m/turn (500kph/311mph)*
+41(13d+2)	*153m/turn (551kph/342mph)*
+42(14d+0)	169m/turn (608kph/380mph)
+43(14d+1)	*186m/turn (670kph/416mph)*
+44(14d+2)	*205m/turn (738kph/459mph)*
+45(15d+0)	225m/turn (810kph/506mph)
+46(15d+1)	*248m/turn (893kph/555mph)*
+47(15d+2)	*273m/turn (983kph/611mph)*
+48(16d+0)	300m/turn (1080kph/675mph)
Each extra +1d	times one and a third
Each extra +1	times one and a tenth

A vehicle with adjusted Strength of +48 (16d+0) can reach Mach 1 (the speed of sound), and every +7 past that would be another Mach number.

Note - The faster a vehicle can go, the less important small speed differences become. All that really matters is whether or not you are faster than the other guy...

EXAMPLE: We decide to build a Post-Atomic Era aircar (flying limousine). We decide it will be 8 tons (it is armored), and give it a touchy engine that takes up two hexagons, for 15d+0 Strength.

Post-Atomic Era	+36
2 hexagon power plant	+6
Touchy x 1	+3
Modifier total	+45
Total	15d+0

After taking mass and flying ability into account, +39 Strength is left, so it has a top speed of 126 meters per turn. This is going to be a stub-wing VTOL design, so its stall speed based on lift will be -6 from this, on the +33 row, or 71 meters per turn.

Power plant Strength	+23
8 ton loaded vehicle mass	-9
Flying vehicle	+3
Modifier total	+17

It can accelerate/decelerate based on half its power plant Strength(+23), minus its mass penalty (-9), plus the fact that is is an air vehicle (+3), for a final row of +17, or an acceleration of 16. Since you only need an acceleration of 10 to counter gravity, the aircar can accelerate straight up at 6 meters per turn, which means it is VTOL capable. Because this is meant to be a vertical takeoff vehicle we opt for "stubby wing" (aerodynamic control surfaces), because these take up less space and weight in the vehicle. However, their complexity will make the vehicle more expensive per hexagon than a non-VTOL flying vehicle.

Note - You may have noticed that you could theoretically get any flying vehicle off the ground (very slowly) using nothing more than a gerbil on a treadmill. *In general*, winged vehicles should have enough Strength (modified power plant minus the mass penalty) to "lift themselves" (e.g. a plane with a residual Strength of 2d+0 can "lift" 50 kilograms).

Note - As a practical matter, no "spinning the wheels against the ground" type of power train is going to have an acceleration of more than +13. It is exceeding difficult to get more than 1g of forward acceleration, since it would mean the car is pushing against the ground with more than its weight.

How big? - You need one hexagon of space for each standing or sitting person of normal size. To see what this is like, lay twelve sheets of paper on the ground and then sit down on them with a yardstick next to you to get a one meter height, or stand on six sheets with two yardsticks of height. You really need a minimum of two hexagons per person if there is standing room with room to do anything. You can get three people in two hexagons if it is cramped, and two in one hexagon if they are really crammed in. Beds take up two hexagons, and other permanent facilities you can get an idea of by looking around the place you live. Keep in mind that all but the smallest vehicles are very unlikely to take up the same number of hexagons on a map as their total volume. The advanced rules (page 3.38) have more details on space needed for people and stuff.

EXAMPLE: A van might have two hexagons of space for the engine compartment (one hexagon high, two hexagons wide). It might have six more hexagons of floor plan where there is more or less standing room, but these take up twelve hexagons of vehicle volume. So, you have eight hexagons of space on a map, but fourteen in vehicle volume.

After you fit any people in, you need space for storage, the powerplant, gizmos and possibly extra fuel. Small vehicles like motorcycles will completely fit in two hexagons and may actually have a volume of one hexagon or less.

Flying vehicles with wings (those that can't take off vertically) will have wings and control surfaces that take up *double* the hexagons of *everything else*. Flying vehicles that *can* take off vertically will have *half* the hexagons of *everything else* taken up by control surfaces. Space vehicles generally don't need control surfaces. In terms of a vehicle drawing, you should assume about four hexagons of space for each hexagon of full wings (since they are usually less than a meter high). In general, you design any sort of air vehicle by fitting in everything you want, and then seeing how big the wings are.

EXAMPLE: If you only have two hexagons of stuff in your airplane design, you need a plane that has a size of six hexagons (a plane with a size of six hexagons has four hexagons of wings, leaving two hexagons for your stuff). For purposes of weight, armor calculations and the like, you use a vehicle size of six hexagons. But if you want to draw it out on a sheet of paper, you pencil in two hexagons of stuff, and *sixteen* hexagons of wings.

For now, generally ignore anything else that takes up space. A blimp may be huge, but the passenger cabin is not. For purposes of "floor plan" a vehicle may have multiple levels.

EXAMPLE: This aircar/limousine carries a driver and five seated passengers, plus luggage space and room for gizmos. That is six hexagons of space for people, plus two more for luggage/gizmos, plus two more for the engine, a total of ten hexagons. The thruster nozzles and stub wings for the vertical take-off capability take up half this (five hexagons), for a total vehicle size of fifteen hexagons.

Note - Space used by wings is a generalization that works for *most* design purposes. If you are trying to recreate a real-world airplane, use any wing area numbers you can get or sort of measure from a picture. It's a game, not rocket science.

How tough? - You know how much the vehicle masses, and you just figured out how big it is. *Now you need to armor it.* Subtract half a ton from the *loaded* vehicle mass for each hexagon of power plant, a tenth of a ton for each hexagon of *total* space (including wings!), a tenth of a ton for each person carried, and half a ton for each hexagon of cargo, gizmos or fuel. The remainder is what is left for armor. This fills out the mass you based vehicle performance on, for a loaded, fully fueled vehicle of exactly your design weight. If you don't think there is enough weight left for sufficient armor, then you have to go back, adjust power plant size and/or performance and try again. Round the weight of armor *and* vehicle size to the nearest table increment. For instance, a 9 hexagon vehicle would count as an 8 hexagon vehicle.

EXAMPLE: The aircar masses 8 tons. It loses 1 ton for two hexagons of power plant, 1 ton for two hexagons of gizmos/cargo, .6 tons for six passengers and 1.5 tons for the total size of fifteen hexagons, leaving 3.9 tons for armor, which rounds to 4 tons.

When you get a final armor number, you always convert it to an **EABA** value in dice of armor, like +7 armor would be 2d+1. A vehicle will always have an overall armor of at least 1d+0, *even if no extra armor is bought*. This is the normal, minimal outer skin or structure of the vehicle and is only applied *after* extra armor is bought. *Huh?* What we mean is that if the vehicle is *unarmored*, it gets a final armor of *at least* 1d+0. However, if you want to armor it, you buy the armor up from whatever number the tables indicate, *even if this is a negative amount.*

EXAMPLE: If a passenger car has -1d+0 armor, it counts as 1d+0 armor. However, to buy armor for the car you would buy it up *from* -1d+0, *not* 1d+0.

You may pull some protection from one side of a vehicle to add to a different side, and this *can* drop armor on one or more sides to 0d+0. Imagine a canoe or rowboat, or to some extent a convertible.

Each -2 of armor from any number of sides can be used to give a *different* side +1 armor. The sides are top, bottom, right, left, front and back.

Technological Era	Overall armor
Basic or earlier	+3 Armor
Industrial	+9 Armor
Atomic	+15 Armor
Post-Atomic	+21 Armor
Advanced	+27 Armor
Early part of an era	-2 penalty
Late part of an era	+2 bonus
.06 tons armor	-12 penalty
.12 tons armor	-9 penalty
.25 tons armor	-6 penalty
.5 tons armor	-3 penalty
1 ton armor	+0 bonus
2 tons armor	+3 bonus
4 tons armor	+6 bonus
8 tons armor	+9 bonus
16 tons armor	+12 bonus
Each doubling	+3 bonus
Each 25% extra mass (max +50%)	+1 bonus
Each 25% less mass (max -25%)	-1 penalty
Land vehicle	+3 bonus
Water vehicle	+6 bonus
Sloped armor	+6 bonus

Vehicle size	Damage limit	Armor effect
.5 hexagon	9	+3 bonus
1 hexagon	8	-0 penalty
2 hexagons	7	-3 penalty
4 hexagons	6	-6 penalty
8 hexagons	5	-9 penalty
16 hexagons	4	-12 penalty
32 hexagons	3	-15 penalty
64 hexagons	2	-18 penalty
125 hexagons	1	-21 penalty
250 hexagons	0	-24 penalty
500 hexagons	-1	-27 penalty
1000 hexagons	-2	-30 penalty
2000 hexagons	-3	-33 penalty
4000 hexagons	-4	-36 penalty
Each doubling	-1 additional	-3 penalty
Each +25% extra (up to twice)		-1 penalty
Each -25% less (once)		+1 bonus

EXAMPLE: The aircar is Post-Atomic Era, so it has an overall armor base of +21. It is effectively a 16 hexagon vehicle, for a -12 penalty, but it has 4 tons of armor (not sloped) for +6, for an overall armor of +15(5d+0) on a sixteen hexagon vehicle. Remember, an "overall armor" means *each* facing has 5d+0 armor. The player designing the aircar figures that if it is shot at, it will be from behind or below, so they take -6 off the top and -3 from each side, and add +3 to the back and underbelly. The aircar now has a front armor of 5d+0, a top armor of 3d+0, side armor of 4d+0 and rear and underside armor of 6d+0. Using the damage limit rule, no single point target attack can do more than 4 hits through armor to this vehicle because of its size. Explosives and battering attacks can alter this limit.

ADVANCED TOPIC: SLOPED ARMOR

Armor can be tilted at an angle to make it more effective, but this decreases the efficiency of the vehicle. Most tanks will have **sloped armor**. If you count the usable interior space of the vehicle as being 1 level of size less than normal, basic vehicle armor (*each* side) is increased by +6, or by +3 if the vehicle is unarmored or has the default armor of 1d+0. Typically, this +6 bonus is taken off the top and bottom where it does not really apply anyway, and +6 more is added to the front or +3 to each side.

EXAMPLE: If the total size figured for a vehicle were ten hexagons, and you sloped the armor, it would still be a ten hexagon vehicle, and you get an overall +6 bonus to armor. However, the usable space inside is now less than ten hexagons. Looking at the **EABA Universal Chart**, you see that there is no "10 hexagon" row, but there is a "1000 hexagon" row. Apply a -1 to *that* row and you get a result of "700 hexagons", which you just divide down to 7 hexagons. You treat all your vehicle components as being of normal size, but you put them in a 7 hexagon space instead of a 10 hexagon one.

Yes, sloped armor adds some complexity to vehicle design, but it only really applies to tanks and a handful of other specialized vehicles. That's why it's an advanced rule.

ADVANCED TOPIC: MOTORCYCLES

Or *any* vehicle that you ride on the *outside* of. This is more of a special effect than a design calculation. A vehicle like an open-topped boat is just a vehicle with *no* top armor (hits from above would hit the bottom armor if they didn't hit something else first). A motorcycle is a vehicle small enough that you *can't* get in it. The driver/passengers count towards the total loaded mass of the vehicle, but *not* its size (i.e. a motorcycle does not allot space or mass to seating). The weight of the driver/passengers also does *not* count towards vehicle Hits (page 3.12). Vehicle armor *can* be rearranged or sloped, but it will only protect the *vehicle*. You would need to use the Hit Locations rule (page 3.13), and passengers get no protection from vehicle armor. As an option, *one* facing can protect the driver and passengers, and *two* other facings have a 50-50 chance of offering protection. This would represent a wrap-around windscreen or similar protection.

EXAMPLE: If you had a 250 kilogram motorcycle that could carry up to two people (200 kilograms), it counts as a 250 kilogram vehicle for design purposes relating to its armor and hits, but as a 450 kilogram vehicle for figuring out its performance, or as a 350 kilogram vehicle when it only has one rider.

ADVANCED TOPIC: DAMAGE LIMIT

Damage limit is for large vehicles, those too big to demolish in a single hit by anything short of an explosion. No matter how much gets through armor, the damage limit is the maximum amount of hits the *vehicle* will take from one attack. It's a really just a game balance issue. A vehicle of almost any kind has a *lot* more hits than a person, but keeping track of hundreds or *thousands* of hits is just not what **EABA** is about. Damage limit lets us reduce the number of hits to keep track of, without sacrificing too much realism in terms of damage effects.

Damage limit will apply *after* everything else. *If a vehicle has a damage limit of zero or less, poking little holes in it simply doesn't do anything!* Imagine trying to sink an ocean liner with a machinegun. Sure, you are poking a lot of little holes in it, but the ocean liner will rust to death before you actually sink it that way.

Vehicles of 250 hexagons or more are mostly immune to simple hole-punching weapons. Note that while the vehicle might not be losing *hits*, it can still be suffering *effects*. Holes may be letting air out or water in. All those bullets could be ventilating the crew and passengers. Combat damage may cause authorities to look suspiciously at the vehicle when it shows up in civilized areas. Cosmetic repairs still cost money, etc.

The damage limit for *explosions* (**EABA**, page 5.7) is increased by one for each die of explosion damage that *exceeds* the armor. This means that even with a damage limit of zero or less, a vehicle will still lose hits from a large enough explosion. The penetrating damage of shaped charges *does* count as an explosion for this rule. Damage limit does *not* affect passenger or internal equipment damage. Just because the battleship loses no hits from an attack doesn't mean people in the area are unhurt! The damage limit of a vehicle can also be altered by weapons that have the "battering power" modifier (page 2.27).

EXAMPLE: Say a heavily armored ship (10d+0) with a damage limit of -4 is hit by a 16d+0 torpedo (an explosive attack). The attack exceeded the armor by 6d+0, so the damage limit is increased by 6, from -4 to 2. The ship only takes 2 hits from the attack, but anyone in the area of the ship that is hit still takes the effects of a 6d+0 explosion!

Damage limit will generally *not* apply to effects that by their very nature involve the whole vehicle (like crashing a plane). How important damage limit is to your vehicle designs is directly related to how big they are...

How big a gun? - For purposes of mounting it on the vehicle, a weapon is counted as a gizmo. The **Weapons** chapter is where you need to go if you have not been there already. Each hexagon of weapon and its mounting will mass half a ton. Extra ammunition is stored in cargo space and takes up as much space as the weapon for 200 shots unless you bought it to have an altered efficiency in this regard. Weapons are assumed to have the same armor as the vehicle for attacks from that facing. *Externally mounted* gizmos or weapons (like a missile on the wing of a fighter jet) have only their own armor as protection. They do not count towards vehicle size, but do add their mass for performance purposes. A *really* short version of the weapon design guidelines are below.

Technological Era	Damage for 1 hexagon
Primitive	+12 lethal
Basic	+18 lethal
Industrial	+24 lethal
Atomic	+30 lethal
Post-Atomic	+36 lethal
Advanced	+42 lethal
Weapon of .125 hexagon	-9 penalty
Weapon of .25 hexagon	-6 penalty
Weapon of .5 hexagon	-3 penalty
Each doubling of space	+3 bonus
Autofire (Industrial Era or better)	-3 penalty
Takes a minute to reload a shot	+3 bonus
One-use weapon	+6 bonus
Explosive damage	-6 penalty
Manually aimed	+1 bonus
Fixed weapon	+0 bonus
60° arc weapon	-3 penalty
180° arc weapon	-6 penalty
360° turret weapon	-9 penalty

EXAMPLE: The aircar designer decides to allot .25 hexagons of space to an autofire weapon in a rear 60° arc, just to discourage tailgaters. At the Post-Atomic Era, a 1 hexagon weapon starts at +36, and is modified down to +24(8d+0) by the size, autofire and firing arc. The extra ammunition supply is 100 shots, which takes .125 hexagons from the cargo capacity. Alternately, the designer could have put in a pair of one-use rockets, each with an explosive damage of 8d+0. Note that if we use the weapon arc notes on page 2.15, we would actually get 200 shots of ammunition, since the space taken up by the 60° traversing mechanism does not count towards weapon size when figuring ammunition space.

How many gizmos? - You've already figured out how much space you've allotted for non-standard stuff. First, the standard stuff:

Technological Era	Freebies
Primitive	None
Basic	Protection from sun and rain
Industrial	Climate control, lights
Atomic	Basic communications
Post-Atomic	Computer links, autopilot
Advanced	?

Large vehicles will have all the necessary infrastructure for their tech era, whether ladders, stairs or turbolifts. Everything more than this takes up the space you've allotted for gizmos. Some of the common ones are below. There will be a lot more in the **Gadgets** chapter, including explanations of how to use sensors and similar navigational or detection aids.

Gizmo	Tech Era	Hexagons
Life support	Industrial	.5 per 10 pass.
Life support	Atomic	.25 per 10 pass.
Ejection seat	Atomic	.12 each
0d+0 sensor	Industrial	.5 hexagon
2d+0 sensor	Atomic	.5 hexagon
4d+0 sensor	Post-Atomic	.5 hexagon
6d+0 sensor	Advanced	.5 hexagon
+1d sensor bonus	-	double size
-1d sensor penalty	-	.25 hexagon
-2d sensor penalty	-	.12 hexagon
+6 wpn Acc.	Industrial	.5 per weapon
+6 wpn Acc.	Atomic	.25 per weapon
+6 wpn Acc.	Post-Atomic	.12 per weapon
+12 wpn Acc.	Advanced	.12 per weapon
each extra +6 to Acc.	-	double size

Bonuses to weapon Accuracy are still subject to tech era limits (page 2.22), and if you used the weapon chapter to design the weapons on your vehicle, you should not use the Accuracy bonuses listed above. The numbers above are just quick-and-dirty guidelines for simple vehicle designs.

EXAMPLE: The aircar has 1 hexagon of space for gizmos. Since it is a Post-Atomic Era vehicle it already comes with weather protection, climate control, lights, basic communications, computer links and autopilot. We want to be able to fly high, so we put in life support for 10, for .25 hexagons of space. We add a small radar so we can spot things, for a 3d+0 Awareness roll and .25 hexagons of space. We add the previously designed machinegun & ammo for another .375 hexagons of space. This leaves .125 hexagons, which we turn into an ejection seat for the owner of the aircar (the other passengers will apparently have to fend for themselves).

Until we get into the **Gadgets** chapter, a vehicle "sensor" is simply a tech era-appropriate technology that provides an Awareness roll in conditions that are outside human perceptions. An Industrial Era sensor might be an optical rangefinder and a set of very large mounted binoculars to collect the faint light on moonlit nights to give a passable image. An Atomic Era sensor might be a radar, and something from a future era might be geared to detecting fusion power plants or ion trails.

A sensor simply gets an Awareness roll, and has an Accuracy of 20 at Early Industrial Era to negate range, and can be used for one roll per turn in a narrow (15°) arc, or 24 seconds for a 360° sweep. Faster sweeps are at a corresponding penalty for taking less time than normal. Sensor "Accuracy" goes up by +2 for each fraction of an era past Early Industrial. Vehicle sensors require an operator until the Atomic Era, after which they can operate more or less unattended and send an alert if they spot something that meets some pre-defined criteria (like a collision alarm).

How much? - While credits are independent of technology, certain manufacturing techniques are more expensive. Vehicles will have a cost per ton *and* per hexagon based on the era in which they are built. Use the **EABA Universal Chart** to get the level shift based on the size (round nearest) of the vehicle, then apply level modifiers as appropriate. That is, you add the size of the vehicle in hexagons to its weight in tons to find an equivalent Size level, and then subtract 2.

EXAMPLE: A 100 hexagon vehicle that weighs 75 tons (total of 175) would have a size level of 13, which becomes a base cost level of 11.

The first part of the table is the *overall* cost. Specific parts of the vehicle may cost more. For instance, each hexagon of gizmos and weapons costs quadruple for the era of the weapon or gizmo. However, gizmos and weapons only count the hexagons taken up (not the tonnage) and only use the tech era base amount (and you don't subtract 2). If you have a designed weapon or gizmo cost from another chapter, use that amount instead.

Modifier	Cost
Vehicle of 1 hexagon	-2
Primitive Era	+0
Basic Era	+2
Industrial Era	+4
Atomic Era	+6
Post-Atomic Era	+8
Advanced Era	+10
Early/late part of an era	±1
Mass production	-2
Average production	+0
Limited prod.(luxury/security)	+2
Limited production(military)	+4
On *and* off-road vehicle	+2
Flying vehicle	+2
Vertical takeoff (VTOL) ability	+2
Water vehicle	+2
Gizmos	+4 on those hexagons

EXAMPLE: What is the cost of the aircar? The aircar is 15 hexagons and 8 tons. This adds up to 23, which is a Size level of +7, then we subtract 2 for a base Cost level of +5. Other modifiers are:

Modifier	Cost
Vehicle size & weight	+5
Post-Atomic Era	+8
Flying vehicle	+2
VTOL-capable	+2
Limited prod.(luxury/security)	+2
Final cost level	+19
Final cost	700,000 Credits

We have to figure the 1 hexagon of gizmos separately, which is a cost of -2 for size, +8 for tech era and +4 for being gizmos, a total level of +10, or 32,000 Credits, for a final cost of 732,000 Credits.

ADVANCED TOPIC: OBSOLESCENCE

An out-of-date vehicle will be cheaper than a new one. A well-used or low quality vehicle is half price (-2). Vehicles from a previous era (or previous part of the same era) are also half price (-2). So, an Atomic Era buyer could get *Early* Atomic Era vehicles at half price (-2), used ones at a quarter the price (-4), or used low quality ones for an eighth the normal price (-6).

As always, the price of any vehicle is open to negotiation and is seldom a strictly cash-and-carry (or drive off) affair. Especially when dealing with used vehicles, consider the price to be a guideline, not a done deal. Sellers will of course want more, buyers will want to pay less.

How do I blow it up? - Vehicle combat runs much the same as normal combat. Vehicles will move based on the sequencing of their driver's or pilot's skill. A vehicle that is being tailed is at a disadvantage in sequencing, just as a person attacked from behind would be.

Vehicles have a size that will affect how hard they are to hit, and range and movement are handled normally. The operator of a vehicle may use the vehicle's acceleration as the equivalent of of Dodge, points that reduce an enemy's chance to hit the vehicle, but which also reduce the chance of any of your vehicle's weapons hitting anything. Everyone in a vehicle is affected by any of the movement penalties and dodging of the vehicle. Driving or piloting is normally a major action, so aiming or operating a weapon at the same time will likely result in penalties on both.

Vehicles will generally make turns in increments of 30°, which correspond to half a hex facing. These turns may not be exactly the listed number of degrees and do not happen at a particular instant. A turn is a change of facing that occurs gradually, but is rolled for at a particular moment.

The difficulty of pulling off a proper facing change is a simple use of the **EABA Universal Chart**. The base difficulty is the movement, adjusted down by the acceleration, and +0 difficulty for a 30° turn, +3 for each 30° increment after that. A maneuver like a lane change, swerve or sideslip counts as a 30° turn. If you are going too fast to make a facing change once per second, you can subtract time levels and do the facing change over a longer interval. This roll is made using the pilot or driver's skill with the vehicle. Each facing change after the first (done as a separate manuever) is at +6 difficulty. Remember that any acceleration used for dodging is *not* available for facing changes.

EXAMPLE: Our aircar has a top speed of 126 meters per turn, which is a movement difficulty of 12. Its acceleration is 16, which is a movement difficulty of 6. So, making one 60° facing change (+3 difficulty) at full speed is a difficulty of 12 - 6 + 3 = 9. Making a second one (+6 difficulty) would be at a difficulty of 15. If the pilot had allotted 3 points of acceleration to dodging, then the difficulty of any facing changes would be increased by 3.

If you fail to make a "turn roll", you usually just make a turn of a level that your roll would have succeeded at, like making a 30° turn instead of the 60° turn you were trying for. This is usually not a problem, unless there was something in your way that you *really* needed to avoid.

Armor works the same way for vehicles as it does for adventurers, with the exception that vehicles never take any type of non-lethal hits. A vehicle has 10 "Hits" for 1 ton of mass, +2 Hits each time you double this, and -1 Hits each time you halve it. If armor is exceeded by damage, the vehicle loses Hits. When the vehicle runs out of Hits, it stops working.

Vehicle mass	Hits	Example
.06 ton	6	
.12 ton	7	Scooter
.25 ton	8	Motorcycle
.5 ton	9	
1 ton	10	Compact car
2 tons	12	Pickup truck
4 tons	14	
8 tons	16	
16 tons	18	Moving van
32 tons	20	Tractor-trailer
64 tons	22	Heavy tank
125 tons	24	
250 tons	26	
500 tons	28	
1,000 tons	30	
2,000 tons	32	Destroyer
4,000 tons	34	
8,000 tons	36	
16,000 tons	38	
32,000 tons	40	
64,000 tons	42	Battleship
125,000 tons	44	

It is recommended that you use the **Damage Limit** rule (page 3.8) for most vehicles. In the meantime, any penalty the vehicle takes from lost Hits affects its speed, skill rolls for maneuvering or use of vehicle-mounted equipment.

EXAMPLE: Someone takes a shot at the aircar while it is engaging in full evasive maneuvers at top speed. The aircar has a loaded mass of ≈8 tons, which means it has 16 Hits.

The range is 500 meters and the attacker has a weapon with an Accuracy of 12. The range is a difficulty of 21, and the movement adds 12 more, making it 33. The Accuracy of the weapon drops this to 21, and the size of the aircar drops it to 17. Not a very good chance, but after all, they are shooting at an evading target 500 meters off. Only the fact that they have a high tech weapon makes it possible at all! Anyway, they *do* roll a 17, and hit the aircar in the rear, which has an Armor of 6d+0. The attack is from a 9d+0 explosion. The fact that it is an explosion means it can alter the aircar's Damage Limit. Since it exceeded the Armor by 3d, Damage Limit is raised by 3, to 7. The aircar takes 7 hits from the 3d+0 that get through armor (as long as that 3d+0 roll is 7 or more). This puts it at the -1d penalty level.

The vehicle's Strength for top speed and acceleration purposes is dropped by -1d, and all skill rolls for piloting or shooting the machinegun take a -1d penalty. The new top speed is that for a Strength of 12d+0, or 95 meters per turn, and acceleration is that for a Strength of 4d+2, or 11. The aircar's ability to use vertical thrust is greatly compromised (remember that you subtract 10 to represent gravity). A -2d damage penalty would drop the acceleration to less than gravity, which means the aircar will no longer be able to hover, and must use a runway to land. A -3d penalty would drop the aircar's top speed to below its stall speed. It would go out of control and crash.

ADVANCED TOPIC: VEHICLE HIT LOCATION

Instead of applying a generic penalty as a vehicle accumulates hits, you can choose to have *where* it is hit determine the effects. Roll 1d for hit location and effects. Even with special effects, a vehicle will become non-functional after it takes *all* its hits.

Roll	Vehicle hit in:	General effect:
1	Engine	Engine shutdown
2	Fuel	Lose half fuel
3	Passenger area	Passenger injury
4	Cargo	Cargo damaged
5	Gizmo	Gizmo damaged
6	Body	Vehicle takes hits

Engine - If the hits cross a damage threshold, the engine is "stunned" and conks out. It has a base Will roll of 3d+0 (2d+0 if touchy, 4d+0 if durable), and must make an Easy(5) Will task to restart each turn.

Fuel - If the hits cross a damage threshold, half of any *remaining* fuel is lost. If the damage knocks out all the vehicle's Hits, the fuel tank catches fire or does something else unpleasant. If a vehicle uses batteries or fuel cells, they are hit on a fuel hit.

Passenger - A random occupant is hit, using the vehicle armor and worn armor as layering (**EABA**, page 4.9). The vehicle loses no more than 1 Hit from the attack unless it is an explosion, in which case the vehicle and *all* occupants in that area take hits.

Cargo - A random stored item is affected just like a passenger would be on a passenger area hit. If the cargo area is empty, treat as a body hit.

Gizmo - A random gizmo is hit, affected just like a passenger would be on a passenger area hit. If there are no gizmos, treat as a body hit.

Body - No special effects, the vehicle just takes the appropriate Hits.

EXAMPLE: The aircar is hit by an 8d+1 explosion. The gamemaster says the hit is to the underside, so the 6d+0 armor drops the damage to 2d+1. The roll for hit location is a 1 and the roll for damage is a 6. The engine takes 6 hits (the maximum, taking into account the explosion and the Damage Limit rule). This crosses the -1d damage threshold, so the engine conks out. *The aircar starts to plummet!* It is an Easy(5) task to get the engine restarted, but this is a touchy engine with a default Will roll of 2d+0. But with the -1d penalty, it only gets a 1d+0 roll! *Unless it starts quickly, that ejection seat will come in handy!*

LET'S SEE IF IT WORKS - We'll do a fairly straightforward example for you to refer back to. We may embellish upon this in other rule sections to make it mesh more closely to the real thing, but the basic vehicle data is here.

M-113A3 APC - This is an Atomic Era armored personnel carrier. Real-world data tells us that it has a volume *as a box* of about 36 hexagons (5.3m long by 2.7m wide by 1.9m high, divided by .75m^2 per hexagon) and a loaded mass of about 12 tons. This is actually more volume than we need, so we say that between the slightly sloped front and the high ground clearance underneath (.4 meters), the usable volume is 24 hexagons.

Note - Keep this in mind for your own designs. A vehicle's volume in hexagons is everything "inside the paint". Ground clearance *doesn't* count.

Power - The real world top speed is about the same as for an adjusted Strength of +19(6d+1). So, we have to design the power plant backwards to see how big we need to make it. It is an Atomic Era powerplant, durable (-3 to Strength), and loaded vehicle mass is another -12 to Strength. So, we need a powerplant that gives us +34 to start with. This would be a 1 hexagon powerplant (+30) with 50% extra size (+4 extra Strength), which gives a total of +34(11d+1) and 1.5 hexagons of power plant.

We know what the top speed is. The +19(6d+1) row lists it as 19 meters per turn. Acceleration is half the power plant Strength(+17), minus the penalty for a 12 ton vehicle (-11), -3 for an off-road vehicle, and an extra -9 penalty for a land vehicle, gives us a result of -6, or an acceleration of 1 meter per turn. It will take the M-113 nineteen seconds to get to its top speed from a standing start.

How big? - We already know how big it is, but we need to see what we can fit in there and how much room will be left over for other stuff. The powerplant takes 1.5 hexagons. An M-113A3 carries 13 people and their stuff, with standing room for all but two of them. This takes up 13 hexagons of space. It is armed with a 6d+1 machinegun in a pintle mount. From the weapon notes on page 3.9 we would say this is a manually aimed 360° autofire weapon, which takes up 1 hexagon at the Atomic Era. It also has 2,000 rounds of ammunition. Using the weapon arc notes on page 2.15, we can see that each 200 extra rounds will take up one-eighth of a hexagon, so 2,000 extra rounds will take up about 1.25 hexagons. This uses up 16.75 hexagons out of the volume of 24 hexagons, leaving 7.25 hexagons of extra room. Much of this is actually just manevering room for the passengers, who need to be able to enter and exit the vehicle in short order.

How tough? - We have a loaded mass of 12 tons. We lose .75 tons for the powerplant, 2.4 tons for the vehicle size, 1.3 tons for the passengers and driver, and 1.125 tons for the machinegun and ammunition. If we allot .425 tons for gizmos and other cargo, this leaves 6 tons for armor.

Note - We could have rounded everything to easily added .1 ton increments and gotten the same result, i.e. .8 tons for power plant, 2.4 for vehicle size, 1.3 for people, 1.1 for weapon and .4 for everything else. While you cannot use the **EABA Universal Chart** to do simple addition, you shouldn't need to. In either case, the contents of the vehicle add up to 6.0 tons, leaving 6 tons for armor. You don't need more tha two digits of accuracy for **Stuff!** If this vehicle had been ten times larger, we could have rounded things to the nearest ton instead of tenth of a ton and been just as well off.

Atomic Era gives a base of +15 for armor. The vehicle size is a -14 penalty, land vehicle is a +3 bonus, and 6 tons of armor is a +8 bonus, for an overall vehicle armor of +12(4d+0), and a damage limit of 3. We can rearrange this to be 2d+2 on top and bottom, and 3d+1 on the back to make the front 5d+0 and the sides 4d+1.

How many gizmos? - We've already taken the machinegun and ammunition into account (≈1.1 hexagons), and we allotted ≈.43 tons for gizmos (about a hexagon's worth). If we add a life support system (protection against gas attacks) and a 2d+0 sensor suite (night vision, etc.), this about takes up the space. The **Gadgets** chapter will go into a lot more detail on what gizmos can be made and what they do.

M113A3 Armored Personnel Carrier

Crew	1+12
Strength	6d+1
Top speed	19
Acceleration	1
Fuel supply	5 hr
Hits	17
Damage limit	3

Armor

Front	5d+0
Right	4d+1
Left	4d+1
Top	2d+2
Bottom	2d+2
Rear	3d+1

How much? - We have an Atomic Era vehicle that takes up 24 hexagons and masses 12 tons, a total of 36. Checking on the size column of the **EABA Universal Chart**, this is closest to a size of +8, which becomes a cost of +6. The M-113 is Atomic Era (+6), limited production (+2) and offroad capable (+2), for a final cost level of +16.

Modifier	Cost
Vehicle size & weight	+6
Atomic Era	+6
Limited production	+2
Offroad-capable	+2
Final cost level	+16
Final cost	250,000 Credits

Note that if it were a dedicated combat vehicle like a tank, it would have used the more costly limited production modifier. But since it is really just an armored box witha machinegun tacked on, we just used the "limited production" modifier. Last, we have about 1.5 hexagons of gizmos.

Modifier	Cost
Gizmo size	-1
Atomic Era	+6
Gizmo modifier	+4
Final cost level	+9
Final cost	23,000 Credits

The vehicle costs 250,000 Credits and the gizmos cost 23,000 more, for a final vehicle cost of 273,000 Credits.

How do I blow it up? - Our M-113A3 masses 12 tons, so it has 17 Hits, and it has a damage limit of 3. Let's say someone hits it in the side with 3 shots from a 6d+2 machinegun (just about right for a Soviet 14.5mm machinegun). Each hit will get 2d+1 through armor, and since the minimum roll for 2d+1 is 3, each one will just do 3 Hits to the vehicle. The first hit will do no serious damage unless it hits a person, since 3 Hits will not cross the first damage threshold (which is at 5 hits, just like for an average person). This first hit *can* knock out a gizmo. The second hit brings Hits lost to 6, which crosses the -1d damage threshold. Anything but a body hit will have some nasty side effect. The last shot puts the Hits lost to 9, which *just* crosses the -2d damage threshold. Hoses have been severed, the cabin is filled with smoke and it is generally not a fun place to be, but it has only lost about half its Hits, so though crippled, it is still in the action.

ADVANCED VEHICLES - Now that we've run through the simple stuff, there are a number of modifiers (okay, a *lot* of modifiers) to cover all the permuations and special cases. Quite a number of permutations. The advanced section of the rules is about three times as long as the basic section, and you are unlikely to need more than a few of the subcases that follow. Ask yourself: "Do I really need to go further to have my vehicle do what it needs to do in the game?" Once you are *absolutely sure* the answer is "yes", continue.

A lot of the topics will be described in seeming mind-numbing detail, but they really *aren't* that bad. We will just belabor a point to describe it as unambiguously as possible. Any actual math is usually no more hazardous than "divide A by 2, round down and add the result to B".

The advanced rules will cover topics in about the same order as vehicle design. Some topics may have overlap, and some topics here will be used in other chapters. For instance, batteries/ powercells used in gizmos will actually be designed using the power plant rules. Anything here that is listed as an "advanced topic" is really something that *we're* not too sure of, and should be considered optional. So, in order, the following topics are covered:

It's worth mentioning that you can consider a person a very small articulated vehicle, and armor it as such. Rules for creating personal body armor, exoskeletons and robots are a subset of the vehicle rules, starting at page 3.46.

ADVANCED TOPIC: WHAT *IS* POWER?
Vehicle power plants are listed as having "Strength", but how does that relate to some real-world units of measurement? As best we can figure out, *about* like the table below. It's not rocket science. Seven hundred fifty watts is one horsepower.

Strength	kilowatts(hp)
0d+0	.25(.3)
2d+0	1(1.3)
4d+0	4(5.3)
6d+0	16(21)
8d+0	64(85)
10d+0	250(340)
12d+0	1,000(1.4k)
14d+0	4,000(5.5k)
16d+0	16,000(22k)
18d+0	64,000(87k)
20d+0	250,000(350k)
Each ±1d	factor of 2
Each ±1	factor of 1.25

This is raw output, not modified by vehicle type, mass and so on. Different power plants will also vary in accuracy for the correlation between Strength and horsepower. Gasoline engines are probably -1d on the listed correlation, and diesels (durable) are probably -2d.

EXAMPLE: An Atomic Era sports car with a mass of 1.5 tons (-2 speed penalty) needs a power plant of 11d+2 in order to have a top speed of 256kph (160mph). If we apply a -1d to this, the table above gives a result for this engine of about 531hp.

EXAMPLE: The M-113 design example had a power plant Strength of 11d+1. If we apply a -2d to this (durable power plant), the table says it should have about 217hp, which is actually just about right.

Note - If you were wondering, a human in good condition can for very limited periods generate a peak power output of about 1 horsepower. Climb 120 steps in one minute and you're about there. *Sustained* output is about 2d+0 less than this.

POWER PLANTS - Not all powerplants are the simple "put gas in and turn the key" variety. This subsection will deal with things that affect the performance of the power plant or the vehicle itself.

Usage modifiers	Amount
Not air-breathing	-3 penalty
Limited environment	+2 bonus
Warmup required	+1 bonus
Hazardous fuel	special

Type modifiers	Amount
Magical power	special
Animal power(normal)	+0 bonus
Animal power(leveraged)	+6 bonus
Solar power	-24 penalty
Rockets	+3 or more bonus
Reactors	-3 or more penalty
Boosters	+1 or more bonus
Lighter than air	+0 bonus
Power generation	-3 penalty
Batteries	-3 penalty
Fuel cells	+0 bonus

Not air-breathing(-3): The default power plant requires oxygen to combine with the fuel it carries. Any sort of powerplant that can work *without* needing air will take this modifier. What it really means is that you use the same amount of fuel as an air-breathing power plant of the same size, but have a -3 on the output.

Batteries, rockets, atomic reactors and the like all take this modifier. If a powerplant can operate using air some of the time, and without it some of the time (like a ramjet that can turn into a rocket), you take a -1 penalty for airbreathing use, and a -4 penalty for non air-breathing use. Note that fuel cells normally require air, so if you have a fuel cell or any other power plant with its own oxygen storage for use in space, you would take the -1d modifier (or -1 and -4 if it is set up for use in and out of atmosphere).

EXAMPLE: You have a submarine using a diesel engine (normally an air-breathing power plant). You have it set up so that the submarine uses surface air when surfaced, and diesel fuel and stored liquid oxygen when submerged. The submarine's power plant gets a -1 to Strength when operating on the surface, and a -4 to Strength when submerged. However, if you note that underwater vehicle performance is +3 higher than surface vessels, it means that the sub operates at the same speed when surfaced *or* submerged.

Limited environment(+2): If a power plant can *only* work in one *particular* environment (*aside from* an oxygen-containing atmosphere), it gets a +2 bonus. For instance, an ion rocket or solar sail might only work in near-vacuum conditions. If it can work *somewhat* in other environments (at -12 penalty) or does not work at all in one particular environment, the bonus is only +1. This is different than a say a tracked vehicle being able to move through the water. In this case, it is engine itself that has the limit, not the means it uses to propel the vehicle. Note that any exclusionary environment has to be one the vehicle might reasonably be expected to encounter.

EXAMPLE: A conventional rocket engine might reasonably be expected to not ignite while it is underwater. So, even though it is not air-breathing (-3 penalty), it is excluded from working in an underwater environment (+1 bonus), for a total modifier of -2. However, the gamemaster can reasonably rule that most vehicles using rocket engines seldom need to use them underwater, and deny the +1 bonus.

Warmup required(+1): Some powerplants do not startup quickly. For a car, you turn the key and go. For a steam engine or a cold nuclear reactor, you turn the key and wait...a while. If a vehicle has a warmup period, it gets an overall +1 bonus. But it doesn't get full power immediately. It gets 1d+0 Strength per 2 time levels. This applies to the power-plant Strength *before* it is adjusted for the vehicle's mass. The powerplant *can* operate before it reaches full Strength, but the vehicle's top speed and acceleration will be affected.

EXAMPLE: A steam engine with a Strength of 8d+0 (a Strength level of 24) would require a time level of 16 (four minutes) to warm up from a cold start. This warmup time applies whether it is sitting on a test stand or in a multi-ton vehicle. If the vehicle had to try to move after only one minute (time level of 12), it would be at 1d less than full power.

If the gamemaster allows, this modifier can be taken multiple times. Taking it for a higher bonus means the warmup time is +1 time level for each 1d+0 of output.

EXAMPLE: If applied to the previous example, the engine would require a time level of 24 to warm up, instead of a time level of 16.

Hazardous fuel(special): The default fuel for a powerplant is generally something along the lines of gasoline. Quite flammable, moderately toxic, and requires some form of industrial infrastructure to manufacture. The energy stored in the fuel is what makes the powerplant go, and as a result what goes in can be used to modify how much you get out. The examples listed at the bottom cover only the *fuel type* modifiers, *not* modifiers like "non-airbreathing", etc. You can usually substitute the word "dangerous" whenever you see "toxic", and if there is any conflict, use the average of the results.

Fuel is:	Powerplant output
Non-toxic(wood, coal)	-1 penalty
Moderately toxic(petroleum)	+0 bonus
Toxic(battery acid)	+1 bonus
Highly toxic(rocket fuels)	+2 bonus
Long duration toxic(radiation)	+4 bonus
Toxic and unshielded	+2 bonus
Fission bonus (Atomic Era)	+3 bonus
Fusion bonus (Post-Atomic Era)	+6 bonus
Antimatter bonus (Adv. Era)	+9 bonus

Fuel byproducts:	Powerplant output
Non-toxic(water)	-1 penalty
Moderately toxic(smoke)	+0 bonus
Toxic(corrosive or irritant)	+1 bonus
Extremely toxic(poison)	+2 bonus
Long duration toxic(radiation)	+3 bonus
Byproducts easily contained	-1 penalty

Fuel refining:	Powerplant output
None(wood)	-1 penalty
Some(petroleum, coal)	+0 bonus
Moderate(packaging)	+1 bonus
Intense(multiple processes)	+2 bonus
Isotopic(fission, fusion, antimat.)	+3 bonus
Has toxic byproducts(radiation)	+2 bonus

The bonuses for fission, fusion and antimatter assume each of these technologies reaches its maximum limit of efficiency at the end of the listed era and cannot be applied at *higher* tech eras.

EXAMPLE: A Post-Atomic Era fission reactor would only be +3 over an Atomic Era model. It gains +6 for the increase in tech era, but loses the +3 fission bonus.

Examples:	Powerplant output
Wood	-2 penalty
Non-toxic fuel(-1)	
No fuel refining(-1)	
Coal	-1 penalty
Non-toxic fuel(-1)	
Fuel cell(Atomic Era)	-1 penalty
Non-toxic byproducts(-1)	
Most petrochemicals	+0 bonus
Defaults(+0)	
Gaseous hydrogen	+1 bonus
Fuel packaging(+1)	
Most batteries	+3 bonus
Moderately toxic fuel(+1)	
Toxic byproducts(+1)	
Fuel packaging(+1)	
Exotic rocket fuels	+4 bonus
Highly-toxic fuel(+2)	
Multiple process refining(+2)	
Fission(Atomic Era)	+12 bonus
Long duration toxic fuel(+4)	
Fission bonus(+0)	
Long duration toxic byproducts(+3)	
Isotopic fuel refining(+3)	
Toxic refining byproducts(+2)	
Fusion(Post-Atomic Era)	+10 bonus
Non-toxic fuel(deuterium)(-1)	
Fusion bonus(+6)	
Long duration toxic byproducts(+3)	
Easily contained(-1)	
Isotopic fuel refining(+3)	
Antimatter(Advanced Era)	+16 bonus
Antimatter(+9)	
Long duration toxic byproducts(+3)	
Easily contained(-1)	
Isotopic fuel refining(+3)	
Toxic refining byproducts(+2)	

Note - Oddly enough, conventional hydrogen-oxygen rocket fuel is a +0 modifier. While the fuel is somewhat dangerous due to its cryogenic nature, it is also non-toxic and its combustion byproduct is also non-toxic (water).

Note - While fusion apparently has a smaller bonus than fission, remember two things: First, fusion is a tech era ahead of fission, which is a +6 bonus by itself if you limit the maximum efficiency of fission to Atomic Era tech; and second, fusion is a lot cleaner and cheaper because of the vastly reduced and more easily contained byproducts of the process.

Almost all fuel preparation involves something toxic being left behind. The "toxic byproducts" of fuel refining are things that are *not* biodegradable, can cause long-term genetic damage and which the tech era the fuel comes from does not have a good way of getting rid of.

EXAMPLE: Most petroleum fuels would be a total of +0 bonus. While the refining generates toxic byproducts, most of these are also fuels or used elsewhere in industry. That is, they aren't just left lying around because no one has a good way to use or get rid of them. Coal would be a -1 penalty to powerplant output, while fissionable material like uranium or plutonium would be a +15 bonus!

A power plant that *uses* a toxic fuel has sufficient containment measures to protect the crew of the vehicle and those in the immediate vicinity from the toxicity, as long as the powerplant or fuel system is undamaged. Occupants of a car don't have to worry about gasoline fumes, and the crew of a nuclear sub doesn't have to worry about radiation(much). If the powerplant or fuel storage takes damage, that's another matter...

If a powerplant using a toxic fuel is *unshielded*, it means the crew and environment around the vehicle is constantly exposed to the toxic hazards of the fuel. *A reactor with less shielding is more powerful for its weight than one with more*. The exact nature of the toxicity depends on the fuel, but if it could be protected against easily and for little mass penalty, then you wouldn't be getting the bonus for it. Radiation is the typical "unshielded" powerplant problem, but it could just as easily be evil emanations from a bottled demon you are using for a magical airship. For crew purposes the toxicity can be worked around by putting them far enough away from the powerplant that they are not subject to the effects. This is a layout decision. A distance level of 1 per 1d+0 of Strength is a good guideline.

EXAMPLE: An unshielded atomic rocket with a Strength of 17d+0 would require the crew be kept at a distance level of 17 (125 meters) to be safe.

Obviously, an unshielded powerplant makes maintenance or repair a problem. The time level for these situations would be increased by +6 (a factor of eight), as would the cost.

The exact nature of toxicity is hard to define, but you can try the following:

1. Start with a time level of 24 (1 hour) and 1 Hit of damage.
2. Each +1 in fuel toxicity or each +2 in fuel byproducts reduces this time level by 1 (round up). Do not use the "unshielded" modifier.
3. Each 1d+0 of raw powerplant Strength reduces this time level by 1. Raw power plant Strength is that before the mass of the vehicle is taken into account.
4. An adventurer close to the power plant takes 1 hit in this time interval, and 1 more each 2 time levels after that. Exposures of less than this are cumulative, but only count half the time. Add 2 to the time level for each one-quarter of the safe distance away, and add 1 to the time level for each point of armor worn, *if* it is a type that can shield against the toxicity.

EXAMPLE: An adventurer has to work on a ship system near (but not right next to) the previous atomic rocket. They have a 4d+0 anti-radiation suit, and are one-quarter the safe distance away from a 17d+0 unshielded reactor. So, we start with a time level of 24 (step 1). Subtract 6 for the toxicity of the fuel (4 for the fuel, 2 for the byproducts, step 2), subtract 17 for the output of the powerplant (step 3), add 12 for the anti-radiation suit (each 1d+0 of armor is 3 points), and add 2 for the distance (step 4). This is a final time level of 16, which is 4 minutes. After 4 minutes, the adventurer takes 1 Hit. They take another after 8 minutes, 15 minutes, 30 minutes and so on.

Toxic damage heals as normal lethal injury. Long duration toxicity heals as crippling injury (**EABA**, page 5.8), and long-term toxicity in both fuel *and* byproducts would be a "crippling" crippling injury (the extra healing time *multiplies*).

Environmental power - In the basic design section we touched on the idea of wind or animal power, and in the weapons chapter, we dealt with magical weapons. Now for a little more detail:

Magical power: As for magical weapons, you would assign a "magic era" to particular types of magic, and power plants would be built normally within those guidelines. The efficiency of magic compared to technology will affect the degree to which it is used, as will any modifiers you choose to put on its cost and method of operation.

EXAMPLE: If magical power plants run on wyvern blood, then filling fuel tank is *not* an easy matter.

Similar to the way in which you can power a magical weapon by taking hits, you can power a magical power plant the same way. A creature the size of a person can provide fuel for a +6 Strength power plant for 1 hour (time of +24) by taking 1 non-lethal hit. You can alter time and Strength output within reason using the normal fuel efficiency numbers, and get a +6 to output by making the damage lethal hits instead of non-lethal ones. Creatures that are considered "magical" are also good for a bonus, equal to the difference between their Fate and the normal Fate of non-magical creatures (or just use a +6 to Strength). The creature acts as fuel, but only up to a certain maximum level of power. You can adjust the practicality of this fuel source by adjusting the base Strength supplied.

EXAMPLE: A power plant that sucks the life force from a person at the rate of 1 non-lethal hit each 4 minutes (time of +16) would have an output of up to +14 (base of +6, +8 more because of the faster interval for taking damage).

Larger creatures can provide more power, based on their size, and multiple creatures provide +3 Strength each time you double the quantity.

EXAMPLE: If a vehicle is using four captured mages as a fuel source, and is sucking 1 lethal hit from each of them for each hour the power plant is running, the maximum output would be:

Modifier	**Strength**
Person-sized creature	+6
4x creatures	+6
Magical fuel	+6
Lethal hits	+6
Modifier total	+24
Total	8d+0

Animal power(+0): For draft animals or any animal used as a vehicle powerplant, you do not normally count more than one animal as a total mass. You would instead count the Strength of one animal based on its mass, and then add +3 each time you double the number of animals (or +1 for each 25% increase). Animals are *theoretically* half a ton per hexagon, just like other power plants, and are counted this way for their Strength output, but since they have to have room to move their legs or otherwise power the vehicle, they actually occupy quadruple this amount of space, but the extra space only counts for vehicle size and structure if the animal is actually *in* the vehicle. It is same difference in space as the difference between just sitting in a car seat, and being able to swing your arms and legs without hitting anything.

EXAMPLE: If you have a draft animal that weighs half a ton, the animal itself will have a volume of 1 hexagon and generates Strength like a 1 hexagon power plant. *But, it takes up 4 hexagons of space in the vehicle.* One hexagon of an animal power plant has a Strength of 2d+0. If you had four of them in harness, the total Strength would be 4d+0 (+1d for each doubling), and they would occupy 16 hexagons of total space. If the animals are simply pulling the vehicle, they simply count as 2 tons of weight towards vehicle performance, but occupy 16 hexagons in a visual layout (think of four horses pulling a stagecoach). If the animals are propelling the vehicle from inside (like on a treadmill), they count as 2 tons towards vehicle weight, but occupy 16 hexagons of internal space in the vehicle.

Animal power comes in two forms, normal and leveraged. Normal power just relies on the animal doing whatever it is it does (usually walking), and gives the listed power output. Leveraged power means the animal actually applies its effort towards some type of machinery. Think of the difference between pushing a bicycle along by running alongside, or pedaling it. Leveraged power will give you a significant speed advantage, but at the cost of extra mechanical complexity.

Whether it is inside the vehicle or outside, an animal which can use some sort of mechanical leverage to generate power gets a +6 bonus. This is a significant bonus, but it will also increase the complexity (and therefore cost) of the vehicle, and the designer will have to rationalize how the animals are used. The simplest example would be that you can pedal a bicycle (leveraged power) a lot faster than you can run (non-leveraged power). A vehicle pulled or powered by *external* animals should generally be no less than the *actual* size of the animals pulling or powering it. A leveraged power vehicle does not require that the animals be inside the vehicle unless they are going to be protected by the vehicle's armor.

EXAMPLE: If you had an 8 hexagon cargo wagon, it could be pulled by the 16 hexagons of draft animals from the previous example. The animals count their own mass towards total vehicle mass for performance purposes, but not for vehicle Hits, and the space they occupy does not generate extra vehicle mass for the hexagons used. We have 4 hexagons of actual animals (even though they take up 16 hexagons of space), so they should not pull a vehicle that is less than 4 hexagons in size.

EXAMPLE: If we designed a bicycle this way, the person would be an animal power plant that has a mass of say up to .1 ton (100 kilograms), or .2 hexagons (a penalty of -10). Since the vehicle doesn't actually *contain* the power plant, the total size of the vehicle (sans rider) is a minimum of the animal size, or .2 hexagons. The structural weight of a vehicle is a tenth of a ton per hexagon, so the bicycle has an empty weight of .02 tons, or 20 kilograms.

This vehicle would have a motive Strength figured as such:

Animal power	+6
Leveraged power	+6
.2 hexagon power plant	-7
Loaded vehicle mass of .12 tons	+9
Modifier total	+14
Total	4d+2

This gives an adjusted Strength of 4d+2, for a top speed of 11 meters per turn (40kph/25mph). We could tweak the acceleration to adjust the top speed, and the cyclist's actual Strength would also come into play if it was above average.

As mentioned in the basic design section, the maximum adjusted Strength for an animal-powered vehicle is probably going to be 5d+0, but the raw Strength to get the maximum load can be any amount. Vehicles where the animals power a mechanism to make the vehicle go may exceed this 5d+0 limit. The 5d+0 limit on top speed is a combination of what you can do with things like legs and the problems of wind resistance. It is a limit the designer can decide to exceed if biology and conditions permit.

For most animal-powered vehicles, the animals are *not* going to be protected by vehicle armor. However, if the animals *are* protected, and you want this protection to be different than the vehicle, this would be handled the same as the "turret armor" rule on page 3.43. That is, you compare the Size level of the power plant to the Size level of the vehicle. The difference becomes how many points of "power plant armor" you can give up to gain an overall armor bonus on the rest of the vehicle.

EXAMPLE: If you have a team of four animals from the previous example (16 hexagons, a size level of 6) pulling a war wagon whose *total* size is 32 hexagons (a size level of 8), and the animals *are* included in that size (armored animals), there is two levels of size difference. So, for every 0d+2 of armor you pull off the animals, you get an overall 0d+1 bonus to the rest of the vehicle. So, if the vehicle as designed had a real armor of 1d+0, you could do this twice. The first time would drop the protection on the animals to 0d+1, and the second time would drop it to no protection at all. The rest of the vehicle would now have an armor of 1d+2 instead of 1d+0.

ADVANCED TOPIC: POWER TRAINS

More advanced technologies can more efficiently use animal power. Instead of using a generic +6 for animal power, you get +1 per +3 available at the tech era the vehicle is built at. Add +6 it if the power is leveraged through some sort of machinery.

EXAMPLE: A Primitive Era animal-powered vehicle gets +4 as a base (+1 for each +3 at Primitive Era). An Industrial Era animal-powered vehicle would have +8 as a base (+1 for each +3 at Industrial Era).

So, an Atomic Era bicycle will be faster for the same weight than an Industrial Era one, because it has more efficient means of using a rider's Strength, better wheel bearings, tires with less rolling friction, etc. If you use this rule, you can use it to make a vehicle smaller than its less advanced counterpart. That is, an animal power plant does not actually get any smaller, but you can *count it* as smaller (and the minimum vehicle size is based on the size of the animal power plant). Technological bonuses to an animal powered vehicle's Strength will allow it to exceed the normal 5d+0 animal-power speed limit.

EXAMPLE: In our bicycle example, it assumed an animal power plant of .2 hexagons and an animal power Strength of +6. If we used the advanced rules and this were an Atomic Era bicycle, it would have an animal power base Strength of +10 instead of +6. So, we can make the "animal" part of the power plant half the size (-3 penalty) and still have better performance (and performance will be based on the lower weight of the "smaller" power plant). *What does it mean?*

Our bicycle frame can now be the same size as the "reduced" power plant, which is half as much as it was before. So, the bicycle now weighs in at 10 kilograms instead of 20 kilograms, and "total vehicle weight" is this plus the "50 kilograms" of the "smaller power plant", or a loaded weight of .06 tons. Compared to the first bicycle, this one would be:

Animal power	+10
Leveraged power	+6
.1 hexagon power plant	-10
Loaded vehicle mass of .06 tons	+12
Modifier total	+18
Total	6d+0

This gives an adjusted Strength of 6d+0, for a top speed of 17 meters per turn (61kph/38mph). **Stuff!** really isn't meant for bicycle design, but it serves for example purposes.

Exertion: *Animals get tired.* The top speed listed for an animal-powered vehicle is when the animals are exerting themselves in a sprint (extreme exertion, see **EABA**, page 7.12). As the animals take penalties from exertion, the dice of penalties apply directly to the Strength and therefore speed of the vehicle.

Each level of exertion less than extreme will drop the Strength of the vehicle by -2. A light exertion would be a Strength penalty of -8, but can be maintained all day. Medium exertion can be maintained for up to an hour without suffering penalties, and is a Strength penalty of -6.

Exertion	Vehicle power output
Extreme	+0 bonus
Very heavy	-2 penalty
Heavy	-4 penalty
Medium(up to an hour)	-6 penalty
Light(all day)	-8 penalty

EXAMPLE: If our war wagon from a previous example had a total mass of 4 tons (including the draft animals), then its Strength of 4d+0 pulling a 4 ton vehicle (-6 penalty) would give it a *maximum* performance based on 2d+0 Strength, which is 5 meters per turn. This is if the animals are exerting themselves at a sprint level of effort, though. If they are going to plod along at a pace they can maintain all day, this is would be at the -1d+0 Strength level, which is only 2 meters per turn. If they needed to be "rushed" (sort of) for an hour, they could do so at the 0d+0 Strength level, which is a speed of 3 meters per turn.

EXAMPLE: Our Atomic Era bicyclist from the advanced rule (adjusted vehicle Strength of +18 (6d+0) could maintain a +10(3d+1) speed (18kph/ 11mph) all day.

Wind power - Using the wind as a power source usually involves some sort of sail. This could be a conventional fixed sail, or a rotating sail like a windmill. Wind power starts off using the animal power Strength of +6 for 1 hexagon. The nature of harnessing wind means that it takes up a lot of space. It is not actually going to be *occupying* a lot of space, but it needs an unobstructed area in which to work. Sails will have the same space inefficiencies as animal power, and can also use the advanced rule about power trains (advanced sail technologies will be more efficient at moving the vehicle). A conventional sail will have its mass included in the vehicle it is on. If a wind power technology uses the "leveraged power" option, the full space occupied by the sail counts towards vehicle mass (the "sail" counts as being in the vehicle).

EXAMPLE: A boat with 8 hexagons of sails will have 4 tons of sails and masts and be counted as an 8 hexagon power plant in terms of power output, but would actually occupy 32 hexagons of space. The boat would have to be at least 8 hexagons in size (at least as large as actual sail size). If this boat had some sort of windmill or other odd mechanical means of harnessing the wind, it would get a +6 to its output, but the weight of the boat would be increased by 32 hexagons of structure (four times the size of the sails), and the boat has to be big enough to accomodate this 32 hexagons of space. Let's do a rough performance check for a boat with a total mass of 8 tons, using the advanced rule on power output for an Industrial Era sail setup:

Industrial Era animal power	+8
8 hexagon power plant	+18
8 ton loaded vehicle mass	-9
Water vehicle	-9
Modifier total	+8
Total	2d+2

This gives an adjusted Strength of 2d+2, for a top speed of 6 meters per turn (22kph/13mph). Note that this will be under optimum conditions, which we'll get to later.

By their very nature, sails are usually outside the vehicle's armor, and because they suffer little effect from puncturing weapons, they will have a damage limit that is different than the rest of the vehicle. You normally model this by putting the sails outside the vehicle armor, just as you would for animal power. This would give the sails an armor of 0d+0. However, the sails will have a damage limit of 2 points less than the rest of the vehicle. Most punctures and cuts will have no effect on vehicle performance or hits. Explosions, flames and attacks that are specialized against sails will reduce this damage limit in the same way they would for the overall vehicle.

EXAMPLE: If the *normal* sails in the previous example were on a boat whose total size was 64 hexagons, the overall vehicle has a damage limit of 2, which means the sails have a damage limit of 0. Bullets, shrapnel or even cannon shot will have no effect. However, a flame attack with a damage of 3d+0 would increase the damage limit to 3, as would an explosion with a damage of 3d+0.

Wind powered vehicles are at the mercy of the wind when determining their top speed. The designed top speed of the vehicle is what it can do under the most favorable conditions. For water vehicles, this is a wind speed of +9 more than the adjusted Strength of the vehicle. For air vehicles powered by sails, it would be a wind speed of the adjusted Strength, and for land vehicles, it would be a wind speed of -3 less than the adjusted Strength of the vehicle. *Yes, sail powered land vehicles can go faster than the wind!*

Wind speeds less than the optimum simply reduce vehicle speed by the same amount. Wind speeds higher than the optimum generally do the same, as you have to take down some sails to avoid structural damage, among other things. Trying to run full sail in extreme conditions is likely to tear off your masts, and would be adjudicated similar to excess pressure on a pressure hull. That is, each time the safe wind speed at full sail is exceeded, the vehicle takes damage. This is done once for any given wind speed, so long as it is maintained. Gusts that go higher will do more damage, and you never know when this will happen or how strong the gusts might be.

Solar power: The sun can be used as a power plant, even before the advent of photovoltaic cells. A solar power plant has a peak output for a normal power plant of its size and era, with an additional -18. In addition, most solar power is not air-breathing (-3 penalty), and photovoltaic arrays are only used for power generation (-3 penalty). In addition, each hexagon of solar power plant requires a minimum vehicle size of eight hexagons, since the power plant is spread across the surface rather than being in a solid block like most power plants. A stationary solar array (spread out over a flat surface rather than the surface of a vehicle) will cover twenty hexagons of space per hexagon of volume. For convenience sake, this would be an area five hexagons across.

EXAMPLE: An Atomic Era photovoltaic array with one hexagon of solar power plant would have a useful Strength of:

Atomic Era	+30
1 hexagon power plant	+0
Solar power	-18
Not air-breathing	-3
Power generation	-3
Modifier total	+6
Total	2d+0

So, half a ton of solar panels can generate a Strength of 2d+0, and cover all the usuable surface of a vehicle the size of a car.

Note - Solar power is not all that practical as a primary motive source. The current crop of "solar racers" are so specialized that it is hard to model them in **Stuff!**, but it *can* be done with some effort.

Solar power can include photovoltaic cells, solar-fired steam engines, Stirling-cycle engines or any other means of converting radiant energy into a form that can be used for motive power or generating electrical power.

Note - As a quick reference, solar panels plus their mounting structure will mass 25kg per hexagon (33kg per square meter), and using the guidelines on page 3.15 will generate about 110 watts of power at the Atomic Era. So, a 1 megwatt solar array will be about 9,200 hexagons, close to 100 meters by 100 meters sqaure!

Rockets - This is a specific type of power plant that trades fuel efficiency for *absurd* amounts of power, and which uses action-reaction for its propulsion, rather than a conventional power train like wheels, propellor or turbine. It is designed like a normal power plant, but can take advantage of the following additional modifiers. Rockets will automatically get a "touchy" maintenance interval (-2 time levels) for *each* multiple of fuel consumption. Add or subtract an *extra* multiple for each tech era above or below Atomic Era (more advanced rockets are less touchy, less advanced ones are more touchy). If a vehicle can use different types of fuels at different efficiencies, the bonus to Strength is always the lowest of these amounts.

EXAMPLE: A normal "touchy" power plant (+3 Strength) requires maintainance each 125 hours of use (time level of 38). One with 1/16th fuel efficiency (another +12 Strength) requires maintainance each 125 hours x 1/16 = 8 hours of use (time level of 30).

Modifier	Modifier
1/8000x fuel efficiency (18 sec.)	+39 bonus
1/4000x fuel efficiency (35 sec.)	+36 bonus
1/2000x fuel efficiency (70 sec.)	+33 bonus
1/1000x fuel efficiency (140 sec.)	+30 bonus
1/500x fuel efficiency (4.5 min)	+27 bonus
1/250x fuel efficiency (9 min.)	+24 bonus
1/125x fuel efficiency (19 min.)	+21 bonus
1/64x fuel efficiency (38 min.)	+18 bonus
1/32x fuel efficiency (75 min.)	+15 bonus
1/16x fuel efficiency (2.5 hours)	+12 bonus
1/8x fuel efficiency (5 hours)	+9 bonus
1/4x fuel efficiency (10 hours)	+6 bonus
1/2x fuel efficiency (20 hours)	+3 bonus
1x fuel efficiency (40 hours)	+0 bonus
2x fuel efficiency (80 hours)	-3 penalty
4x fuel efficiency (1 week)	-6 penalty
8x fuel efficiency (2 weeks)	-9 penalty
16x fuel efficiency (1 month)	-12 penalty
32x fuel efficiency (2 months)	-15 penalty
64x fuel efficiency (3.5 months)	-18 penalty
125x fuel efficiency (7 months)	-21 penalty
250x fuel efficiency (1 year)	-24 penalty
500x fuel efficiency (2 years)	-27 penalty
1000x fuel efficiency (4.5 years)	-30 penalty
2000x fuel efficiency (9 years)	-33 penalty
4000x fuel efficiency (19 years)	-36 penalty
8000x fuel efficiency (38 years)	-39 penalty

The time in parenthesis is the duration of fuel in an *extra* fuel tank the same size as the power plant. The default fuel carried as part of the power plant mass will be one eighth of this.

EXAMPLE - A 1 ton (2 hexagon) Atomic Era power plant has a Strength of +33. If we make it a touchy power plant with 1/4000x fuel efficiency it will have a Strength of +69(23d+0), but it will also burn through 1 ton of fuel each 35 seconds! It also takes -26 time levels on its normal maintenance interval. If it started with a normal maintenance interval of a time level of 44, it would end up at a time level of +18, so it would have a scheduled maintenance interval for each eight minutes of use.

Reactors - A reactor is any sort of power plant that has an incredibly high fuel efficiency. They are the bottom half of the table in the previous column. Normally, you get five hours of full output from the power plant included in its size, and forty hours for each increment of its size. A reactor can run anywhere from double to over a thousand times this. At the very lowest levels you are simply dealing with an ultra-efficient powerplant of a conventional type, but anything past about 4x fuel efficiency starts exceeding the bounds of normal chemical reactions. However, you pay for this efficiency with decreased output per hexagon of powerplant. Reactors do not automatically get increased maintenance intervals with each decrease in fuel consumption. However, you *may* take the "durable" modifier(-3) for increased maintenance intervals if desired.

As for rockets, the time in parenthesis is the duration of fuel in an *extra* fuel tank the same size as the power plant, rounded to convenient amounts for easy reading.

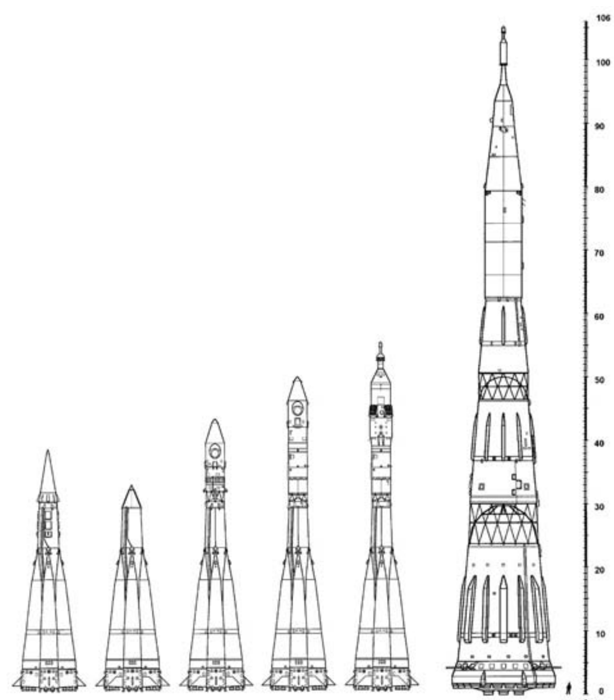
EXAMPLE: You want a nuclear power plant for a 8,000 ton Atomic Era submarine. You decide the power plant will take up 1,000 hexagons (about 20 hexagons by 8 hexagons by 6 meters high). The output for one hexagon at this tech era is +30, with +6 each time you double the size. This power plant has ten doublings, for +60. You say the fissionables within the reactor itself need to last for at least two years of full output. Normally, you get five hours with the powerplant, and you need about seventeen thousand. So, you take the 4000x fuel efficiency modifier. The final reactor output is:

Atomic Era	+30
1,000 hexagon power plant	+60
Not air-breathing	-3
4000x fuel efficiency	-36
Hazardous fuel(fission)	+12
Modifier total	+63
Total	21d+0

The fact that it is a water vehicle is another -6 (submerged). This is good for a total Strength of +57(19d+0), which is sufficient to push a vehicle with a Strength modifier of -39(8,000 tons) at the +18 (6d+0) rate, or a speed of 17 meters/turn (61kph/38mph). While exact figures for nuclear subs are not available, this seems to be about right, and tweaks of various kinds in powerplant size and modifiers should be able to make up any difference.

Liftoff!: Why do rockets need such excessive amounts of Strength? *To reach orbital or escape velocity from a planetary gravity well*. Or, to make a very fast vehicle with a short operating duration (like a rocket-powered land speed record vehicle). If a vehicle has a power plant that can provide thrust in the vacuum of space (not air breathing), once it gets out of the atmosphere, it has no "top speed". It can just keep accelerating until it reaches a stable orbital velocity, or keep going until it breaks free of Earth's gravity entirely.

Technically, any air vehicle with an acceleration greater than gravity can eventually reach orbit. For design purposes, you will want significantly more acceleration than local gravity, which for Earth would be on the +13 row, the +3 row for Mars and the -7 row for the Moon. The trick is to get there with the least amount of fuel, which can require a lot of tweaking and playing with the numbers. We're going to give an example here, but surely you have better things to do than design low-tech moon rockets...



The table below tells you how long (in time levels) it will take to accelerate to orbital or escape velocity, based on how much you exceed local gravity. Oddly enough, the results seem largely independent of actual gravity, so it should work on any planet. You could also figure these times out yourself using the **EABA Universal Chart**.

Extra acceleration	orbital v	escape v
+1 Strength	27	28
+2 Strength	25	26
+3 Strength	24	25
+4 Strength	23	24
+5 Strength	22	23
+6 Strength	21	22
+7 Strength	20	21
+8 Strength	20	21
+9 Strength	19	20
+10 Strength	19	20
+12 Strength	17	18
+14 Strength	16	17
+16 Strength	16	17
+18 Strength	15	16
+20 Strength	15	16
+22 Strength	14	15
+24 Strength	13	14

EXAMPLE: You have a rocket that has a final acceleration on the +17 row, or 16 meters per turn, an acceleration of 1.6 gees. To get the time to orbit, you take this +17 acceleration and subtract the amount for the gravity of the world you are leaving. So, to reach orbital velocity from Earth(+13) would be on the +4 Strength row, from Mars(+3) you would check the +14 Strength row, and from the Moon you would check the +24 Strength row. Looking at the time results on the **EABA Universal Chart**, these translate out to 45 minutes, 4 minutes and 1.4 minutes. Obviously, if you have a very high fuel consumption, that 45 minute liftoff from Earth is going to be a problem, but this rocket is probably fine for Moon or Mars missions.

EXAMPLE: You want to build an orbital rocket with Atomic Era technology (base of +30 Strength). You start with:

Atomic Era	+30
8 hexagon power plant	+18
Not air-breathing	-3
1/2000x fuel efficiency	+33
Modifier total	+78
Total	26d+0

This fuel consumption means the engine goes through 4 tons of fuel (its own weight) each 70 seconds. Note that a conventional hydrogen-oxygen rocket engine has a +0 hazardous fuel modifier. We can have a total vehicle mass of 32 tons (-15 Strength for mass and +3 Strength for a flying vehicle) and end up with an acceleration of +27, which is 40 meters per turn, or 4 gees.

If our vehicle is 60 hexagons, we lose 6 tons for the basic size (.1 ton per hexagon), and 4 tons for the rocket engine, leaving 22 tons and about 32 hexagons for fuel and payload (remember that it is an air vehicle and has wasted space in the form of its airframe, even if it doesn't have wings). The acceleration of our rocket is +14 Strength more than gravity, which means it takes a time level of 16 (240 seconds) to reach orbital velocity. We already know that we're going through 4 tons of fuel each 70 seconds, and we need to do this about three and a half times, for 14 tons of fuel, which take up 28 hexagons. This leaves us 4 hexagons of space and 8 tons of capacity.

You can see that at this level of tweaking, even small modifiers can *vastly* alter the efficiency of such a system. Keep saying "it's just a game..."

Note! - A quick reality check here. Once you are in outer space, speed in **EABA** terms starts being irrelevant. If you are in a stable orbit and have any acceleration at all, you can eventually spiral your way outwards to escape velocity. There is nothing there to slow you down, so unlike a car on the pavement or an airplane in the atmosphere, you can keep accelerating forever. A spaceship with an adjusted Strength of -4d+0 can still accumulate a speed of thousands of kilometers per hour. It just takes long enough that the time scale is no longer interesting from a role-playing standpoint. It would just be a matter of comparing acceleration to the difference between orbital and escape velocity to figure out how long it will take.

Staging: One way to increase efficiency of extremely fuel-hogging engines is to have multiple stages, dropping off empty fuel tanks and larger rockets after they are no longer needed. You would design this as a vehicle with multiple fuel tanks and power plants, dropping off fuel tanks and/or power plants at some point during the flight, and then refiguring fuel consumption, thrust and top speed based on the new configuration. A staged vehicle would be +1 cost due to the extra complexity.

Problems: A nasty little performance problem is that vehicles that burn off fuel at such a staggering rate quickly get lighter, which means they can either go faster better, or use less fuel to keep the same top speed. Also, the speed table is designed for an atmosphere with drag. Once you escape the atmosphere, top speed is irrelevant and only acceleration will matter. We just sort of gloss over this and assume it averages out. If you want to adjust performance figures for full, 3/4, 1/2 and 1/4 fuel capacity, you are welcome to do so.

Hit locations: Another problem with vehicles like this is that they are virtually all fuel. So, normal hit location tables and effects are not going to work. In practical terms, any attack that isn't aimed at something is going to hit a fuel tank, and if enough Hits are taken to cross the -1d threshold, enough fuel will be lost to usually prevent the rocket from doing what it was built to do (reach orbit).

Special cases - Rockets are always special cases because of the way they work. And within this special case, there are subcases to be dealt with.

Ion Drives: Rockets like ion drives use *lots* of electrical power and very little fuel. An ion drive plus its power source would be built as a "reactor", very fuel efficient and fairly low output. An ion drive by itself would be a regular powerplant with lower (but still very good) fuel efficiency, but its Strength output would have to be matched by an equal input from some dedicated source of electricity. So, a space-ship might have an electricity-generating reactor whose output can be switched to the ion drive as needed.

EXAMPLE: A 1 hexagon ion drive at Late Atomic Era would look something like this:

Atomic Era	+30
Late era	+2
1 hexagon power plant	+0
500x fuel efficiency	-27
Not air-breathing	-3
Limited environment (vacuum)	+2
Hazardous fuel	+2
Modifier total	+6
Total	2d+0

This is a terribly low output for a power plant of this size, but it still far more efficient than the real thing. If you wanted to say this was *just* the ion drive (*not* including its power supply), you might decrease the fuel efficiency (thus increasing power output for its size), but the Strength generated by its size and tech era would have to be supplied by an *outside* generator. In this case, the generator would have to provide +32 Strength (the power plant's size and tech era modifiers).

ADVANCED TOPIC: FRACTIONAL ACCELERATION

If you really, *really* have to, you can use fractional accelerations. Figure out what you have to add to the *adjusted* vehicle Strength to get acceleration of 1 (which is .1g, the -12 row on the table on page 3.5). Subtract half this from the +13 Distance level, find the *result*, then divide that result by 10.

EXAMPLE: You have the aforementioned ion drive being used to slowly nudge a 1000 ton asteroid towards a mining operation. This mass is a -30 modifier, so the acceleration ends up as:

Halved vehicle Strength	+3
Vehicle weight	-30
Flying vehicle	+3
Modifier total	-24
Total	-8d+0

For an acceleration of -24, we need to add +12 to get to the -12 level (.1 gee acceleration). Then subtract *half* this (+6) from +13 to get a Distance result of +7, which is 4 meters. We divide this by 10 to get .4 meters, or an acceleration of .04 gees.

This calculation is really only needed if you are running a low-tech space campaign and have to figure out things like transit times for ships with really lousy acceleration capability.

Multiple fuels: If a rocket or any other type of power plant uses different fuels at significantly different rates, you use the average of the two, rounding towards the lower fuel consumption.

EXAMPLE: If you have an atomic rocket engine that uses a long-lasting fission pile (say 4,000x fuel efficiency, -36 output) and a much larger quantity of hydrogen reaction mass (say 2x fuel efficiency, -3 output), then the actual Strength output of the engine would be the average, or a -17 output penalty). There is a 2,000-fold difference in fuel consumption between the two types. The fission core would be used up at 1/2000th the rate of hydrogen consumption. For every 2000 units of hydrogen fuel pumped through the engine, you use 1 unit of fissionables.

Boosters: This is a vehicle mobility-enhancer that is used not as a main form of propulsion, but as an occasional or emergency device. A nitrous boost, JATO units, or jump jets in an exoskeleton would be examples. Generally, they are a small, high maintenance power plant with a limited fuel supply, higher than normal fuel consumption, or both.

If the booster Strength is the same as the main power plant (before adjustments for vehicle mass) the Strength of the vehicle when the unit is used will be +3 more than normal. That is, two power plants of the same output combine to be +3 more than either them separately. If the booster is more or less powerful than the main power plant, see below.

Booster	Vehicle Strength
Is ≥6 less than power plant	+0
Is 5 less than power plant	+1
Is 4 less than power plant	+1
Is 3 less than power plant	+1
Is 2 less than power plant	+2
Is 1 less than power plant	+2
equal to power plant	+3
Is 1 more than power plant	+3
Is 2 more than power plant	+4
Is 3 more than power plant	+4
Is 4 more than power plant	+5
Is 6 more than power plant	+6
Is ≥6 more than power plant	=booster

If an Attribute other than Strength is affected by a booster, figure it in the same way. Applying it to Health for any sort of "running" or "jumping" enhancement generally counts as an "enhanced mobility" and is halved before adding it to Health.

EXAMPLE: Our Post-Atomic Era aircar builder from the basic rules decides to use some of their gizmo space to put in a rocket booster. The main power plant has a raw output of 15d+0 (see page 3.6). A Post-Atomic Era rocket booster might be:

Post-Atomic Era	+36
.125 hexagon power plant	-9
Touchy power plant	+3
1/125x fuel efficiency	+21
Not air-breathing	-3
Hazardous fuel	+3
Modifier total	+51
Total	17d+0

Since we are just using on-board fuel (5 hours), the booster is good for a little more than 1/125 of this, or 2 minutes. When it kicks in, it overshadows the main power plant by 2d+0, so performance is based on the booster, not the main power plant. Acceleration with the rocket would end up on the +20 (6d+2) row, or 21 meters per turn.

An afterburner added to a regular air-breathing jet engine would *not* be a booster, but would be a "rocket" modifier on fuel use and reliability, with up to a +12 bonus for up to a 1/16x fuel efficiency. That is, you hit the afterburner button and guzzle fuel at 16 times the normal rate to get a temporary +12 boost to vehicle speed, which will also affect acceleration by +6.

EXAMPLE: A jet with normal performance and a Strength of +48(16d+0, or mach 1) ends up with an acceleration on the +16(5d+1) row, or 14 meters per turn). If the jet had afterburners, its Strength for top speed purposes would go to +60(20d+0, or mach 2.6). Since acceleration is based on half the power plant Strength, each +2 Strength turns into +1 Strength for acceleration purposes. So, since the afterburner has +12 Strength compared to the normal engine, acceleration is boosted by +6. This would put acceleration on the +22(7d+1) row, so for as long as the fuel held out, the plane would have a top speed of Mach 2.6 and acceleration of 25 meters per turn. One minute of afterburner use would go through 16 minutes of normal fuel use, and would also count as 16 minutes of engine use for maintenance purposes.

Antigrav: Antigravity is not a rocket, but it is used in most of the same conditions a rocket would be (spacecraft, etc.). If you have a system that allows a reactionless drive like antigravity generators, the Strength they generate would have the following modifiers: not air-breathing (-3) and hazardous fuel (or lack thereof)(-3). It would have to be powered by a generator of some kind, which has its own inherent -1d losses (page 3.31).

As a special case that we really have no idea how to implement in the real world, a gamemaster can tweak it as desired by adding any bonus they choose to in order to make antigrav practical at the tech era they want it to be practical at. As is, it is barely practical for "hovercars" at Advanced Era tech. To make it a commercial reality for all kinds of cool personal transport would require about a +12 bonus on top of the other listed modifiers.

Lighter than air(+0) - Lighter than air vehicles are one of the few cases where a *lot* of tweaking has to be made to the normal **Stuff!** rules in order to make it work. Like solar power and animals, lighter than air craft will be counted as a power plant that takes up more space than its actual volume. In this case, the "power plant" is heated air or some lightweight gas that is contained within the mass of the gas envelope, and this has to be able to "accelerate" the vehicle enough to offset gravity. The Strength generated by a lighter than air "power plant" can only be used to generate acceleration, and only in the vertical dimension (it lifts you up, and that's it). The +0 modifier on this sort of power plant gets reflects its acceleration limits. The lighter-than-air power plant may *not* be tweaked to adjust its top speed and acceleration, and it does *not* count as a "flying vehicle" for purposes of adjusted Strength for lighter than air lift. This means that for an Earth-normal gravity and atmosphere, you need an adjusted vehicle Strength of +26(8d+2) in order to hover. A balloon will want more than this, and carries extra mass to adjust its rate of ascent and descent. A powered vehicle like a blimp can use normal acceleration from a power plant to accelerate forward, up or down.

Within all these limits, a lighter than air power plant occupies one *thousand* hexagons per actual hexagon of power plant. This extended volume has no structural weight associated with it, and takes damage like a wind powered vessel's sail would (see page 3.22). The modifier for lighter than air power plants is +2 (but with all the listed limits on it). A lighter than air power plant that relies on a light-weight gas usually has an additional -6 for a low fuel consumption (4x fuel efficiency) and is not an air-breathing power plant for an extra -3 penalty, while one which relies on hot air for lift will just have a fuel consumption appropriate to the method of heating the air. Last, a lighter than air vehicle that has no internal structure cannot be powered. A lighter than air vehicle *with* an internal structure (like a rigid zeppelin) will take a -1 to adjusted Strength for lift purposes for each +6 of adjusted Strength in its era and power plant size. Rigid zeppelins can use other power plants to push the vehicle around, and the acceleration of these power plants *can* be used for altitude changes. However, due to the high drag of these huge vehicles, all powered lighter than air vehicles are counted as air vehicles for top speed purposes, but *water* vehicles for acceleration purposes. The maximum possible top speed for a lighter than air vehicle is its Strength for power plant size, minus the penalty for its structure.

A lighter than air vehicle loses lift Strength when it takes damage, just as a propulsive power plant would, and will descend (but will usually not accelerate downwards) if the lift is not sufficient to counter the force of gravity. If the lifting force runs out of fuel, the lighter than air power plant will lose -1 of Strength after 15 minutes (time level of 20) and each 2 time levels after that (doubling of the time).

EXAMPLE: The *Graf Zeppelin* is a Late Industrial Era, structured, powered, lighter-than-air vehicle relying on hydrogen for lift. Its basic design would look something like this (numbers rounded):

Industrial Era	+24
Late era	+2
125 hexagon power plant	+42
Structure for lighter-than-air (which is -1 for each +3 in the era + size)	-11
Lighter-than-air power plant	+0
Loaded vehicle weight of 125 tons	-21
4x fuel efficiency	-6
Not air-breathing	-3
Hazardous fuel (hydrogen go boom!)	+1
Modifier total	+28
Total	9d+1

This is more than the +26 needed for neutral lift, so the zeppelin can hover just fine by adjusting its ballast or the amount of hydrogen in its gas bags.

The lighter-than-air power plant masses 62.5 tons, and has a volume of 125,000 hexagons. This would be a cylinder about 25 meters high and wide, and 215 meters long. It leaves another 62.5 tons for normal vehicle structure, engines, fuel, people and cargo. If we installed four 2 hexagon Late Industrial Era engines in the Graf Zeppelin, its performance would look like this:

Industrial Era	+24
Late era	+2
2 hexagon power plant	+6
Eight power plants	+6
Loaded vehicle weight of 125 tons	-21
Air vehicle	+3
Modifier total	+20
Total	6d+2

This gives it a top speed of 25 meters per turn (90kph/56mph), and an acceleration of 1 meter per turn. The theoretical maximum speed for this vehicle would be its power plant size(+42) minus the penalty for its internal structure(-11), or a Strength of +31, or 58 meters per turn (209kph/130mph).

EXAMPLE: A modern hot air balloon (wicker basket holding up to say four people) might look like this:

Atomic Era	+30
.75 hexagon power plant	-1
Lighter-than-air power plant	+0
Loaded vehicle mass of 1 ton	+0
Modifier total	+29
Total	9d+2

This is more than the +26 needed for neutral lift, and gives a maximum vertical acceleration (after gravity) of 3 meters per second.

The balloon has say two hexagons of space, for a structure mass of .2 tons (see the advanced seating notes on page 3.38), the four overweight or overmuscled passengers are another .4 tons, and the power plant takes up the remaining .4 tons (.375 tons, but we'll add a little spare fuel). We can overload the vehicle to provide ballast, enough so that we barely rise up when the mooring lines are released. We can split our extra weight capacity between fuel and ballast as needed.

The gas envelope takes up 750 hexagons, which would be the equivalent of a sphere about 10 meters across.

ADVANCED TOPIC: ALTITUDE

One thing that hasn't been covered is the role of lower air pressure at higher altitudes. This makes it hard for air-breathing engines to get enough oxygen, wings provide less lift, and so on. The high altitude air vehicle modifier takes into account that at these rarefied heights, drag is less and so you can go faster than in the thicker air near the ground.

Air-breathing power plants and lighter than air vehicles will lose -3 from their output at the edge of the breathable range in the atmosphere, -6 at the edge of the range where you can get by with a breathing mask, and -9 at the limit of where aero-dynamic surfaces can do any good. Anything higher than this is out of the range of air-breathing power plants. The high altitude modifier on air vehicle speed starts at the edge of the breathing mask range.

Parachutes: A parachute is effectively a lighter-than-air power plant that uses no fuel. Its effective acceleration is compared to that of gravity (4d+1), and the difference becomes the parachute's rate of descent (not rate of acceleration). Parachutes always descend at least 1 meters per turn.

EXAMPLE: A personal parachute (7.5 kilograms) might look something like this:

Atomic Era	+30
.015 hexagon power plant	-18
Lighter-than-air power plant	+0
Loaded vehicle weight of .125 tons	+9
Modifier total	+21
Total	7d+0

This gives the "power plant" an acceleration of half the power plant Strength(+6), the mass modifier (+9) and the lighter-than-air acceleration penalty (-9), for a Strength of +6, which is an acceleration of 5 meters per turn. This is 5 meters less than gravity, so the descent rate is also 5 meters per turn.

ADVANCED TOPIC: OPERATING TEMPERATURE

One thing that is vitally important and usually overlooked in the interest of simplicity is the fact that things are not 100% efficient. And every last bit of the difference somehow ends up as heat. A car needs a radiator to cool its power plant down. So do the fuel cells of the Space Shuttle. For **Stuff!**, we are going to assume that the extra weight of any necessary cooling apparatus is part of the modifiers that contribute to power output and thus the power to weight ratio of the power plant.

What is not covered is the effect of *external* temperature on the power plant. Cars overheat in the summer more than the winter. Power plants will have a comfortable temperature range, just like people do, but they are a bit more tolerant in many respects. A vehicle that is operating at the edges of its comfort zone (hot *or* cold) has a -1 penalty on its power output. A vehicle that is operating at the edges of its safety zone has a -3 penalty on its power output. Anything more extreme than this risks immediate breakdown of the power plant, or at the very least, lost Hits. In either case, any extended use at full remaining power gives the gamemaster an excuse to force a maintenance check on the vehicle. If it hasn't been well maintained, pushing it in extreme conditions will do 1 Hit of damage, counting as a power plant location, with any special effects that are appropriate.

ADVANCED TOPIC: GRAVITY

Most land or air vehicles can take advantage of gravity, or be impeded by it. Earth-normal gravity acts as a power plant with an *adjusted* Strength of +26(8d+2), *regardless of vehicle size*. Coincentally, this is an acceleration of 10 (or 1g, straight down).

Since very few vehicles *want* to accelerate straight down, the actual adjusted Strength will be less, depending on the slope the descent takes place at. For land vehicles, you just find the slope, and the vehicle can coast at the appropriate speed for the listed Strength, or this Strength can add to the vehicle's Strength when going downhill, or subtract going uphill. Practically speaking, most land vehicles cannot actually go up any hill with an effect of more than ±9 (they may have the power, but not the traction). For fully winged air vehicles, find the slope that corresponds to -18 from the actual minimum Strength required to fly (the stall speed, which has a default value of -12 less than adjusted vehicle Strength). The result you get is the "glide path" of the air vehicle. *It's not perfect, but works for most purposes*. The air vehicle drops a number of meters per turn appropriate to its forward speed, and will take impact damage counting this speed as a height (**EABA**, page 5.5).

Slope	Strength effect
Straight down	±26
1 meter forward/1 meter down	±18
2 meters forward/1 meter down	±13
4 meters forward/1 meter down	±9
8 meters forward/1 meter down	±5
16 meters forward/1 meter down	±2
32 meters forward/1 meter down	±1

EXAMPLE: A car with an adjusted Strength of 10d+1 is going down a hill whose Strength effect is ±2. The car is counted as 11d+0 when going downhill, and 9d+2 when going uphill. If coasting with no engine power, it would accelerate like a vehicle with a Strength of 0d+2 (the dice equivalent of a +2 modifier).

EXAMPLE: A plane with a normal speed of +39 (13d+0) (stall speed of +27) loses its engines and has to make a forced landing. The stall speed with a further -18 modifier is +9, or the ±9 row on the table. With engines out, this plane drops one meter for each four meters of forward motion. Its stall speed is 40 meters per turn, so it drops 10 meters per turn, which will be about a 3d+1 impact. Both the impact and anything the plane runs into will be unaffected by the plane's damage limit...

Power generation(-3) - A power plant can be used to generate electricity (or possibly magical energy), depending on the vehicle. It can generate power for use by *other* (compatible) powerplants at a -3 penalty to its Strength. The penalty represents the extra machinery and losses resulting from having a non-dedicated power plant. If power is generated and consumed at the same place in the vehicle, and only a tiny surplus is available for other uses, *do not* take this modifier. If on the other hand, you have one source of power that does many things in the vehicle, then this modifier *is* appropriate.

EXAMPLE: A diesel-powered generator is a power plant that does not move a vehicle. However, a diesel locomotive uses a diesel-powered generator to run electric motors in the engine, and these *do* move the vehicle. If the electric motors had a Strength of 15d+1, then the diesel generator would need a Strength of 16d+1, so that it has 15d+1 left after the -3 penalty is applied.

Depending on technology, most motive power plants can have a small part of their energy siphoned off for other purposes. A car engine can power an air conditioner, headlights and so on. The available power is generally about 2d less than maximum power plant output, and using this full amount of power is a -1 penalty on vehicle Strength (your car won't go as fast if you are running the air conditioner full blast).

A generator can be used to recharge *weapons* at a -24 penalty to its Strength. In the latter case, each ±3 more or less than needed either doubles the time needed to recharge a shot or doubles the number of shots charged per second. Power generation systems in a vehicle count as "gizmos" for cost purposes (+2 cost).

EXAMPLE: A laser point defense system with a 5d+0 damage will need a 13d+0 power generation system to recharge one shot per second. A 14d+0 power generator could recharge two shots per second, while a 12d+0 power generator could recharge one shot each two seconds.

The reason for the -24 penalty is that energy weapons usually have short-term outputs that are extremely large. Think of it like winding up a catapult. The energy is stored gradually, and released suddenly. It might take four men to wind up the catapult, but those four men could *not* just heave a rock the same distance. They can't concentrate their output over the same short interval. The same is true for energy weapons. The powerplant puts energy into storage banks (with some electrical losses), and this energy is released in the output pulses of the energy weapon.

If a power generation system does not have the Strength required to meet the needs of a powerplant it is running, that powerplant is limited by the output of the generator.

EXAMPLE: A generator with 9d+0 output running a 10d+0 electric motor can only run it at the 9d+0 level.

A power generator can split its total Strength between multiple tasks. A 10d+0 power plant can act like a pair of 9d+0 power plants, four 8d+0 power plants, and so on. Conversely, a pair of 9d+0 loads counts as a 10d+0 draw on power plant output.

In general, you can largely ignore power loads of 3d or more less than full power plant output, and loads that total to 2d less than the power plant output are only a -1 to full output.

EXAMPLE: A generator with 9d+0 output can ignore a 6d+0 load and still be counted as 9d+0. A pair of 6d+0 loads counts as 7d+0, and would be a -1 to output, dropping it to 8d+2 for other purposes. Four 6d+0 loads would count as an 8d+0 load, which means the spare power available is only 8d+0 (since a pair of 8d+0 loads is the full 9d+0 output of the power plant).

Electric motors(+3) - Electric motors are not air-breathing power plants and take a -3 to Strength. This is offset by a 1/4x fuel efficiency, which is +6, for a general bonus of +3 Strength. Electric motors are compact and powerful, but they go through fuel (batteries) at an alarming rate. Since electric motors are power plants, they come with an inherent fuel supply like other power plants. If you want a motor without any inherent battery, you get an additional +1 to the output.

EXAMPLE: An Atomic Era powerplant has a base Strength of +30 for one hexagon, and will run for five hours at full power with the fuel included in that size. An Atomic Era powerplant that is an electric motor will be +33 Strength for the same size, but will only run for one and a quarter hours, or have a Strength of +34 and be totally dependent on an outside source of energy.

Batteries - Batteries are not actually "fuel". Batteries are a powerplant that is used to run another powerplant (see the previous notes on power generation). The "fuel" in the battery is what makes it go. When the fuel in the battery runs out, the battery is dead and has to be recharged. Batteries are usually non-airbreathing powerplants, and take an *additional* -3 penalty on top of this.

Batteries are unique in that the fuel is not "used up". That is, an electric car with depleted batteries masses the same as one with fully charged batteries. Batteries have the advantage that electricity from almost any source can be used to replenish them to full capacity.

EXAMPLE: A one hexagon Atomic Era battery would have a Strength of 8d+0 and five hours of output at this level.

Atomic Era	+30
1 hexagon power plant	+0
Not air-breathing	-3
Battery	-3
Modifier total	+24
Total	8d+0

Unlike most generators, a battery can be discharged at a rate *higher than its actual Strength*. An 8d+0 battery could run a 10d+0 electric motor at full power, but not for the full five hours of normal output. You can go up to +7d more than the actual battery output (and any amount less), at a penalty or bonus to duration. See the table below. Numbers in parentheses are time levels.

Load vs. battery	Battery good for:
-3d	40 hours(35)
-2d	20 hours(33)
-1d	10 hours(31)
+0d	5 hours(28)
+1d	2 hours(26)
+2d	1 hour(24)
+3d	30 minutes(22)
+4d	12 minutes(20)
+5d	6 minutes(17)
+6d	3 minutes(15)
+7d	90 seconds(13)
each ±1	±25% closest value

EXAMPLE: You have a remote controlled observation drone that has an adjusted Strength of 6d+0. It runs off of a battery with a Strength of 3d+0. The difference is +3d, so the drone can fly at full power for 30 minutes (a time level of +22).

Batteries can either be rechargeable *or* non-rechargeable. So far, we have been assuming *rechargeable* batteries. A non-rechargeable battery (when it is used up, you throw it away) will have a Strength of +3 more than normal.

Battery charging: To charge an on-board energy storage system is a matter of comparing the Strength of the charger to the size and duration of what is being charged. Each time you double or halve the duration, you add or subtract 1d to the Strength of the charger. Once the charger Strength equals the power plant Strength, you can then see how long the charger has to operate.

EXAMPLE: A 2d+0 charger replenishing the batteries in an electric car with 10d+0 Strength will have a long haul. To get the +8d needed to match vehicle Strength will take eight doublings of time. Using the **EABA Universal Chart** (**EABA**, page 3.4) we can go down sixteen rows (eight doublings) from a time of one second and see it takes four minutes of charging to replenish one second of operating time. You can use this same sixteen row difference to see that if the vehicle's energy storage was normally good for an hour (time of 24), it would take a time of 24 plus 16, equals a time level of 40 (11 days) to fully recharge using this tiny charger.

Powercells: EABA uses a standard "powercell" for energy storage, a .1 kilogram cylinder that is supposed to fit into a variety of gizmos. So, powercells are actually a mini-powerplant that is simply used to power other powerplants or devices. When it's own on-board fuel supply is exhausted, the battery is either recharged (or thrown away if it is non-rechargeable type). The standard **EABA** *rechargeable* powercell would look like this (insert tech era as appropriate):

Atomic Era	+30
.1 millihex power plant	-39
Touchy	+3
Not air-breathing	-3
Hazardous fuel	+3
Battery	-3
x1/8 fuel efficiency	+9
Modifier total	+0
Total (rechargeable)	0d+0
Total (non-rechargeable)	1d+0

Note that if you want to get high tech, you can use *any* of the hazardous fuel modifiers you want. Rechargeable powercells are not easily "maintained", so when they hit a maintenance interval, they permanently lose capacity.

EXAMPLE: A "fission powercell" would have a a hazardous fuel modifier of +12 instead of +3. This could be used for a much higher output, a much longer life or some combination of the two.

Add to this basic battery design an extra fuel supply equal to the size of the powerplant itself, and you get a total size of .2 millihexes and weight of .1 kilograms. This gives 5 hours (actually, 5.6 hours) of full power operation at the following effective Strengths:

Tech Era	Strength	Energy
Early Industrial	*-2d+2*	*6*
Industrial	-2d+0	10
Late Industrial	*-1d+1*	*16*
Early Atomic	*-0d+2*	*25*
Atomic	0d+0	40
Late Atomic	*0d+2*	*65*
Early Post-Atomic	*1d+1*	*100*
Post-Atomic	2d+0	160
Late Post-Atomic	*2d+2*	*250*
Early Advanced	*3d+1*	*400*
Advanced	4d+0	640
Late Advanced	*4d+2*	*1000*

If you use less Strength, battery life is doubled per 1d less. If you need more Strength, doubling the number of powercells is +1d Strength, at the same rate of power drain. Powercells can be drained faster than the "5 hour" rate, and would get extra Strength as a result, +1d per halving of the time (as per the table on the previous page).

EXAMPLE: An electric motor with a Strength of 8d+0 could not be run by a single Atomic Era rechargeable powercell, since you can only halve the life of the battery seven times (to .025 hours or ninety seconds), for +7d Strength. You could use *two* Atomic Era powercells, since a pair of them would have a total Strength of 1d+0, which could be increased to 8d+0, and the pair of them *would* run the motor for ninety seconds.

A powercell holds a certain amount of energy as represented by its Strength and default five hour lifetime, depending on its tech era. This electrical power can be used for any purpose except actual firing of energy weapons (though powercells can be used to recharge these weapons). Rather than comparing the "Strength" of a flashlight to the table, handheld items will usually have an energy consumption for a unit of time, and comparing this to the energy on the table determines how long the powercell can run the item.

EXAMPLE: If a flashlight holds two powercells and consumes 10 energy per hour, you can see that a pair of Atomic Era powercells (total of 80 energy) will run the flashlight for 8 hours.

Energy weapons can be recharged from powercells just like from any other kind of power generator. One shot from a weapon counts as one second's worth of powercell use. Remember the -8d penalty for recharging weapons. Each ±1d of difference doubles or halves the number of seconds the powercell will last. The table below has already figured various charging levels to determine how many shots a powercell can recharge in an energy weapon clip. For weapons with area effects or continuous beams, *do not* count these modifiers on the damage of the weapon.

EXAMPLE: A plasma gun with a 5d+0 explosion would be counted as a 7d+0 for recharging purposes (because explosion is a -2d modifier on the weapon's damage, and we do *not* count that for recharging purposes).

For most weapons, assume they recharge one shot per second. However, technically a powercell cannot be drained in less than ninety seconds, so for weapons that may only get a few shots from a powercell, it may take a while to recharge them.

Strength difference	Shots per powercell
+15d	1
+14d	2
+13d	4
+12d	9
+11d	18
+10d	35
+9d	70
+8d	140
+7d	280
+6d	560
+5d	1,125
+4d	2,250
+3d	4,500
+2d	9,000
+1d	18,000
+0d	36,000
each +1	reduce by 25%

EXAMPLE: A Post-Atomic era powercell is used to recharge a laser pistol that has 3d+0 damage. You add +8d to the pistol's damage to get 11d+0. Compare this to the powercell Strength of 2d+0, and there is a +9d difference. The powercell can recharge up to 70 shots for this weapon. The same powercell is used to recharge a laser rifle that has a damage of 6d+0. You add +8d to get 14d+0 and compare to the powercell's rating of 2d+0. The difference of +12d means the powercell will only recharge 9 shots for this weapon. If this were an older, Atomic Era powercell, the difference would be +14d and it would only recharge 2 shots!

Fuel cells: Fuel cells are simply another means of converting chemical energy into electrical energy. The difference between fuel cells and batteries is that the chemical energy is used up rather than changed from one form to another within the battery. Fuel cells need refueled from outside sources the same way a car would need its gas tank refilled. Fuel cells *are* airbreathing powerplants. Fuel cells used in outer space would have to take the "not air-breathing" modifier.

EXAMPLE: A fuel cell with an output of 6d+0 will go through some quantity of fuel each hour in an atnosphere. A fuel cell *of the same size* in outer space will use the *same* amount of fuel, but since this fuel is both fuel *and* air, you are really running a less efficient fuel cell. It takes the "not air-breathing" modifier of -3 and only has 5d+0 output.

A stand-alone fuel cell is almost but not quite a replaceable battery pack. It would be designed exactly like a power plant whose sole purpose is to run another power plant. The difference is that the fuel cell is refilled with fuel rather than electricity, and that it cannot generate huge surges of power like a battery can.

EXAMPLE: To run a vehicle with an electric motor and adjusted Strength of 8d+0, you *must* have a fuel cell "power plant" with an output of at least 8d+0, unlike batteries, which *could* be less than 8d+0 and would just run out of juice quicker.

A standard **EABA** fuel cell is designed to take the place of twenty powercells in portable gadgets. It would look like this (insert appropriate tech era):

Atomic Era	+30
2 millihex power plant	-27
Touchy	+3
Power generator	-3
x1/8 fuel efficiency	+9
Modifier total	+12
Total	4d+0

Add an extra fuel supply equal to the size of the powerplant itself, for a total size of 4 millihexes and weight of 2 kilograms. This gives 5 hours of full power operation at the following effective Strength:

Tech Era	Fuel cell Strength	Energy
Early Atomic	*3d+1*	*400/hr*
Atomic	4d+0	640/hr
Late Atomic	*4d+2*	*1,000/hr*
Early Post-Atomic	*5d+1*	*1,600/hr*
Post-Atomic	6d+0	2,500/hr
Late Post-Atomic	*6d+2*	*4,000/hr*
Early Advanced	*7d+1*	*6,300/hr*
Advanced	8d+0	10k/hr
Late Advanced	*8d+2*	*16k/hr*

Note - Fuel cells run on hydrogen, but they can be designed to run on hydrogen that is extracted from any hydrogen-containing compound (usually a liquid). This **Stuff!** design assumes a +0 hazardous fuel modifier and figures the fuel cell is designed to run on methanol or some other medium-grade hydrocarbon with a +0 fuel modifier.

EXAMPLE: Let's say the previous example was an electric motor in a 1 ton Atomic Era electric car. To power this would require a fuel cell with an *output* of 8d+0 Strength. You can simply say that you need +4d more than a "standard" fuel cell, which means you double the number of fuel cells four times. This would be a total of sixteen 4 millihex fuel cells, or 64 millihexes worth. This will power the car at full Strength for up to five hours. The other way to look at it would be to design it as a single item to get 8d+0 output:

Atomic Era	+30
32 millihex power plant	-15
Touchy	+3
Power generator	-3
$x^{1}/8$ fuel efficiency	+9
Modifier total	+24
Total	8d+0

When you add an additonal 32 millihexes of fuel, you end up with the same thing.

If you use less Strength, fuel consumption is halved per 1d less. If you need more Strength, doubling the number of fuel cells is +1d Strength, at the same rate of fuel consumption.

EXAMPLE: If you had a Post-Atomic scooter with an adjusted Strength of 5d+0, a 6d+0 Post-Atomic fuel cell would last for 10 hours instead of 5 hours. If all you had were Atomic Era fuel cells, you would need two of them, since two 4d+0 fuel cells can combine to get 5d+0 of output.

Note - If you do the math, it seems like fuel cells would make electric cars extremely practical in the here and now. The problem is, *at this point in time*, fuel cells are a "limited production" item (at least +2 cost) and a "gizmo" (+4 cost) that would be trying to compete in a "mass market" (-2 cost) environment. The previous .064 hexagon fuel cell would be +6 cost (Atomic Era), +4 (gizmo), +2 (limited production), -10 (.064 hexagons), equals a cost of +2 (2000 Credits), compared to an 8d+0 Strength conventional power plant, which is a cost of +6 (Atomic Era), -2 (mass production), -5 (.25 hexagons and .125 tons), equals a cost of -1 (700 Credits). So, ther fuel cell costs four times as much, *and* it is a touchy power plant that requires maintenance several times more often than a normal engine.

Combining batteries and fuel cells can be done to provide long-duration power with short term boosts. You would count the fuel cell as a sort of battery extender. The fuel cell will extend the battery life by one row per +3d of difference.

EXAMPLE: A 6d+0 fuel cell and batteries with a Strength of 6d+0 are paired up and could act as a 7d+0 power source for normal battery life (two power sources of equal value count as the base value +1d). If there is a 6d+0 load, the fuel cell handles it on its own and will run for up to five hours before needing refueled. If there is a 7d+0 load, the batteries and fuel cell together handle it for up to five hours. If there is a 9d+0 load (+3d Strength difference over the battery), the battery has to cover most of the load, but the fuel cell contributes enough that the battery will last an hour (+2d Strength difference) instead of half an hour (+3d Strength difference). So, you can handle surge loads for short periods, and steady loads for longer periods.

SECONDARY POWER PLANT TOPICS - That about covers all the modifiers that *directly* affect the output of a vehicle's power plant (*only* about 20 pages worth...). However, the Strength of a vehicle has a number of other ramifications, and these have their own advanced rules.

Deceleration - Normally, the deceleration of a vehicle is the same as its acceleration. This can be modified for different vehicle environments at gamemaster option. You do this by adjusting the Strength used to get the acceleration number (*after* the row shift).

Land vehicles apply a +3 to their acceleration *row* for deceleration purposes. Friction with the ground **increases** their ability to come to a stop. This is under optimum conditions. Wet or snowy or icy roads will adjust this downwards. Water vehicles apply a +1. Friction and turbulence between a boat hull and the water makes deceleration more effective. Space vehicles have +0 adjustment, or no change. A space vehicle can just turn around and use its engines to decelerate at the same rate it accelerates. If the space vehicle can't turn around easily, it must use thrust diverters or reaction jets to slow down, and would apply a -3 to their acceleration row to reflect these less effective strategies. Last, air vehicles use a -3 to Strength. Air brakes aren't that effective compared to braking strategies used in other environments. Similarly, the small brakes on the wheels of landing gear would also take a -3 to Strength.

EXAMPLE: A 1 ton car with a +30 Strength power plant would have an acceleration of half the Strength(+15), with a -9 for being a ground vehicle, for a final acceleration of +6 Strength, or 5 meters per turn. For deceleration, it could use the +9 Strength row, or 7 meters per turn.

Suspensions - A vehicle can optmize its ability to travel across a particular terrain. This will affect its Strength for purposes of top speed and related factors. For instance, a race car is designed for a very smooth, specific environment. A passenger car is designed for roads in general. An offroad vehicle can travel over any environment the other two can, and more besides. For a given amount of horsepower, the race car will be the fastest in its specific environment.

The way to apply this to vehicle designs is to check the following table and apply the most appropriate modifier:

Environment	Example	Strength
Totally limited	Train	+12
Extremely limited	Dragster	+9
Very limited	Race car	+6
Limited	Sports car	+3
Normal	Passenger car	+0
Enhanced	Off-road 4WD	-3
Very enhanced	Tracked vehicle	-6
Extr. enhanced	Walking vehicle	-9

The examples are all for land vehicles, but to some extent they can apply to other environments. For instance, a racing hydrofoil might be optimized for smooth water conditions, while a foul weather rescue vessel would be optimized for a rougher environment. All of these modifiers apply towards acceleration after power plant Strength is halved.

The way you would apply suspensions in play is simple. Vehicles have a default 2d+0 "Agility roll". You roll this Agility against a target number for the environment type. This target number is 1 for the vehicle's "native" environment and is increased by 2 for each row down the table past that (or reduced to a difficulty of 0 or less for rows above that). You roll upon entering that environment, and again each kilometer. If you make the roll, you keep moving. If you fail, you get stuck or have some sort of mechanical problem that prevents further movement (which might involve taking 1 Hit of damage). A vehicle that is "totally limited" *automatically* gets stuck if it leaves its designed environment (a train *always* gets stuck if it leaves the tracks...).

EXAMPLE: A sports car is optimized for smooth but non-specialized roads, like highways and normal streets. Its Strength is +3 for top speed because of this. However, if you start driving it up a rutted dirt road, you have to roll 2d+0 to avoid getting stuck. The roll for its normal environment is a 1, and the dirt road is one row up from that, increasing the difficulty to 3. *Eventually, it will hit a rut and get stuck.*

Dice penalties a vehicle takes *will* affect this roll at gamemaster option. So, a vehicle that has taken enough hits to be at -1d effect will have to roll each kilometer even in its "native" environment to avoid getting stuck. For instance, if your tires are flat and you keep driving, eventually the rubber will shred off and you end up bottoming your suspension out on the pavement, even if the vehicle has not taken all its Hits. In your vehicle's native environment, it will automatically fail the roll after one kilometer if it is at the -2d penalty level or better (adjusted Agility roll of 0d+0 against a target number of 1). If the Agility roll is negative against a negative target number, you roll a negative total and try to get more (closer to zero) than the target number.

EXAMPLE: If your off-road vehicle has managed to get to a -3d penalty and keep moving on a road meant for normal cars, it is rolling -1d+0 (2d+0 Agility with a -3d penalty) against a target number of -1 (one row easier than its normal environment). So, any roll of -2 or more means that the vehicle gets stuck after a kilometer of travel, while a roll of -1 means the vehicle keeps moving for at least another kilometer after that.

Handling - Normally, a vehicle can maneuver as detailed on page 3.11. However, vehicles can be bought with inherent handling bonuses, which represent better tires, advanced suspensions, spoilers and such. This handling bonus alters the difficulty of making manuevers for better or worse. A vehicle can have up to a +2 penalty to make manuevering *harder*, and up to a -1 bonus at the Industrial Era, and a further -1 for each era past that. Each ±1 to maneuvering difficulty is also a ±1 to the overall cost of the vehicle.

EXAMPLE: You want a sports car to have better handling than normal, so you pay the extra cost for -1 handling. All manuevering tasks with this car are now 1 point less difficult than normal.

Multi-terrain vehicle - If a vehicle can be designed to operate in two or more environments, this will necessitate certain design compromises. First, it will get a -3 on Strength for its primary environment, and then an *additional* -12 for its secondary environment. If it has more than one secondary environment, it takes an additional -3 on *all* environments for each extra capability.

EXAMPLE: A car with a Strength of 10d+0 that can also act as a boat will end up with a Strength of 9d+0 for driving top speed and 5d+0 for boating top speed.

The cost of a multi-terrain vehicle is the cost it would be for all environments. A car that can act like a boat costs like a car *and* a boat (figure them separately, then add together). It is fairly common to trim the cost of a multi-environment vehicle by reducing the handling in a secondary environment for a -1 cost discount on that part of the vehicle. For instance, the boat-car would not handle as well in the water as a regular boat.

Towing things - In general, anything loading down a power plant will affect the top speed, acceleration and deceleration of the vehicle. Any towed load is also an automatic +1 difficulty on all maneuvering tasks, including getting stuck for being outside the right environment. If you prefer, instead of +1 difficulty you can add half (round up) the mass difference between the vehicle and vehicle + trailer to the manuevering difficulty, with a minimum of +1 difficulty.

EXAMPLE: A car with a mass of 2 tons(-3) and a power plant Strength of +33 has a top speed for +30 Strength(53 meters per turn), an acceleration of 5 meters per turn and a deceleration of 8 meters per turn. The loaded mass of the *car* is 2 tons. If it were also towing a 1 ton trailer, it would have a total mass of 3 tons(-5), for a top speed of +28 Strength(44 meters per turn), an acceleration of 4 meters per turn, a deceleration of 7 meters per turn, and all handling tasks would be at +1 difficulty.

That about covers the "how fast will it go?" part of advanced vehicle design. Now, on to the "how big is it?" part of the rules.

VEHICLE SIZE - There are plenty of modifiers and special cases about how big a vehicle is and what you can cram in it.

Seating and Accomodations - The basic rules covered seating, but that was about it. Before we get into this, remember that you are dealing with the abstract. You're just figuring what you need for a certain level of comfort or passenger actions. *You only need to draw what a floor plan looks like if it is important for a particular role-playing aspect.*

EXAMPLE: If you have a dozen first class berths and each one is 144 hexagons, then it means you need about 1700 hexagons of passenger space. This is a number you can plug into the vehicle design, but unless there is going to a firefight in the luxury suites, you shouldn't worry about imagining what it actually looks like.

The basic seating rules assume that there is vehicle structure of some type that completely surrounds the person (much like a car). If a person is in the vehicle, but vehicle protection only provides fractional coverage, you normally have half the hexagons needed for vehicle size purposes.

EXAMPLE: If a rowboat only protects you from the waist down, you only need half a hexagon per person of seating room.

Sometimes you need room to move around. In order for people to change places in a vehicle without actually getting out and getting back in, you need corridor space. We will list some basic seating and accomodation options, and you can decide what fits for the vehicle you have in mind.

Your basic vehicle seat (one hexagon) is just that, a seat. You need to crawl over someone else to get to anywhere else in the vehicle, and you normally have your own door, hatch or other means of getting in and out. Trying to do anything that involves moving your body is probably at a -2d penalty to skill or Attribute rolls. If you can increase your mobility by rolling down a window or opening a hatch, the penalty is only -1d, or might be eliminated entirely for some skills.

Vehicles whose nature requires specialized ingress or egress will not have a door or hatch for each passenger. Think of an airliner, for instance. Vehicles with this limit will need one *extra* hexagon of floor plan for each three passengers.

EXAMPLE: An airliner that carries 300 passengers will have 300 hexagons of space for seating, and an extra 100 hexagons of space for aisles. You may also want to take into account perhaps half a hexagon per passenger in the seating area if the seats have overhead storage bins.

Standing room (one hexagon) is also like it sounds. You have half a hexagon of floor space to stand on, and it is two or so meters high. Take six sheets of paper about the size of this page and lay them on the ground in a three by two pattern. That's "standing room". Trying to do anything physical if you are packed in like sardines is a -1d penalty. Standing room does not have an exit for each passenger. How many exits there are and how large they are depends on the vehicle and its need to get people on and off. A subway car or packed bus would have a capacity based on standing room (two people per hexagon of floor plan set aside for passengers).

This level of accomodation and anything more spacious is assuming that people are able to stand, so each two hexagons is only one hexagon on a vehicle floor plan.

"Military access" is the next level up. It isn't pretty, and it might not be safe, but it is enough room for people to get up, move around and get on, in and around the equipment in the vehicle. This is two hexagons per person. One of these is the crew station, and the rest is scattered throughout the vehicle. If there is no one else around, and you are careful, most physical skills can be done at no penalty. Some manuevers or actions will certainly be out of the question.

EXAMPLE: You can punch someone in the cramped hallways of a submarine, but spinning roundhouse kicks are out of the question.

Military vehicles where the crew is expected to live in the vehicle for extended periods of time will need bunks, showers, galleys and other niceties. In *addition to* "military access", this will take up four hexagons per person for three shift "hot bunking", six hexagons per person for two shift "hot bunking" and eight heagons per person for personal quarters. "Hot bunking" is where a sleeping space is shared by two or more people. For instance, if there are three eight hour shifts, one person is sleeping, one person is on duty, and the other person is doing something else (eating, etc.).

Hot bunking is not recommended for vehicles used by adventurers, since it means by its nature that not everyone will be fully awake and alert at the same time, and adventurers normally operate as a group.

"Civilian access" means the sky is the limit. This can range from the cramped confines of a tramp freighter to the vast atriums in a luxury liner. In general, assume *at least* thirty-six hexagons of space per person, using twelve hexagons of floor plan. This is for ceilings of about two-and-a-half meters, and conduit space above or below it. This would be for "third class" accomodations, a small (maybe three by two hexagons) room per person, narrow halls and the like. Double this for each class up.

Quarters guide	Hexagons per person
Three shift hot-bunk	4 (plus crew station)
Two shift hot-bunk	6 (plus crew station)
Minimum mil. quarters	8 (plus crew station)
Third class civilian	36
Second class civilian	72
First class civilian	144

EXAMPLE: A passenger vessel with a thousand third-class berths, a hundred second-class berths and twenty first-class berths would use about forty-one *thousand* hexagons of *volume*, and over thirteen thousand hexagons of *floor plan*.

When you add in space for crew or passenger access, remember entertainment. Listed amounts cover only the bare necessities. If you want to add a swimming pool or casino or zero-g bowling alley, that's up to you to figure out.

Operating crew - A vehicle will require a certain number of crew to effectively operate it. This is just to make sure it can reliably move from point A to point B,and does not include sensor opeators, gunners and so on. The required crew is based on the vehicle's size and tech era. The main caveat is that cargo or other empty space like fuel tankage, extra space for animals, sails or lighter than air apparatus generally does *not* count towards vehicle size.

Technological Era	Area multiplier
Primitive	+5 rows
Basic	+4 rows
Industrial	+3 rows
Atomic	+2 rows
Post-Atomic	+1 rows
Advanced	+0 rows

Modifiers	Amount
Lower tech system (x$^1/_2$ veh. cost)	+2 rows
Extra automation (x2 veh. cost)	-2 rows
Civilian vehicle	-1 row
Short haul vehicle	-2 rows
Limited maneuverabilty	-4 rows

Adjusted vehicle size	Crew
Vehicle of 1 hexagon	$^1/_{16}$
Vehicle of 2 hexagons	$^3/_{32}$
Vehicle of 4 hexagons	$^1/_8$
Vehicle of 8 hexagons	$^3/_{16}$
Vehicle of 16 hexagons	$^1/_4$
Vehicle of 32 hexagons	$^3/_8$
Vehicle of 64 hexagons	$^1/_2$
Vehicle of 125 hexagons	$^3/_4$
Vehicle of 250 hexagons	1
Vehicle of 500 hexagons	$1^1/_2$
Vehicle of 1000 hexagons	2
Vehicle of 2000 hexagons	3
Vehicle of 4000 hexagons	4
Vehicle of 8000 hexagons	6
Vehicle of 16000 hexagons	8
Vehicle of 32000 hexagons	12
Vehicle of 64000 hexagons	16
Vehicle of 125000 hexagons	24
Vehicle of 250000 hexagons	32

EXAMPLE: An Industrial Era steamship that takes up 500 hexagons will have an operating crew of $1^1/_2$ (vehicle size) +3 rows (Industrial Era), -1 row (civilian vehicle) equals 3. To keep the engines stoked, steer, drop anchor and pass maneuvering orders from station to station requires three people.

A crew requirement of one or less becomes a crew requirement of one (you always need a driver, or an autopilot at least). A crew size of less than one is important if you install an "autopilot" gizmo, as it determines how sophisticated the autopilot has to be. A vehicle with a fractional crew amount greater than one usually means that the extra crew person is only required for stressful or specialized vehicle operations.

EXAMPLE: A boat with a crew requirement of $1\,{}^{1}/_{2}$ will need one person to run it normally, but 2 people for docking or dropping anchor. One person can run the vehcle, but they cannot be at the helm and dropping anchor at the same time...

A vehicle with a fractional crew amount may also mean that the one crew person (driver or pilot) does not need to apply their full attention to running the vehicle. Quite often they have to be at their station one hundred percent of the time, but they can do other things that do not require leaving that station. Doing something else will still cause a penalty to the skills used to operate the vehicle. The smaller the vehicle is, the more immediate the consequences are (you can step away from the bridge of a ship a lot longer than you can ignore the controls of a motorcycle). In general, just assume that driving and doing anything else significant is taking two major actions in a turn.

Automation: A vehicle can have +2 cost for extra automation that effectively increases its tech era, and halves the crew requirement. This can be done in fractional amounts if necessary. A vehicle made with modern materials, but which uses a more primitive form of propulsion (like a modern sailboat) may go the other route. The vehicle has -2 cost, but requires more crew than normal. A vehicle cannot use the lower tech operating system modifier unless it has a crew based on area and actual size of at least 1. Vehicles powered by wind or animals could be counted as anywhere down to Primitive Era.

Civilian vehicle: A vehicle that is more or less unsuited for any sort of military purpose. It has blind spots that are not regularly patrolled, systems that do not require regular monitoring, and less or no need to have someone on duty at each station all the time.

Short haul: A vehicle that always starts and ends a trip within a day of civilization or safe harbor also halves the crew requirement. You take care of any problems that build up each night while the vehicle is in port, back at the depot, etc. Most Primitive Era and many Basic Era water vehicles will be this type.

Limited manueverability: If much of the steering or operating of a vehicle is out of the control of those running it, it requires a lot less crew. A train would be an example. You only go where the tracks go.

If there is not sufficient crew, the difference in rows between that the crew can manage and the actual vehicle size is a penalty on all operations that would be affected.

EXAMPLE: A 8,000 hexagon Advanced Era interstellar freighter has a crew requirement of 6. It has to limp home on a skeleton crew of 2. This is three rows difference, so all ship operations are at +3 difficulty.

Remember that a vehicle needs its crew whenever it isn't "parked". A ship at sea needs crew twenty-four hours a day. A ship in space might only need the full crew while under thrust or manuevering, but someone should be on watch at all times.

Additional crew requirements: Some functions of a vehicle only require crew during specific operations. A cargo ship doesn't need crew to operate or maintain the cargo hold, but when it docks, it will need people to man the hoists or cranes to move the cargo in and out of the holds.

A vehicle that is *not* a short-haul vehicle includes any crew *required* for full-time operation, such as a cook, etc. It *does not* include "luxury" crew. So, if the first class cabins have their own stewards, cooks and cleaning staff, this is extra and is not covered by the basic crew complement.

Now, on to the "how tough is it?" part of the design rules.

HOW TOUGH IS IT? - For the majority of player- or gamemaster-designed vehicles, armor will generally be of some importance, and there are a number of specialized armor topics.

Ablative armor - This is armor that is specialized to stop a *particular* kind of attack, but which has the potential to be damaged or destroyed in the process. Reactive armor plates on a tank, or the heat shield on an old Apollo capsule are examples of ablative armor. The way it works is that you can sacrifice +1 of armor on a facing to get +2 of protection against a *specific* type of attack. You can sacrifice armor down to the last 1d+0 on a facing, and you can only have *one* type of ablative armor on a facing. Ablative armor protection can be spread around the vehicle as needed, using the normal rules (page 3.7).

EXAMPLE: A tank with 10d+0 front armor gives up 1d of armor to get extra protection against shaped charges. Now the tank has 11d+0 protection against shaped charges and 9d+0 against everything else. The tank designer could also have reduced all facings by 0d+1 to get an overall (six facing) increase of 0d+2, and then put all the extra protection on the front. This would be a total bonus to front armor of 1d+1 (0d+1 from each of 5 facings, plus the 0d+2 already on the front).

If an attack of the specific type hits an ablative armor *and* does enough damage to penetrate it, the protection is reduced by 1d each time the protection is penetrated, until there is no special protection left.

EXAMPLE: If the tank were hit by a 9d+0 shaped charge rocket, the overall armor would not be penetrated, but the +2d in the special armor was breached and would be reduced to +1d. The tank would now only have 10d+0 protection against shaped charges on that facing.

Normal armor is defined as stopping kinetic energy from moving objects. You cannot make armor "ablative" against mundane attacks. This armor option is only for specialized attacks.

Note - In **EABA** terms, a controlled atmospheric re-entry would count as a 6d+0 lethal attack. A poor re-entry could be larger than this by almost any amount, depending on the size of the ship, speed and how badly the re-entry was botched.

Repairing or replacing lost ablative armor is done at a cost of the weight of the system and the tech era and scarity of the armor. Each 1d of regular armor sacrificed is about half the remaining armor weight.

EXAMPLE: If a vehicle has 4 tons of armor, sacrificing 1d of regular armor for +2d ablative protection effectively means you have about 2 tons of ablative armor. Sacrificing 2d of regular armor would be about 3 tons of ablative armor (half of the original 4 tons, plus half of the remaining 2 tons).

If you want to add ablative armor to an *existing* vehicle, it will add some weight, which may reduce its performance. Doubling the weight of existing vehicle armor would be good for an overall +2d ablative bonus against a particular attack type. But, you probably don't want to add *that* much weight, nor need the protection on *all* facings. Ablative armor equal to 25% of existing armor is enough for +3d of protection on *one* facing, or +3d split between different facings.

EXAMPLE: A tank with 16 tons of armor adds 4 tons of reactive armor plates to stop shaped charges. This is good for +3d of protection to be split between all vehicle facings, and the designer adds +1d to the front, right and left facings. This extra weight adds to the tank's normal maximum weight, and its performance will probably drop by 0d+1 Strength as a result.

Note - Weight beyond a vehicle's designed limits, whether for extra armor, towed loads or just carrying something really heavy, will probably decrease the life of the vehicle. Engine failures in uparmored Strykers in Iraq would be a good example. A gamemaster can easily justify extra maintenance requirements and costs on any vehicle that regularly operates under excess load, especially if it does so while operating near maximum performance. Similarly, it might be worth an extra point of difficulty when maneuvering in unfavorable terrain (overloaded vehicles are more likely to get stuck). You can play with fractional amounts of increased performance from increased fuel consumption to get the same speed from an uparmored and heavier vehicle, at the cost of increased fuel consumption and more frequent maintenance.

Improvised armor - Sometimes, people discover the hard way that the enemy has better weapons or that estimates of armor performance were optimistic, to say the least. *The result?* A desperate attempt to up-armor parts of the vehicle using whatever materials are available at hand. The easiest way to do this is to count the process as a jury-rigged repair of 1 vehicle Hit (see page 3.61). The armor will have a weight of whatever you want, and you can assume that this will load the vehicle past its normal level. The new armor value will be based on the new armor mass. However, the improvised nature of this armor means that the extra amount only has a fifty-fifty chance of intercepting any given attack. Or, since there are six vehicle hit locations, you can choose three to totally protect and three to leave unprotected.

EXAMPLE: Some tank crews find that enemy fire is just powerful enough to crack open the front of their vehicle like a lobster. Since high command doesn't have any new models coming out for a year or so, they decide to improvise. If they increase total armor weight on the tank by a quarter, they can get an overall 0d+1 bonus. This a total of 6 points (1 for each facing), and they combine these (using the guidelines on page 3.7) into a +1d bonus to the front armor. Normally, this only has half a chance of working against any given hit, but they concentrate it on protecting the crew, weapon and power plant. So, any hit to the front that would hit one of these locations gets +1d to the vehicle's normal front armor, while hits to fuel, cargo and body do not get this protection.

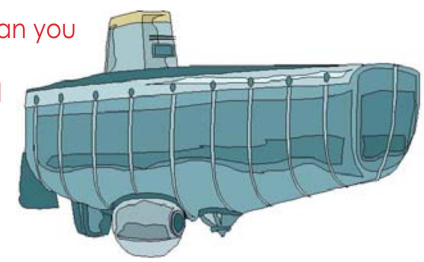
Note - At least in terms of land vehicles, crews have been adding "field-expedient" armor for as long as there have been military land vehicles. Which does not say much for the talent of the people who designed or deployed these vehicles...

Pressure hulls - Vehicles automatically have structure appropriate to their environment. So, a vehicle defined as a submarine is completely watertight. However, this does not say anything about how deep it can go before pressure crushes it like a tin can.

It takes 1d+0 of armor to withstand a pressure of ten meters of water (about one atmosphere). Each time you double the depth, you double the pressure, and each doubling requires an extra +1d of armor (on *all* facings) in order to be safe (or about a +1 to armor for an increase in safe depth of twenty-five percent).

EXAMPLE: A submersible with an overall armor of 4d+0 is safe to a depth of eighty meters (ten meters for 1d+0, twenty meters for 2d+0, forty meters for 3d+0 and eighty meters for 4d+0).

Note - This would mean you would need an armor of 11d+1 to safely withstand the maximum pressure in the darkest depths of Earth's oceans.



Exceeding the safe depth does Hits equal to the difference in "pressure damage". This will happen each time the safe depth is exceeded or each time a deeper unsafe depth is reached. This could be each doubling of depth for 1d+0 damage, or 1 Hit per twenty-five percent below the safe depth. In addition, any damage hitting a pressure hull under 1d+0 stress or more will have +1d added to it.

EXAMPLE: If the submarine in the previous example dove to one hundred sixty meters, it would take 1d+0 Hits (5d+0 pressure damage minus 4d+0 pressure hull). A 4d+0 blast wave from a depth charge would normally do no damage, but because the hull is already under stress, it counts as a 5d+0 blast wave and does another 1d+0 hits to the submarine.

Needless to say, if the damage from outside pressure causes a vehicle to lose all its Hits, it will implode. A compartmentalized vehicle might not implode *completely*, but the vehicle is *still* effectively destroyed. Damage from overpressure is *not* subject to a vehicle's damage limit.

Compartmentalization - A vehicle can devote a sixteenth of its hexagons (round up) to compartmentalization. This protects the various subsystems with internal bulkheads, water- or air-tight doors, or other structural considerations appropriate to the vehicle type. The game effect is to reduce the vehicle's damage limit by 1, and increase its cost by +1. The presence of armored bulkheads means the maximum number of Hits that can be lost from a single attack is reduced. In addition, each hit location of the vehicle is separated from the rest by doors and partitions with a protection equal to the *lowest* armor on any facing of the vehicle (at least 1d+0).

EXAMPLE: A tank that takes up 32 hexagons and whose *weakest* armor is 7d+0 is built using the compartmentalization option. The vehicle loses 2 hexagons that could otherwise go to gizmos or passenger space, but its damage limit drops from the normal value of 3 (for a vehicle of 32 hexagons) to 2. Each of the vehicle's hit locations is separated by internal panels with a protection of 7d+0. So, if a cargo hit detonated the stored ammunition, the vehicle would still lose more Hits from the secondary explosion, but the explosion reaching the crew compartment would be reduced by 7d+0 because of the armored bulkheads.

Remember that each 2 size levels doubles or halves the hexagons in a vehicle, so one-sixteenth would be the vehicle's size minus 8 levels.

EXAMPLE: Our tank has 32 hexagons, which is a size level of 8. A size level of 0 is 2 hexagons. So, you don't have to dig out a calculator for this, even for really large vehicles.

Compartmentalization also allows the designer to put armored bulkheads protecting sensitive areas on a larger vessel as needed, like the bridge, computer core, the brig, and so on.

HOW BIG A GUN? - Weapons and advanced weapon topics are adequately covered in chapter 2. What we deal with here are advanced options particular to mounting them in vehicles.

Turret armor - While it is the default, a vehicle weapon is not *required* to have the same level of protection as the rest of the vehicle. For instance, a tank's turret might be more heavily armored than the equivalent vehicle facings. Or, a open cannon mount on a ship might have no armor (or just a gun shield, which is on page 2.28).

The default is that the weapon is protected the same as any other vehicle component. *Playing with turret armor is tricky*. Read this section carefully. Alterations to/from turret armor will be based on the ratio between the weapon size and total vehicle size. Find the closest size levels for the vehicle and weapon on the **EABA Universal Chart** and see how many rows of difference there are.

EXAMPLE: A vehicle of 64 hexagons that has a 10 hexagon weapon would be respective Size levels of 10 and 5. So, there is 5 levels of difference.

If a weapon and/or its ammunition is protected *less* than the vehicle, then if you reduce *weapon protection* by +1 *times the levels of difference*, the *overall vehicle armor* gets a +1 bonus. You can do this no more than the number of times it would take that would reduce average weapon protection to zero (round the average to nearest +1). You can keep any fractional overall bonuses, applying remaining +1 bonuses to particular armor facings.

EXAMPLE: We will say the vehicle in the previous example had a front armor of 7d+0 and all other facings at 4d+0. This is an armor "total" of 27d+0 (4d+0 on five sides and 7d+0 on one), for an *average* of 4d+2, or +14 armor.

Since there +5 levels of difference between weapon size and vehicle size, we divide +14 by 5. This comes out to 2, with a remainder of 4, so we get an overall bonus of 0d+2, and a 0d+1 bonus on each of four facings). So, if we leave the weapon completely unprotected, the overall vehicle armor is increased by 0d+2, and four of the six vehicle facings get an additional 0d+1. The designer of the vehicle increases the front, sides and top by 1d+0, and the back and bottom by 0d+2.

Rearranging of armor on the two-for-one basis as in the basic design rules is usually done *after* turret armor is calculated for best efficiency.

If the weapon and/or its ammunition is protected *more* than the vehicle, you just do the reverse. Each time you increase the weapon protection by the levels of difference, the overall vehicle armor gets a -1 penalty. You usually cannot do this for more than a +1d bonus on the weapon, and the bonus applies to what the vehicle armor was *before* the penalty.

EXAMPLE: If we take the previous 10 hexagon weapon on a 64 hexagon vehicle and we want to *increase* the weapon's protection, then since there are +5 levels of size difference, each 1 point we drop vehicle armor will increase turret armor by +5. However, we are limited to a maximum of +3 (+1d). This gives overall vehicle armor a -1 penalty to give the weapon mount a +1d bonus. The vehicle started as having 7d+0 on the front and 4d+0 on the sides. Now it has 6d+2 on the front and 3d+2 elsewhere, but the weapon protection is 8d+0 on the front and 5d+0 on the other facings.

External weaponry - Some weapons are completely external to the vehicle, like rockets hanging off an aircraft wing. These are either bought as unprotected weapons, or are added to the weight of the vehicle after it is designed and just considered a drag on performance. If the loaded vehicle weight includes the weight of external weapons (or gizmos), then performance increases when the weapons are gone. If the extras are in addition to loaded vehicle weight, then performace suffers, and only returns to normal after the extra weight is gone.

EXAMPLE: A 10 ton fighter whose *designed* weight includes 2 tons of missiles on the wings will have different performance and design than an 8 ton fighter that someone decides to mount 2 extra tons of missiles on...

HOW MANY GIZMOS? - The design of *most* gizmos will be covered in the Gizmos chapter, but there are a few specialized topics directly related to vehicles.

Specialized space - Any specialized space in a vehicle aside from quarters and cargo will count as a gizmo. This could be scientific laboratories, a secure brig or the ship's bowling alley. A specialized space related to a skill roll, like a laboratory, needs to be at least 5 hexagons in size. This is sufficient for one specialized skill to be used at no penalty for research tasks. In operation, the lab consumes up to 8d+0 of power. For double the size (10 hexagons), you can have enough space to allow an assistant, or use a full skill rather than a specialization, or get a -2 to the difficulty of tasks on the specific skill. For 20 hexagons, a lab can be for a full suite of similar skills, but it would have to be 40 hexagons to do this and have room for an assistant. Every time you double the size of a specialized space, the power requirement goes up by +1d.

Control space - Vehicles naturally include the space required for the driver or pilot at no extra cost, but there is no indication of exactly how large an area this usually is in terms of floor plan. Find the size level of the completed vehicle. For instance, a 90 hexagon vehicle is Size +11. For a military vehicle, subtract 12 from the amount, and for a civilian vehicle, subtract 15. The result is the Size level of the actual controls, with a minimum appropriate to the vehicle in question. Remember that control space represents more than just the driver's instruments. On a large vehicle, it includes the "engine room", the "bridge", and various bits of crawl space scattered about the vehicle.

EXAMPLE: A 64,000 hexagon cargo ship is size +30, so its control space is size +15, or 350 hexagons. This can be split as needed between the "bridge", "engine room" or anything else a vehicle this size might need.

Cargo space - Cargo is always default cost, and can be cargo holds, hangar bays, etc. Vehicles will have cargo moving equipment, docking clamps or other amenities appropriate to the tech era and type of vehicle. Spaceships have airlocks, cargo ships have cargo doors and so on. Cargo space can be used for any vehicle purpose, but usually at a +2 to +4 difficulty. Weapons mounted in cargo space can't be aimed as well, laboratories suffer because of climate control problems, etc.

Artificial gravity - This is available in a particular gameworld if the gamemaster allows. As a convenience in spaceships, it is available for any part of the ship desired, and all hexagons affected are +2 cost. You would figure the ship cost normally, then just count any artificial gravity hexagons like you would for gadgets.

Artificial gravity can have whatever special effect the gamemaster desires. It might be something that can be switched on quickly and at high levels, like an "inertia damper", or it might be something of relatively weak effect that takes a while to turn on and off, like "gravity plating". Artificial gravity will generally consume electrical power. Take the size of the area which is affected, and add an amount appropriate to the gameworld. A +20 is good start for providing 1 gee of artificial gravity. The result is the Strength drawn from some power source whenever the artificial gravity is on.

EXAMPLE: Providing artificial gravity over 64 hexagons (size of +10) would require a power source with a Strength of +30(10d+0).

Artificial gravity as a means of propulsion is just a regular vehicle power plant with appropriate modifiers. The system doesn't care what the method of operation is, only the end results. An artificial gravity drive will have the advantage of being reactionless, so as long as you have a source of power, you're set for extended cruising.

Artificial gravity can also be done the old fashioned way, by spinning the ship or parts of it to create an up/down orientation. Unless a ship is very large, only fractions of a gravity can be generated without causing severe dizziness, not to mention stresses on the structure of the spaceship. A ship generating gravity in this way is more of a floor plan problem than a design problem.

Manipulators - A manipulator is really just a specialized power plant, which instead of moving a vehicle as a whole, is used to move just a part of the vehicle. This *can* end up moving the vehicle, like a legged robot. A hexagon of manipulators has the Strength of one hexagon of power plant at that tech era, with a -9 penalty, and requires an external fuel source or energy of some kind to power it. This Strength penalty represents the inefficiency of manipulators compared to things like wheels for purposes of moving, which is after all, the main use of vehicle Strength (see the notes on vehicle suspensions on page 3.36). However, not all of a manipulator is being used at once, so for purposes of powering a manipulator from a another power plant like a battery, you also count the -9 penalty.

EXAMPLE: A power plant of +27 Strength that is a manipulator is a +18 Strength manipulator, which requires either fuel or a +18 Strength power source to run it.

Note - If you have a vehicle whose suspension has the -9 "extremely enhanced" modifier, you can *assume* it is a vehicle whose movement is powered by manipulators, though in this case you would count it as having inherent fuel like any other power plant.

For purposes of Attributes other than Strength, a manipulator is assumed to have 2d+0 at the Atomic Era, ±1d for each era outside that, and ±1 for the late or early parts of an era. Agility is an upper limit. The operator of the limb cannot use their own Agility for skill purposes past this level. Health is a bonus, and is only applied for exoskeletons. It will boost the operator's Health for movement purposes only.

EXAMPLE: A Post-Atomic manipulator arm will have an Agility of 3d+0. An Industrial Era steam-powered mechanical leg will have a Health of 1d+0.

Manipulators can sacrifice two points (or dice) of one Attribute to get one extra point (or die) in another. This adjustment is done after any other halving for things like exoskeletons.

EXAMPLE: The Post-Atomic manipulator arm can drop its Agility by two points to 2d+1 in order to raise its Strength by 0d+1.

The movement of a legged robot will normally be based on its adjusted Strength, just as for any other vehicle. A manipulator that requires a "human core", like an exoskeleton, will use the abilities of a person, so movement will be based on the person's Health and running ability, which may be enhanced by the exoskeleton.

EXAMPLE: A robot with adjusted leg Strength of 4d+0 would move like a vehicle with an adjusted Strength of 4d+0. An exoskeletal armor for a person with a Strength of 4d+0 would have a Health based on its tech era, which would modify the Health of the user to determine their movement speed.

ADVANCED TOPIC: EARTHMOVERS
High Strength, low Agility manipulators are the usual way of representing earthmoving equipment. You can normally move an amount of loose dirt or crushed rock per *minute* of the lifting capacity of the manipulator's Strength minus 2d, or pulverize an amount of solid rock of the lifting capacity of the manipulator's Strength minus 4d. For reference, one hexagon of dirt is about 1.5 tons, and one hexagon of stone about 2 tons.

In general, earthmovers and other construction equipment are going to want enough armor on key locations to withstand accidents and whole-vehicle effects that are not subject to damage limit. After all, pushing a huge load of earth or rock has a lot of similarity to a low speed collision...

EXAMPLE: A front-end loader whose scoop has a Strength of 10d+0 (Strength level of 30) can move an amount of earth per minute equal to the lifting capacity for a Strength of 8d+0 (Strength level of 24). This amount is 3.2 tons, so it can move about two hexagons of dirt a minute.

EXAMPLE: A tunnel-boring machine with the same Strength can move an amount of solid rock equal to the lifting capacity for a Strength of 6d+0 (Strength level of 18). This amount is 800 kilograms, so this machine can bore through about one hexagon of solid rock each two and a half minutes. If the hole to be bored was four hexagons in size, then it would bore one meter deep each ten minutes.

BODY ARMOR - Body armor in **Stuff!** is a subset of the vehicle rules. You are just armoring a small, articulated vehicle. However, while vehicles are armored by *weight*, people are armored by *area*. One hexagon of armor ten millimeters thick will have a mass of about 40 kilograms if it has a density of 5.3 (5.3 times the density of water). **Stuff!** uses this as default density because it is a nice median. Armor has a weight based on "lifting capacity" levels on the **EABA Universal Chart**, so 40 kilograms is a mass of +5. All armor calculations are done in terms of levels, and only the *final* result is converted into real-world terms. Each +3 levels in armor is 1d+0, with remainders being +1 or +2 to the amount.

The armor ratings are based on vehicle armor numbers, with a +3 for a person as a "land vehicle" of .1 hexagon volume (Size of -8) with .1 tons (2.5 hexagons) of armor. The stats of *one* hexagon of armor at various tech eras are below. If an armor combines materials from different tech eras, use the average, rounding towards the higher tech.

Material	Armor	Mass	Cost
Early Primitive(TL2)	+2	+5	-3
Primitive(TL3)	+3	+5	-2
Late Primitive(TL4)	+4	+5	-1
Early Basic(TL5)	+5	+5	-1
Basic(TL5)	+6	+5	+0
Late Basic(TL6)	+8	+5	+1
Early Industrial(TL7)	+10	+5	+1
Industrial(TL8)	+12	+5	+2
Late Industrial(TL8)	+14	+5	+3
Early Atomic(TL9)	+16	+5	+3
Atomic(TL10)	+18	+5	+4
Late Atomic(TL12)	+20	+5	+5
Early Post-Atomic(TL13)	+22	+5	+5
Post-Atomic(TL14)	+24	+5	+6
Late Post-Atomic(TL15)	+26	+5	+7
Early Advanced(TL16)	+28	+5	+7
Advanced(TL17)	+30	+5	+8
Late Advanced (TL18)	+32	+5	+9

EXAMPLE: A one hexagon area of Basic Era armor has a rating of +6 (2d+0), has a mass of +5 (40 kilograms) and a cost of +0 (1,000 Credits).

The Bronze Age would be Early Primitive Era, the Roman Empire would be Primitive to Late Primitive Era, and most of what you consider medieval armor would be Early Basic or Basic Era. The protective ability of the *same* material often goes up with time because both the quality of the material improves (modern steel vs. archaic iron) *and* because the material is used more efficiently.

Body coverage - Armor is seldom bought as a "whole body" affair. Bits and pieces of armor are acquired, mixed and matched. Soldiers might have helmets of a different rating than their torso armor, or might have their sword arm more protected than their shield arm. It takes about two-and-a-half hexagons of material to fully armor a person (+4 weight), mainly due of inefficiencies of overlapping pieces and contouring to match the human form. Within this total area, individual body parts will have the following mass and cost. Apply a -3 to weight and -2 to cost if an area is covered on just the front or back (if applicable). Armor cost for the hands and feet assumes the armor is detailed enough for normal Agility rolls for using objects and maintaining footing in poor conditions. Mitten-like gauntlets or boots with a limited range of motion are -2 to cost.

Body area/sub area	Mass	Cost
Head and neck(3-6)	-7	-4
Face(3-4)	-13	-9
Neck(5)	-13	-9
Skull(6)	-10	-6
Skull+back of neck(5-6)	-9	-5
Each arm(7-8)	-6	-3
Upper arm (incl. elbow)(7)	-10	-6
Lower arm (not incl. hand)(8)	-10	-7
Upper+lower arm(7-8)	-7	-5
Hand(8)	-13	-4
Torso(9-12)	-2	-1
Shoulders(9)	-13	-7
Chest(10)	-6	-4
Abdomen(11)	-6	-4
Chest+abdomen(10-11)	-3	-2
Hips(12)	-13	-7
Groin(12)	-13	-7
Each leg(13-18)	-3	-1
Upper leg(incl. knee)(13-14)	-6	-3
Lower leg(not incl. foot)(15-16)	-8	-5
Upper+lower leg(13-16)	-4	-2
Foot(17-18)	-10	-5
Whole body	+4	+3
Small shield(+2 block)	-6	-5
Large shield(+4 block)	-5	-4

EXAMPLE: You want to make a default Basic Era cuirass (torso plate), to provide chest and abdomen protection in just the front. This would be:

Item	Armor	Mass	Cost
Basic Era	+6	+5	+0
Chest+abdomen	-	-3	-2
Front only	-	-3	-2
Total levels	+6	-1	-4
Total	2d+0	8kg	250Cr

Thicker/thinner - Armors are available in any thickness within reason. Weight/cost adjustments are according to the following profile:

Bonus/penalty	Armor	Mass	Cost
each -3(x1/2 thickness)	-3	-3	-2
each -2(x5/8 thickness)	-2	-2	-2
each -1(x4/5 thickness)	-1	-1	-1
default thickness	+0	+0	+0
each +1(x5/4 thickness)	+1	+1	+1
each +2(x8/5 thickness)	+2	+2	+2
each +3(x2 thickness)	+3	+3	+2

These add together as needed. An armor that is +4 thicker than normal would use the +3 and +1 rows to get the total adjustment to weight and cost. An important thing to note is that any padded armor with no more than -6 penalty from reduced thickness will always provide at least 0d+1 in protection, no matter what other modifiers are tacked on. So, even a thin Early Primitive Era armor like padded cloth will always provide at least 0d+1 protection as long as it is does not take more than -6 from reduced thickness. This is analogous to a vehicle always having at least 1d+0 armor, even if no armor was bought for it. Similarly, any armor with no more than -9 penalty from reduced thickness will always provide 0d+1 protection from cuts and abrasions. This is simply heavy cloth. It has no effect on punctures or blunt trauma, but it can save you from minor scrapes.

It is impractical to wear armor that is thicker than normal (10mm) on the hands if you want any sort of manual dexterity. Because of the overlap of rigid plates at the joints, it is also impractical to wear armor that is more than +3 thicker than normal anywhere else, which would be 20mm of armor.

Note - If you want to compare commonly used measures for metal or leather thickness to the terms in **Stuff!**, see below. This is not perfectly accurate in terms of the thickness conversions, but it is the best numbers to use to get real-world results.

Thickness	Armor	Mass	Cost
6 gauge/13 ounce	-3	-3	-2
8 gauge/11 ounce	-4	-4	-3
10 gauge/9 ounce	-5	-5	-4
12 gauge/7 ounce	-6	-6	-4
14 gauge/5 ounce	-7	-7	-5
16 gauge/4 ounce	-8	-8	-6
18 gauge/3 ounce	-9	-9	-6
20 gauge/3 ounce	-10	-10	-7
22 gauge/2 ounce	-11	-11	-8

If you are in the SCA, metal fighting armor would be a *minimum* of 16ga mild steel, and is probably counted as Industrial Era material.

EXAMPLE: You decide to throw together a set of Late Basic Era gauntlets. Using info you found on a site that makes recreations of medieval armor, you see that they make some that are 16 gauge steel. Each gauntlet has the following description:

Item	Armor	Mass	Cost
Late Basic(TL6)	+8	+5	+1
Melee armor	+3	+0	+2
Hand coverage	+0	-10	-4
Heavy armor	+2	+2	+1
16 gauge metal	-8	-8	-6
Total levels	+5	-11	-6
Total	1d+2	1.0kg	125Cr

So a pair of these gauntlets will have a mass of 2.0 kilograms and cost 250 Credits.

Note - A normal sheet of paper (letter or A4) has an area of about .08 hexagons (about a mass modifier of -11). If trying to armor part of your body, just see how many sheets of paper it takes! Then see how many it takes if you are wearing padding (put on a coat first).

Armor modifiers - Armor can be made of a variety of materials. Bronze is heavier than iron, while aluminum is lighter, and leather is lighter still. These materials have different protective abilities for the same thickness of material. Armor can have weight modifiers and type modifiers. The default for armor is normal weight, normal composition and rigid in nature.

Weight modifiers	Armor	Mass	Cost
Very lightweight	-4	-5	-1
Lightweight	-2	-2	+0
Normal	+0	+0	+0
Heavy	+2	+2	+1
Very heavy	+4	+3	+5

Type modifiers	Armor	Mass	Cost
Melee	+3	+0	+2
Normal	+0	+0	+0
Ballistic	-2	+0	+1
Organic	+1	+0	-2
Ablative	+3	+0	+0
Rigid	+0	+0	+0
Flexible	+0	-1	+1
Padded	+1	+0	+1
Skintight	+0	-2	+2
Enhanced	+0	+2	+1
Transparent	-3	+0	+3
Hardened	+0	+0	+2
Low grade	-3	+0	-1
Advanced	+1	+0	+1
Crude	+0	+0	-2
Special effect	-6	+0	+2

The ratings, weights and cost take into account that you are ending up with the same *thickness* as the default armor, but ending up with a different weight and protective ability for that thickness. For instance, a 10mm piece of Kevlar (very lightweight) is not going to stop things as well as a 10mm piece of steel (heavy). The steel is going to be +6 better, but it is also going to be several times heavier. In some cases, you may be limited in the material you use by the guidelines on how thick a piece of body armor can be without restricting the wearer's movement.

Keep in mind that for any sort of historical purposes, not all armor types and modifiers are going to be available. For instance, very heavy armor requires the discovery and ability to work elements that are not even discovered until the Industrial or Atomic Era.

The full list of armor modifiers is below, starting with material types, followed by construction methods and material properties.

Very lightweight: This is materials that have a density of less than 2. This includes most types of fabric, including those used in bulletproof vests, leather, wood, bone, wicker, plastic and such.

EXAMPLE: If you wanted to make an Atomic Era bulletproof vest suitable for stopping most pistol rounds, it would look like this:

Item	Armor	Mass	Cost
Atomic Era	+18	+5	+4
Chest+abdomen	+0	-3	-2
Very lightweight	-4	-5	-1
Flexible	+0	-1	+1
Ballistic	-2	+0	+1
Decreased thickness	-5	-5	-4
Total levels	+7	-9	-1
Total	2d+1	1.5kg	700Cr

Very lightweight armors are the lightest armor for a given level of protection, but also the most costly.

Lightweight: This is materials that have a density of around 3. This includes aluminum alloys, titanium, cermet composites, wood with a thin metal facing, or a mix of leather and metal rings. High density synthetic composites can be lightweight armors. Lightweight armors are simply a more expensive way of getting the effects of reduced thickness, and you would use them because it the nature of the material available, not because it is superior from an armoring standpoint. If you are going to use aluminum, you are using a lightweight material. Lightweight materials are often used in vehicles because the increased thickness for the same protection allows the armor to be used as a structural frame.

Normal: This is materials that have a density of around 5.3, the same as a heavy metal-faced wood, steel with composite backing, or steel in some sort of flexible form with numerous small openings (like chainmail). Chainmail can also be counted as a heavy armor, it really just depends on the method of construction and materials used.

Heavy: This is materials that have a density of around 8, roughly the same as steel. You can use the same numbers for bronze, even though bronze *is* heavier than steel. A copper-tin bronze would simply be counted as a fraction of a tech era more primitive than an equivalent iron-based armor. The cost of heavy armor assumes that iron, steel or bronze is readily available and workable, and heavy armor is the least expensive armor type for a given level of protection. It is just a cheaper way of getting the effects of increased thickness.

Very heavy: This is materials that have a density of around 12, which is getting into exotic and/or hard to work materials like depleted uranium and tungsten. Very heavy armors are the thinnest for a given level of protection, but generally are not available until at least the Late Industrial Era.

Note - For a given level of mass, combinations of armor materials and increased and decreased thickness *that give the same mass* give results like this:

Armor	Armor	Mass	Cost
Very lightweight	+1	+0	+3
Lightweight	+0	+0	+2
Normal	+0	+0	+0
Heavy	+0	+0	-1
Very heavy	+0	+0	+2

So, if you really need the maximum armor value *for a given weight*, you use very lightweight armor (use very heavy armor if you need maximum armor value *for a given thickness*). If you've got a lot of armor to buy, heavy armor is cheapest. Everything else is just gameworld special effects. Tanks don't use very lightweight armor because it would be so thick that there wouldn't be any room inside the tank (very lightweight armor is about four times thicker for the same protection than a heavy armor like steel). Armies have to protect thousands to millions of people, and heavy steel is cheapest.

Melee: This is the first and one of the most important type modifiers. It represents that there is a fundamental difference between armors designed to stop low velocity blows and projectiles, and those designed to stop firearms and other high-tech attacks. Melee armor is designed with space between the armor surface and the body (often with padding), and it can move with an impact, helping to soften the blow. These characteristics are very useful against blades and blunt impacts, but useless against modern firearms. Melee armor is going to be inappropriate against firearms and will lose -3 of protection (exactly the same amount gained by this modifier on armor type). Applying the hardening modifier to a melee armor simply hardens it against armor-piercing *melee* attacks.

Note - Anywhere at or past the Industrial Era, armors are generally more concerned about firearms, and armor that is proof against firearms is generally proof against melee weapons, even without this modifier. Sports gear generally *does* use the melee modifier, usually in combination with very lightweight materials, to get a lightweight armor very good at resisting impacts, but unsuited for stopping modern projectile weapons.

Normal: This is the default nature of an armor material. It provides no extra bonus against melee attacks, and it is considered inappropriate against modern firearms, though it will act normally against energy weapons that have no real transfer of momentum (like lasers). Most steels at the Industrial Era would be normal armors. They are strong enough to resist firearms compared to previous era steels, but have not become inherently resistant to high velocity projectiles. Compare the ratings and costs of Industrial Era normal steel and ballistic steel, *after* taking into account the armor-piercing effect of firearms.

Item	Armor	Mass	Cost
Industrial Era normal	+0	+0	+0
Industrial Era ballistic	+1	+0	+1

Since most gameworlds are going to deal with melee weapons or guns, most armors will have either the ballistic *or* melee modifiers. Incidental or improvised body armor will usually be normal armor.

Ballistic: This is the other end of the armor spectrum. It is *only* available on armor of at least Industrial Era. In exchange for the penalty on armor, it counts as normal armor against high-velocity projectiles like those from conventional firearms and gauss rifles. Part of the penalty on armor for this modifier is the difference between a vehicle and a person. A hit that penetrates a vehicle can still be harmlessly stopped by the structure of the vehicle. In the case of body armor, the person *is* the "vehicle structure". For melee armor, the person has the benefit of their armor being able to move with the blow and open space underneath to allow non-damaging partial penetrations, neither of which is available with ballistic armor.

Note - If you wanted an armor for resisting both melee attacks and modern weapons, you would design it with both melee *and* ballistic modifiers. It would be slightly better than a regular ballistic armor against bullets, slightly worse than a normal melee armor against melee attacks, and about twice as expensive as either one alone. A suit of riot armor might be an example of such.

Organic: Many organic materials like wood or leather have some inherent "give", and can absorb blows by flexing and springing back. Since the material is presumably out there for the taking (like wood or animal hides), the cost is much reduced. However, organic materials are almost always very lightweight armors, and usually flammable to some degree. An armor that is part organic (like metal scales on leather backing) would be lightweight and the organic modifier on cost would be -1 instead of -2. Organic materials are never better than Late Primitive Era in effect, and if used in combination with a more advanced material, the organic part would be counted as Late Primitive Era and you would use the average of the tech eras.

EXAMPLE: If you wanted to make a Basic Era cuirass of leather with metal rings riveted to it, it would average to an Early Basic Era armor, and it would look like this:

Item	Armor	Mass	Cost
Early Basic(TL5)	+5	+5	-1
Chest+abdomen	-	-3	-2
Melee	+3	+0	+2
Lightweight	-2	-2	+0
Decreased thickness	-2	-2	-2
Organic	+1	+0	-1
Total levels	+2	-2	-4
Total	1d+2	8kg	250Cr

Organic materials are almost always counted as inappropriate armor against firearms and other high-tech weapons, though this is because they are primitive armors, and is not cumulative with other inappropriate armor effects.

Note - The organic modifier is really just a "gimme" to help out armors at the low end of the tech scale. The strictly linear armor progression with tech era doesn't work without a few tweaks like this.

Ablative: This is an armor that uses a permanent deformation or destruction of its structure to absorb energy more efficiently. This makes it more effective against certain forms of attack, but at the cost of taking permanent damage. An ablative armor can be any type or tech era. It gets +3 protection against a type of attack, but any attack that is equal or greater than the *base* protective value of the material or the actual level of protection (whichever is lower) will permanently reduce the level of the armor by 1d, after the attack resolves its damage. This is cumulative and multiple attacks can eventually destroy the armor.

EXAMPLE: An Atomic Era bulletproof assault vest might be made with ablative ceramic plates. If the armor is normally rated at 5d+1, then the ablative plate version is 6d+1. However, any attack that does 5d+1 or more will reduce the rating of the vest by 1d.

If an armor has an ablative layer *over* a regular layer of armor, this is handled using the normal armor layering rules (the smaller layer is halved). The two layers (normal and ablative) will have a combined armor rating, but any attack which equals or exceeds the non-halved contribution of the ablative layer will cause it to be reduced. Ablative layers have to be the outermost layer of any layered armor.

EXAMPLE: An Atomic Era bulletproof assault vest might be made of steel plates with thinner ablative ceramic plates on top, covering just the chest and abdomen. The ablative plates look like this:

Item	Armor	Mass	Cost
Atomic Era	+18	+5	+4
Chest+abdomen	+0	-3	-2
Ballistic	-2	+0	+1
Ablative	+3	+0	+0
Decreased thickness	-10	-10	-7
Total levels	+9	-8	-4
Total	3d+0	2.0kg	500Cr

If the steel armor is normally rated at 4d+0 and the ceramic plates are 3d+0, then the combined armor is 5d+2 (since we halve the 3d+0 contribution of the ceramic to 1d+2). However, any attack that does 3d+0 or more (the plate rating) will reduce the rating of the ablative part by 1d (down to 2d+0), which means that the overall rating would drop to 5d+0 after one hit (the 2d+0 of remaining ceramic is halved to 1d+0). Another hit would drop the plates to 1d+0, and the total to 4d+2, and the plates would be shattered after the one more hit, leaving only the 4d+0 of the underlying steel. The combo of steel and ceramic plates has a total mass of 10 kilograms, but an armor of steel alone with a 6d+0 rating would have a mass of 32 kilograms, and one with a rating of 5d+0 would mass 16 kilograms.

Whether or not an ablative armor is worth it depends on how many times you think you're going to get hit, and how easy it is to replace bits of broken armor.

While the types of damage that ablative armor could possibly be applied to will vary within a gameworld, the following is a good start: Shaped charge, plasma, re-entry, laser, blunt, bullet.

Rigid: This is the default type for armor. It is made up of some sort of rigid plates, flat or curved, whether interlocked or separate units, with a lot of direct body contact to the armor surface. Rigid armor can sometimes be worn concealed, but is fairly easy to spot most of the time. Rigid armor cannot be layered with other rigid armor. Rigid armor on the torso is an *extra* -1 penalty on Agility and Agility-based skill rolls per -1d of encumbrance. This also reduces the effective Agility available for dodging purposes.

EXAMPLE: An adventurer encumbered to a -1d level while wearing a rigid torso armor would take a 1d+1 penalty on their Agility rolls (instead of a 1d penalty), a -2 on Agility-based skill rolls (instead of a -1) and available Agility for dodge purposes would be reduced by 1d+1 as well (instead of a 1d reduction).

For extremities, a rigid armor with the melee modifier is usually supported at one or both ends with lacing or hinges to give it a limited suspension and ability to move. For instance, the arm pieces may be supported somewhat off the shoulders, and leg pieces may hang off the hips.

Flexible: Armors that are flexible have no extra resistance to being penetrated by attacks, but they are easier to wear, fit closer to the body and are more mass-efficient (try pulling a stocking cap over a motorcycle helmet to get a feel for the extra material required for just that level of spacing between armor and skin). Flexible armors also transmit more of the impact to anything behind them. *A flexible bulletproof cloth wrapped around your head might stop a bullet, but would not keep your skull from being turned into broken chunks!* Flexible armors are inappropriate against blunt trauma (like a mace or a punch) or or sharp piercing attacks (like a stiletto). The benefit of flexible armor is that it is can be worn under a regular rigid or enhanced armor, and is +3 difficulty to be spotted if it is a concealed armor.

An armor that is both flexible *and* hardened simply counts the attacks that would have been armor-piercing as normal. A modern example is a bulletproof vest that has been engineered to stop knife thrusts as well, something it would normally have been vulnerable to.

Padded: This is a modifier that simply represents the fact that many armors have a padded liner or are worn with a padded undergarment like a gambeson. This modifier simply folds this padded layer into a single piece of armor. Flexible, rigid, and enhanced armors can be padded, but the extra bulk from padding means that flexible armor worn loses any concealment bonus it has. Padded armors add an automatic +5°C to felt temperature for any heat exhaustion purposes. If multiple layers of armor are worn, only one can count as padded, and padding only counts if it is *under* the main protection of the armor material. A padded armor or a padded layer under a non-padded armor will always count as at least 0d+1 armor against blunt trauma attacks.

EXAMPLE: A piece of flexible leather with padding has a designed armor rating of 1d+0. This would normally go to 0d+0 against crushing attacks (because flexible armor is inappropriate against this type of attack and takes a -1d penalty), but because it has a layer of padding it provides 0d+1 protection instead.

Skintight: Only possible with certain materials at certain tech eras. The armor is made of a stretchy material or is custom fitted to a *particular* person, either way matching the exact contours of the body with very little waste. At low tech it would be a flexible material that could be tightly laced into place, while at higher tech it could be an elastic material or one which can be electrically altered, or even a spray-on coating. Skintight armors are generally flexible to gain the maximum benefit, but are not required to be. A skintight armor can be very easily concealed and is +6 difficulty to be spotted under clothing (+3 if it is rigid), but a skintight armor cannot use the melee or padded modifiers, or worn with any other armor layer under it.

EXAMPLE: Your high tech commando team has electro-active ballistic skivvies under their combat suits. This underlayer looks like this:

Item	Armor	Mass	Cost
Post-Atomic Era	+24	+5	+6
Full body	+0	+4	+3
Very lightweight	-4	-5	-1
Ballistic	-2	+0	+1
Flexible	+0	-1	+1
Skintight	+0	-1	+2
Decreased thickness	-12	-12	-8
Total levels	+6	-10	+4
Total	2d+0	1.3kg	4KCr

Worn under some other form of armor, the normal layering rules mean it will provide an extra 1d+0 protection.

Depending on the gameworld and the tech, skintight armors might be the only kind that can be worn inside spacesuits, powered armor and the like. These armors might also have an extra cost if they included sensors, force feedback or other goodies related to the control of a vehicle.

Consolidated data - Based on these modifiers and best guesses, different armor materials would have the following defaults for body armor. All of these assume the best possible modifiers for a *non-concealed* body armor. So they all include the "padded" modifier, even the materials normally associated with unpadded bulletproof vests. Simply apply thickness and location modifiers to get the final results.

Melee armors(Era)	Armor	Mass	Cost
Wood(EP)	+3	+0	-3
Flexible leather(P)	+4	-1	-1
Hardened leather(P)	+4	+0	-2
Bronze(P)	+9	+7	+2
Iron/leather scale(P)	+7	+4	+2
Iron chainmail(LP)	+8	+4	+3
Iron(LP)	+10	+7	+3
Mild steel(EB)	+11	+7	+3
Kydex plastic(A)	+15	+0	+4

Ballistic armors(Era)	Armor	Mass	Cost
Armor steel(EA)	+17	+7	+6
Advanced steel(A)	+19	+7	+7
Aluminum alloy(A)	+15	+3	+6
Titanium alloy(A)	+16	+3	+7
Kevlar fabric(A)	+13	-1	+6
Cermet plates(LA)	+17	+3	+7

EXAMPLE: You want to throw together a quick Late Atomic Era bulletproof vest that has a mass of 2.5kg (mass of -7), so you use the Kevlar fabric numbers and get:

Item	Armor	Mass	Cost
Kevlar fabric	+13	-1	+6
Chest+abdomen	+0	-3	-2
Decreased thickness	-3	-3	-2
Total levels	+10	-7	+2
Total	3d+1	2.5kg	2.0KCr

A hardened leather cuirass (front only) with the same final weight would be:

Item	Armor	Mass	Cost
Hardened leather	+4	+0	-2
Chest+abdomen	+0	-6	-4
Decreased thickness	-1	-1	-1
Total levels	+3	-7	-7
Total	1d+0	2.5kg	90Cr

ADVANCED TOPIC: GETTING IT ON

Sometimes the main concern for users or issuers of body armor is the time it takes to put it on. If it takes you an hour and three assistants to get you into your armor, it won't be much use if you are out adventuring on your own.

Take *half the mass level* of your armor or any given piece and add 12 to get a time level (with a minimum of 0). If you have the armor in hand and make an Average(7) Agility roll, you can get the armor on in that amount of time. You can do it in more or less time just by altering the difficulty of the roll by the time level shift (up to ±4). That is the default. The nature of the armor will adjust the time required.

Armor modifier	Time
Whole body armor	+0
Head only	-8
Torso only	-4
Arms only	-3
Legs only	-3
Melee armor	+1
Ballistic armor	-1
Rigid armor	+0
Flexible armor	-2
Padded armor	+1
Skintight armor	+3
Enhanced armor	-1
Crude	+1
Powered	+2
You have an assistant	-2
You have two assistants	-4

EXAMPLE: You have a suit of powered armor, which has a final mass of +6 (halved to +3) and the following modifiers: ballistic(-1), padded(+1), enhanced(-1), powered(+2), plus you have two people to help you get the thing on(-4), for a total of +0, plus 12 to get a time level of +12. With the help of two assistants, you can get the armor on and powered up in 1 minute, maybe a little less if you have a good Agility. Without your assistants, it will take you 4 minutes.

EXAMPLE: You have a mail shirt that has a mass of -1 (halved to +0) and the following modifiers: torso(-4), melee(+1), flexible(-2), padded(+1), for a total of -4, +12 to get a time level of +8. It takes about 16 seconds to shrug the thing on and lace it down.

EXAMPLE: You have a bulletproof vest that has a mass of -8 (halved to -4) and the following modifiers: torso(-4), ballistic(-1), flexible(-2), for a total of -11, +12 to get a time level of +1. You can throw it on over your shirt and slap down the velcro straps in a second or two.

Enhanced: This option is mainly for high-tech powered armor and the like. Powered armor rules are the next major section, so pay attention.

What it means is that the armor has room for a person *and* room for .1 hexagons of machinery under the armor. It is just like assuming a person is a .2 hexagon vehicle instead of .1 hexagon. They are bigger, therefore it takes more armor to cover them, which weighs and costs more for the same level of protection. Each doubling of mass over the norm can use this, or each halving can use the inverse, so you can apply the modifier multiple times to get extra space for cramming in more gizmos, or make body armor for a giant or a dwarf. Each three times this modifier is taken effectively doubles the height of the armor and makes the wearer 2 points easier to be hit (2 points of size difference). If you need intermediate values, do the following:

Type modifiers	Mass	Cost
Enhanced x 1/2(.15 hexagon)	+1	+1
Enhanced x 1(.2 hexagon)	+2	+1
Enhanced x 1.5(.3 hexagon)	+3	+2
Enhanced x 2(.4 hexagon)	+4	+2

EXAMPLE: If you were making body armor for a 400 kilogram giant, you would apply this modifier twice to get the weight and cost of his armor (+4 mass and +2 cost). If you wanted to make a power armor that had .2 hexagons of machinery and .1 hexagons of person, you would take the x1.5 level (+3 mass and +2 cost).

Transparent: Like glass or bulletproof glass. Transparent armors have an armor rating 1d+0 less than normal. Most forms of glass are lightweight materials, while most plastics are very lightweight materials.

Hardened: The armor is resistant to armor-piercing attacks from that tech era and *earlier* eras. It does not change armor rating or weight, only the cost. Optionally, an armor can have "limited hardening" for +1 cost instead of +2. This is for specialized cases where an armor style or material provides protection against a subset of an attack type it normally does not protect well against. Limited hardening has one of two limits, chosen based on the properties of the armor. It can either have no effect on attacks larger than 1d+0, or it has no effect on attacks that equal or exceed the armor's rating.

EXAMPLE: Silk can be made into a flexible body armor which can be effective against low-velocity handgun rounds. So, even though it is an organic and low tech material, you could say that silk armor is hardened against guns doing 1d+0 or less (such guns would normally ignore the first 1d of organic armors). More powerful guns would overcome the tensile strength of the silk and would ignore the first 1d+0 of the silk armor's protection.

Low grade: If armor is made out of a non-armor quality material it takes this modifier. Improvising a piece of armor out of scrap steel or aluminum you find lying around would be an example. Regular window glass would be a low-grade transparent armor. Low grade armor is never going to be hardened. Another way of looking at low grade armor is to simply say it is a fraction of a tech era behind normal armor.

Advanced: If an armor is technologically superior to its counterparts, but is technically within the same tech era or fraction of an era, you can apply this modifier. The armor is a point better than other armors, but also costs about forty percent more.

EXAMPLE: You might say that silk armor is better than other cloth armor, or that mail armor is superior to other flexible armors available when it was introduced.

Crude: This is an armor that is "slapped on". It might or might not be low grade material, but the fit and finish leaves a bit to be desired from both an appearance and efficiency standpoint. Taking a piece of hide and strapping it to your torso with leather thongs is a crude armor. It may chafe and have spots with no coverage, but where it does cover is protected as well as a professionally fitted armor of the same material. The basic modifier (-2 to cost) cuts the cost to half normal,which would be about right for poorly fitted, one-size-fits-all or cheaply mass-produced pieces but depending on circumstance it could drop even more, with the "hide strapped to your body" being perhaps a -8 to cost.

POWERED ARMOR & ROBOTS - Obviously, the manipulator rules and body armor rules are just begging to be used together. It is a complex topic and includes advanced rules from other sections as well. Important ground rules:

Powered armor is built like a vehicle and armored like body armor. It *does* take the -9 Strength penalty for "manipulators", but *does not* count overall vehicle size for determining Strength. If the motive source for the powered armor conks out, you would figure the numbers based on the wearer's Strength.

A useful volume is to assume the armor is a 100 millihex device that has a total volume of 200 millihexes. That is, all the vehicle components have to fit in a 100 millihex volume that surrounds an additional 100 millihexes of person. This would be a body armor as for one use of the "enhanced armor" modifier. If you need extra room, you can adjust the modifier and have 300 millihexes of vehicle and 100 millihexes of person. Remember that in any case, the person has a mass of *up to* 100 kilograms.

If you want to use these rules to make replacement (normal size) artificial limbs, they would have volumes as follows:

Limb	Volume	Strength penalty
Arm	8 millihex	-21
Hand	2 millihex	-27
Leg	17 millihex	-18
Foot	4 millihex	-24
Body	41 millihex	-14
Head	8 millihex	-21
Whole body	100 millihex	-10

A head is just a place to put electronics or components, though if attached to a body we suppose you could use it for a robotic "head butt". You can use more or less volume than is listed, but Strength will be proportionately affected.

EXAMPLE: A child-sized robot might be half the size, which would be an extra -3 on the Strength of all the limbs.

Note - For a .2 hexagon powered armor, all of this optimistically assumes a minimal amount of wasted space and that everything you need to fit inside the armor can on average be housed within about 15 centimeters of the person wearing it.

The "Strength penalty" is the difference between a one hexagon power plant and the Strength of the limb. Hands and feet have the same Strength as the arm or leg they are a part of. A bionic limb has a Strength of the penalty for its size, and the mass of the person it is attached to, not its mass by itself. Bionic limbs have to act in concert with the organic parts they are attached to. For instance, the Strength of your bionic arm has to work with the whole weight of your body when trying to do chin-ups or push-ups.

The numbers on the previous table apply to *purely* robotic limbs. A limb that enhances an existing limb would *not* have an *inherent* Strength. Instead, the equivalent Strength is halved (round down) and becomes an addition to the Strength of the limb it is enhancing. The limb itself surrounds the limb it is enhancing. For purposes of powered armor or exoskeletons it is easier to say that the Strength of the armor is used to support its own weight, so it doesn't count for encumbrance purposes. Only the *leftover* Strength applies towards enhancing the ability of the wearer. This gets a bit tricky, so pay attention.

To do this, you first find the "lifting capacity" of the exoskeleton from the Strength of the most powerful part (typically the body). Then, subtract the weight of the exoskeleton *and its contents* from this amount and find the Strength that can lift this. The *difference* is the penalty to the limb Strength. You would do it this way instead of using total "vehicle" weight.

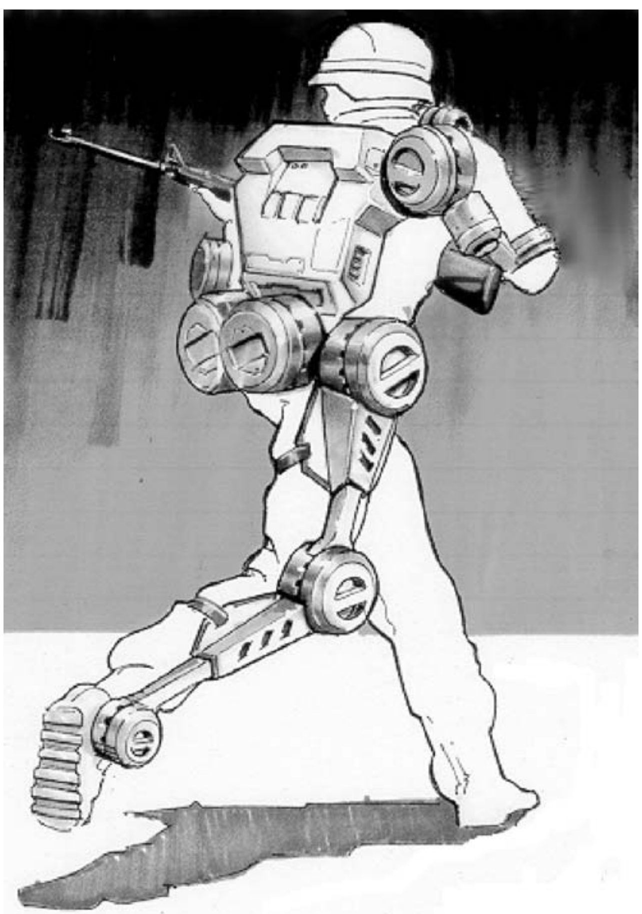
EXAMPLE: If your powered armor has a body Strength of +15 (5d+0), the **EABA Universal Chart** shows this is a lifting capacity of 400 kilograms. If the powered armor and the person inside had a total mass of 250 kilograms, then you would subtract 250 kilograms from 400 kilograms, leaving 150 kilograms. Looking back at the **EABA Universal Chart**, this is about the lifting capacity for a Strength of 11. This is four points difference from the armor Strength of 15, so all the limb strengths are reduced by 4 (to a Strength of 11). Since a "power assist" is halved, rounding down (to 5), this means that this particular power armor gives the user +5 to normal Strength *after* taking its own weight into account.

That sounds complicated, but you are just figuring the Strength that is left over after the armor has lifted itself *and* the person inside it, and halving the result for power assisted armor. For a robot, you would do the same process, but you *wouldn't* halve the result. So, the previous example as a robot would have a Strength of 11.

Quick design - Now that those basics are out of the way, the quick way to do powered armor is this:

1. Build a .1 hexagon or smaller power plant. This is the exoskeleton of your armor. It will have a -10 to Strength because of its size, and another -9 because of its extreme mobility suspension (i.e. manipulators). If you make the powerplant *exactly* .1 hexagon, you will have no room for any gizmos under the armor.
2. Add as much body armor as you think you can carry.
3. Use the weight of the armor, the (up to) 50 kilogram mass of the power plant and the weight of the person to get the empty armor weight.
4. Figure how much Strength the armor loses to carry itself. Half the remaining Strength is the bonus it gives to the user.
5. The top speed of the armor is based on its Strength and total weight, and the Strength the user can use for lifting and carrying is based on what it has left after step 4.

This armor will have a 5 hour fuel supply from the fuel that is included with the power plant, unless you altered its fuel efficiency. So, let's try it.



EXAMPLE: Build a 200 kilogram suit of powered armor at the Late Atomic Era.

Step 1. The power:

Item	Strength
Late Atomic Era	+32
.1 hexagon power plant	-10
Not air-breathing	-3
1/2x fuel efficiency	+3
Manipulators	-9
Modifier total	+13
Total	4d+1

Step 2. Create some body armor:

Item	Armor	Mass	Cost
Late Atomic Era	+20	+5	+5
Whole body	-	+4	+3
Ballistic	-2	+0	+1
Enhanced	+0	+2	+1
Lightweight	-2	-2	+0
Hardened	+0	+0	+2
Reduced thickness	-3	-3	-2
Total levels	+13	+6	+10
Total	4d+1	50kg	32KCr

Step 3. The power plant masses 50 kilograms, the armor masses 50 kilograms, and the user masses up to 100 kilograms, for a total of 200 kilograms.

Step 4. A Strength +13 can carry 252 kilograms, and the armor(occupied) is 200 kilograms. This leaves 52 kilograms of spare capacity, or a Strength of +6. This is counted as an assist to the wearer of half its value(+3), so this armor will give the wearer a +1d boost to Strength.

Step 5. We figure the performance out:

Item	Strength
Late Atomic Era	+32
.1 hexagon power plant	-10
Not air-breathing	-3
1/2x fuel efficiency	+3
Manipulators	-9
Vehicle weight of .2 tons	+7
Modifier total	+20
Total	6d+2

This gives the armor a speed of 21 meters per turn (76kph/47mph) and an acceleration of 5 meters per turn, or we could say that a Late Atomic Era armor is a 2d+1 boost to the wearer's Health for movement purposes (see page 3.45). For a person with a Health of 2d+2, this 2d+1 boost would give them a walk of 5 meters per turn, a run of 10 meters per turn, and a sprint of 15 meters per turn.

Note - If you wanted an exoskeleton to just affect running and/or lifting capacity, you would build it to hold half a person (from the waist down), with any extra carrying capacity being in a back-pack attached to the waist, so the upper torso is not encumbered by the weight (it is transferred directly to the legs and thence to the ground).

Robots - If you are making artificial limbs or humanoid robots, you would simply design an even smaller vehicle, and it would have various abilities appropriate to the level of its Attributes, rather than a normal vehicle top speed and acceleration, etc. The robot or artificial limb could be armored as needed, with any space not utilized in its body, head or limbs to put internal gizmos.

The brain of an independent or artificially intelligent robot would be created in the gizmos chapter and would be a separate cost.

Remember that bionic limbs are limited by the organic body they are attached to. They cannot normally exceed one-and-a-half the Strength of the person wearing them. Also remember that bionic limbs can also be done as gadgets using the paranormal power system. If you are going to use a particular technology in a gameworld, decide how you intend to implement it and stick with it. This includes using vehicle chapter or gadget chapter rules for making them (not both). A vehicle-design bionic arm is going to be similar but not identical to a paranormal-power or gadget-based bionic arm.

EXAMPLE: An Early Post-Atomic Era adventurer loses an arm and decides to get a bionic replacement. It would look something like this:

Item	Strength
Early Post-Atomic Era	+34
.008 hexagon power plant(the arm)	-21
Not air-breathing	-3
Manipulators	-9
Vehicle weight of .1 tons(the person)	+10
Modifier total	+11
Total	3d+1

This arm runs off some sort of internal power plant that has 5 hours worth of fuel. For simplicity's sake we didn't design it up with batteries and electric motors, but that's probably what it is. In order for a person to use this arm at full effect, they need a normal Strength of 2d+1 (2d+1 times one-and-a-half is 3d+1). A Strength of 2d+0 would only be sufficient to handle an arm of 3d+0 Strength.

Other considerations - A power plant for an artificial limb or exoskeleton has its own built-in fuel supply, good for 5 hours unless you tweak its fuel efficiency or build it solely as an externally powered manipulator. Batteries and powercells can also be used as "fuel" sources. While our example used a non-airbreathing power supply, you could just as easily say the armor is run off a tiny gas turbine or some other air-breathing engine.

We do recommend that you use the notes on how powered armor gives a bonus to Health for movement purposes rather than simply using its Strength to find a movement rate. This is especially the case for an exoskeleton. Even if the machinery is doing all the work, the person's limbs are still moving or being moved as the armor walks or runs, and this can be a form of exertion. If your armor is large enough to have a cockpit that a person can sit in, then this is not as much a consideration and you are dealing more with a walking vehicle than a suit of powered armor.

These rules can be used to make "giant robots" or "mecha". Each three times the "enhanced" modifier is taken in armor, the height doubles, and the interal volume increases by a factor of eight.

EXAMPLE: If you take the enhanced armor modifier nine times, your armor profile looks like this:

Item	Armor	Mass	Cost
Enhanced	+0	+18	+9

The armor is 16 meters tall, is +6 size for purposes of being hit in combat, and has a total internal volume of 51.2 hexagons. You could cram a *lot* of weapons and gizmos into that, and if would act like a large vehicle in that respect, but it would also be armored like a person, have hit locations like a person and could punch, kick, run and jump like a very, *very* large person.

Note! - Anything up to about 300 millihexes and shaped like a person (enhanced armor x1.5) will fit in any vehicle seat an overweight person can, though the upper end is a really tight fit and probably requires first class airline seats. Double the seat space requirements for 300 millihex robots or armor or beings, and increase it proportionately for each 300 millihexes after that. For instance, a 1.2 hexagon volume of robot would require four times the normal seating room and remember that headroom will be important too.

Exoskeletons can be partial, but this limits them. Powered external leg braces might enhance running or kicking, but will not enhance lifting (but might enhanced carrying). The natural spine and arm strength would be a limiting factor in many cases. A "power glove" that runs up an arm could deliver a mighty punch or crushing grip, but without a body harness, its ability to *lift* would be the *natural* shoulder strength of the wearer.

The numbers listed for limbs on page 3.55 are for a human-sized or human-encasing set of limbs. In the latter case it is enough to make a 200 millihex volume that encloses a 100 millihex volume (the person), and people, unlike equipment, have a mass of 1 kilogram per millihex. If you are building a robot rather than an exoskeleton, there is still a useful volume of 100 millihexes for a human-sized robot, but the space is around and between limb and structural components, rather than outside them like an exoskeleton would be. The volume taken is the same, but the way it look inside is different. The default weight would be 50 kilograms, but its armor would only be the default of 1d+0. Any extra armor would be bought as body armor, and would add weight.

If you want to put extra equipment under armor, that would affect the total volume taken by an exoskeleton or robot for structure and armor purposes, but it does not affect the volume needed for human-sized limbs. Remember that the volume of human-sized limbs is just the external dimensions. You do not have to completely fill them with "power plant". An 8 millihex arm could have 4 millihexes of power plant and a 4 millihex weapon. And, you can always mount things externally to the robot or limb or exoskeleton. These externally mounted items would only have their own armor rating to protect against damage, and do count towards the total carried weight of the armor for mobility purposes.

That covers more than you should ever need for body armor and related topics. Now, one more *really* esoteric topic and then we'll move to the next section.

HYPERDRIVE - This is the one vehicle mobility item that isn't designed in this chapter. A hyperdrive or warp drive or whatever is designed as a "weapon" and counts as a gizmo. *Why?* Because it's easier that way. For purposes of **EABA**, a hyperdrive is a big chunk of machinery and electronics and god-only-knows what else. You push a button, and you disappear from normal space and reappear somewhere else, hopefully in *less* time than it would take the speed of light to get there, during which the ship is incommunicado from the rest of the universe and can't be attacked or attack anything else. The generic hyperdrive requires a lot of energy to charge, and can only be operated far from interfering gravity wells.

How do you design this as a weapon? A hyperdrive will be built as a 0° arc vehicle weapon whose tech era and size combine to be at least +54(18d+0) damage. We presume this requires at least Post-Atomic Era technology, but if you want to design a monstrously large Atomic Era hyperdrive, you can. This gets you a hyperdrive that can traverse a one hundred ton vehicle (Mass level of +39) a distance of one light year (a Distance level of about +107, if you're interested) in one hundred hours (about 4 days, or a Time level of 37). Each +3 of hyperdrive capability is either +3 to the mass that can be moved,+2 to the distance that can be traversed in one hundred hours or -2 to the time it takes to make the trip (doubling the maximum jump distance for a given time and halving the time for a given distance are not quite the same thing). You may scale this in the other direction if you want, and smaller changes are allowed.

Item	Mass		Dist.		Time
Hyperdrive +1	+1	or	+1	or	-1
Hyperdrive +2	+2	or	+1	or	-1
Hyperdrive +3	+3	or	+2	or	-2
Hyperdrive +4	+4	or	+2	or	-2
Hyperdrive +5	+5	or	+3	or	-3
Hyperdrive +6	+6	or	+3	or	-3

EXAMPLE: An Advanced Era(+42) hyperdrive will require 16 hexagons(+12) of space (8 tons) to get the +54 capability needed to move a hundred tons one light year in one hundred hours. A hyperdrive that has +9 over this (three +3 modifiers) will take 128 hexagons of space (64 tons), but can move an eight hundred ton ship one light year in one hundred hours, a one hundred ton ship eight light years in one hundred hours, or a one hundred ton ship one light year in twelve and a half hours, or any permutation that involves the required factors of two. Supposedly, you could also make a hyperdrive with -3 capacity. This would take 8 hexagons of space (4 tons), but have half the capacity in terms of mass and/or speed.

Hyperdrives take time to charge up. This is one hour (Time level of 24) for a power plant whose Strength is the same as the dice in the hyperdrive. Proportionately more if the power plant is smaller, less if it is bigger. Each die more or less than that of the hyperdrive halves or doubles the time.

EXAMPLE: We use an Advanced Era power plant with an adjusted output of 16d+0 to charge the hyperdrive. Since this is 2d+0 less than the 18d+0 default of a hyperdrive, the time is doubled twice, to four hours for hyperdrive preparation.

Obviously, a vehicle power plant charging a hyperdrive is *not* being used to provide movement for the vehicle.

Gravity wells are a problem for hyperdrives. Traditionally, you can't jump out of one, and you end a jump if your path across real space traverses one. The easiest way to figure this in **EABA** is to say an Earth-like body is a "distance" of 1 meter (Distance level of 3), and the safe jump distance is +60 distance. For planets with a gravity different than Earth, you just compare their gravity to an Earth rating of "1".

EXAMPLE: If Earth is at Distance level +3, then the safe jump distance is +63 (1 million kilometers). For Mars, which has a gravity closer to a distance of +0, the distance would be +60 (350,000 kilometers), and for Jupiter's gravity of 12 gees (distance of +10), the distance would be +70 (11,000,000 kilometers). A star like the Sun would have a distance of around +73 (32,000,000 kilometers).

Youcan alter the nature of interstellar travel in a gameworld just by tweaking the constant. If you made it +70 instead of +60, then you would need to get a billion kilometers from the sun in order to be able to activate a hyperdrive, and for us, that would be out past the orbit of Jupiter.

The hyperdrive rules are a basic framework that you can hang *any* FTL technology off of. Just keep it internally consistent. Some examples:

A "warp gate" that ships could pass through would be counted as a hyperdrive, but would have a "360° arc" modifier (you have to make it bigger). A hyperdrive that moves you into and through a "hyperspace" would be exactly the same, and the basic drive gets you a speed of about 300 times the speed of light. A "warp drive" that speeds you through normal space and lets you see stars pass by the portholes would be a hyperdrive that has a continuous power requirement of the total in the drive with a -12 modifier, and has no charging time.

Note! - If using a comparison to a popular fictional system, the following hyperdrive numbers are needed:

Warp speed	Lightspeed	Hyperdrive
1	≈1x	10d+0
1.3	≈2.2x	11d+0
1.7	≈4.5x	12d+0
1.9	≈9x	13d+0
2	≈11x	13d+1
2.5	≈18x	14d+0
3	≈35x	15d+0
3.7	≈70x	16d+0
4	≈110x	16d+2
4.3	≈140x	17d+0
5	≈215x	17d+2
5.7	≈285x	18d+0
6	≈350x	18d+1
6.7	≈570x	19d+0
7	≈700x	19d+1
8	≈1100x	20d+0
9	≈1400x	20d+1
9.3	≈1800x	20d+2
9.7	≈2300x	21d+0
9.9	≈2900x	21d+1

Trying to go faster than warp 9.9 may be quite hazardous to the part of the spacetime continuum where your ship happens to be, not to mention hazardous to the ship as well...

EXAMPLE: Say you want to make a 1,600 ton Post-Atomic Era "warp freighter". To get the default +54 Strength(18d+0) required at Post-Atomic Era (+36) takes 64 hexagons(+18) of "warp drive". To push a 1,600 ton ship means we either have to give up -12 of capacity (four doublings of the default 100 ton capacity), or make the warp drive big enough to have +12 (sixteen times bigger!), or something in between. We dcecide to go the slow route, and accept -4d of capacity (down to 14d+0). From the table above, we can see that this is a speed of "warp 2.5", about 18 times the speed of light. Now, even though we accepted reduced capacity, this warp drive *still* requires a +42 Strength (14d+0) power plant to run it (base of +54, -12 for "warp drive"). A Post-Atomic Era fusion reactor might be:

Item	Strength
Post-Atomic Era	+36
250 hexagon power plant	+24
Not air-breathing	-3
Fusion fuel	+10
125x fuel efficiency	-21
Power generation	-3
Modifier total	+43
Total	14d+1

So, we have 62 tons of warp drive, 125 tons of reactor, and we need 250 hexagons (125 tons) of deuterium per 7 months to run it. At 18 times the speed of light, a run to Alpha Centauri (4.3 light years) would take 87 days (about 3 months), and so a round trip requires around 100 tons of fuel. Adding the drive, reactor and say 125 tons of fuel together leaves us about 1300 tons for the rest of the ship.

Looking at the power plant output notes on page 3.15, we can see that a 14d+1 reactor is about 5 megawatts worth, and that a 14d+0 warp drive consumes about 4 megawatts worth, leaving 1 megawatt or 12d+0 Strength for other purposes.

This covers all the advanced design rules. Now, for some advanced rules regarding tearing apart what you have just built.

HOW DO I BLOW IT UP? - Once you get to the point where you have to start blowing up your creations, things get more interesting.

Damage Limit - As mentioned earlier, there are exceptions to damage limit. Explosions can alter damage limit, and affects that cover the entire vehicle can even negate it. Things that damage limit will *usually* not apply to:

- Vehicle collisions
- Re-entry damage
- Falling damage
- Crushing damage on pressure hulls

Vehicles of exceptionally large size might still have damage limit apply to some degree, or the nature of the damage might adjust it. For instance, if you add 15 to the damage limit in all these cases, things still work out the same for small vehicles, but large ones still get *some* damage limit effect.

EXAMPLE: A battleship has a damage limit of somewhere around -10. It's very hard to get an attack that will actually do any of its Hits. However, if you run a battleship into another one, you would count it as a damage limit of -10 plus 15 equals 5. The battleship would not take *all* its Hits in such a collision, but it would take more than enough to notice it. And repairing *any* Hits on a battleship is very expensive...

Similarly, puncturing attacks that are physically large enough can end up doing hits to even a huge vessel. Even a dud round from a battleship is going to leave a noticeable hole in a destroyer, even if the destroyer has a damage limit of zero or less (which it does). It could also be an application of the "battering power" modifier on a weapon.

If you want to use damage limit in this alternate way, simply count the very large but inert attack as a battering attack. A quick way: Drop the damage of the attack by a third, then increase the Damage Limit of the vehicle by 1 for each +2d remaining.

EXAMPLE: You have a tanker with an armor of 2d+0 and a damage limit of -4 that is hit by a 15d+0 cannon shell. *Wham!* Drop the damage of the shell by a third (to 10d+0). The damage limit is raised by 1 for each +2d remaining, so the damage limit goes from -4 to +1. The tanker takes 1 Hit from this attack.

Note - As an example of damage limit in action, in 1987CE an Iranian off-shore platform (used as a weapon emplacement) in the Rostam oil field was attacked by several US destroyers. It was hit with *over 1,000* medium-size naval shells, and was only set on fire as a result. Special forces had to board it and plant explosives in order to sink it.

Repairs - Any time a vehicle loses Hits, it should probably look into getting repairs done. The time and cost involved depends on the vehicle, what was damaged, and the facilities available for the repair. The simplest case is that it takes a time level of the vehicle's Hits +10 to repair 1 Hit of damage, and +2 time for each Hit after that. This repairs any *functional* damage. The cosmetic damage does not involve the Hits of the vehicle, and will take longer.

EXAMPLE: A car with 10 Hits was in a minor accident and took 3 hits (for a normal car, this might be a 10kph fender-bender). A time level of 20 (10 Hits plus 10) is 15 minutes. A +4 time to repair 3 Hits makes 60 minutes. In one hour, a mechanic pulls the fender away from the wheel and replaces a punctured tire. The front end still *looks* bad, but everything *works* as good as new.

If you take less than the full amount of time, you get less repairs done. You get hits back in *reverse* order of time spent.

EXAMPLE: If you were in a hurry, the 3 Hits on the car could be partially repaired. It takes 60 minutes to repair all 3 hits. It takes 15 minutes to repair the first Hit, 30 minutes to repair the second Hit, and the rest of the hour to repair the last Hit of damage.

A skill roll is required for each Hit repaired, with a difficulty of the vehicle's total Hits -10 (with a minimum difficulty of Average(7)). This skill roll requires the efforts of a number of people equal to 1 minus one-third of the Strength adjustment for the vehicle's mass (page 3.4). The time modifiers for poor repair facilities and lack of repair crew will increase the difficulty of the roll in addition to increasing the time required. You use the average skill of the repair crew for making any repair rolls. Each doubling of repair crew may be used for a -2 difficulty on this roll instead of altering the time it takes. Similarly, you can also take quadruple the listed time (+4 time levels) to get a -2 on the difficulty of the task.

EXAMPLE: A vehicle that masses 500 tons has a Strength modifier of -27, and one-third of this is -9. This means that a basic repair roll requires 1 minus (-9) equals 10 people. A 500 ton vehicle has some *heavy* parts, and one person just isn't enough to get the job done. A 500 ton vehicle also has 28 Hits, so it will have a base difficulty on the repair of 28 Hits minus 10 equals 18. If the repair crew were 20 instead of 10, the difficulty could be dropped to 16, and if these 20 people took four times as long as normal, the difficulty could be dropped to 14.

There are plenty of modifiers on how long a repair will take.

Modifier	Repair time
Full repair facility	+0 time levels
Adequate repair facility	+2 time levels
Inadequate repair facility	+4 time levels
Barely adequate repair facility	+6 time levels
Jury-rigged repair	-4 time levels
All repair parts available	-2 time levels
Most repair parts available	+0 time levels
Reconstructed parts	+6 time levels
Sabotage repair	-2 time levels
Cosmetic repair	+6 time levels
Double crew (up to 4x)	-1 time level
Down to one-half crew	+2 time levels
Down to one-quarter crew	+4 time levels
Down to one-eighth crew	+6 time levels

Repair facility: The quality of the repair facility or tools available in the field. A full facility is one designed around repairing that kind of vehicle or damage. A full facility can be specialized enough that it can only repair some a vehicle's Hits. For instance, if your car was in an accident, it might go to one "full facility" for the body work, and another to repair any engine damage. An adequate facility is sufficient for the task or a very specific repair, but not nearly as good or flexible. A tire jack is an adequate repair facility for repairing tire damage, especially in combination with "all repair parts available"(spare tire). Inadequate and barely adequate facilities go down from there, with barely adequate being the minimum level of tools and equipment you could imagine anyone being able to manage the repair with. In general, "adequate" facilities for all the needs of a specific vehicle type (i.e. cars) is more stuff than you are likely to carry around in that type of vehicle. The best you could reasonably expect for any sort of a "toolbox" equivalent would be the "inadequate" or "barely adequate" modifiers.

Jury-rigged repair: This is a repair that is just barely functional. The vehicle will still have at least 1 Hit of damage on it, even after the repair. Any use of a specific system or gizmo that was damaged is at +4 difficulty. If the vehicle takes *any* damage, a new "repair roll" will have to be made. If this roll is failed, the repair fails *and* the vehicle loses all the Hits that were recovered *and* any systems or gizmos affected become inoperational. It may also have to make a "repair roll" every time it has to roll for being in a bad terrain (all that jouncing isn't good for things).

Parts: If it is just a matter of getting a part out of the spares bin and installing it, you have all the repair parts you need. If you have most of the parts, but have to customize or improvise to get it all working, that is most of the parts. Reconstructed parts means you have a lot of broken bits, and have to piece together something that works out of a bunch of things that don't (hello, duct tape!). If this last modifier is used, no more than half the vehicle's Hits can be repaired, and no more than half of any damaged gizmos or systems can be repaired, rounding up.

Sabotage: Damage from saboteurs is generally confined to a limited area, and this makes it easier to repair. On the other hand, the gamemaster can usually declare that any Hits lost due to sabotage can render a *specific* system non-functional just as if it has crossed the next highest damage threshold.

Cosmetic: It takes a while to undo the scrapes, burns, punctures, wrinkles and bends so that the vehicle looks as good as new. If you have all the repair parts available, this modifier is +0 time levels instead (when you replace the parts, it looks good as new).

Repair Crew: If you have more or less than the normal repair crew, the repair will take a different amount of time. If you have less than one-eighth the people needed, repairs may be impossible.

EXAMPLE: A 250 ton starship (26 hits) has taken 1 Hit of sabotage damage to the hyperdrive. The normal time for the repair is a Time level of 36, or 2.5 days, and will require a nine person repair crew (1 plus 8 for the Strength modifier on a ship this size). But, there is only a crew of two to do this, and they have to use some spares and cannibalize some parts from the ship to make the repair. In the end, the modifiers are:

Modifier	Repair time
Ship size	+36
Jury-rigged repair	-4
Most repair parts	+0
Sabotage repair	-2
Inadequate repair facility	+4
One-quarter repair crew	+4
Modifier total	+38
Total	5 days

The end result is a Time level of 38 and a final difficulty of 16 to successfully complete the repair. The jury rigged repair means the vehicle is *still* down 1 Hit, but the hyperdrive now works...sort of. If the ship takes *any* damage, a new roll at a difficulty of 16 is needed, or the makeshift repair fails and the ship is once again without a hyperdrive. And, any skill use involving use of the hyperdrive will be at +4 difficulty.

Repair cost: The first hit of damage on a vehicle will have a repair cost equal to the vehicle Cost level per ton, minus 20, plus 1 for each Hit the vehicle has.

EXAMPLE: An Atomic Era vehicle costs 4,000 Credits per ton (cost of +4), so if this vehicle had 10 Hits, the cost to repair the first Hit is its cost(+4), minus 20, plus its hits(+10), equals a cost of -6, or 125 Credits. Repairing 3 Hits would be +4 cost, or a cost of -2 (500 Credits). Repairing 1 Hit on an Atomic Era vehicle that had 28 Hits would be:

Modifier	Repair cost
Atomic Era vehicle	+4
Repair constant	-20
Vehicle hits	+28
Modifier total	+12
Total	64,000 Credits

Repairing 3 Hits on this vehicle would be a cost of +16, or 250,000 Credits!

If a particular gizmo was damaged, normally, you just add the cost of the gizmo to the total repair. Jury-rigged repairs are a quarter the normal cost. Repairs involving a full complement of *your* spare parts are also one-quarter normal cost, but you have to pay to replace them. If they were someone else's spare parts, repair is at normal cost. Rush jobs or extra people add to the repair cost. Having twice as many people work on your vehicle is +2 to the repair cost. Having your repair done with overtime labor so it is finished in half the time is also +2 cost.

In some cases, you can "go to the back of the line" and get a discount on repair cost of -1, but this depends on the situation.

ADVANCED TOPIC: SABOTAGE

One thing that happens to vehicles in role-playing situations is sabotage. This is using a relatively small amount of damage to effectively incapacitate or destroy a vehicle or vehicle system.

In game terms, you would use whatever skill is used to do the damage, against a difficulty equal to the vehicle's total Hits minus ten. This skill could simply be pointing a gun at just the right spot, using your piloting skills to set the controls so the vehicle damages itself, or planting a bomb where it will do the most damage. Sabotage from within generally ignores the armor rating of the vehicle (with the possible exception of compartmentalization), and is always applied against an armor of 1d+0. However, sabotage from without (like a limpet mine) *does* require breaching the vehicle's armor.

Making the sabotage roll, and each two points this roll is made by alters the Damage Limit of the vehicle for this one specific attack, *or* counts as 1 Hit of damage if the vehicle is somehow being made to act against itself. Both aspects can be used on the same roll if needed, splitting the effect as desired.

A sabotage attempt may be made against a *particular* vehicle gizmo or system, if time and circumstances permit. If the attack does any Hits to the vehicle, that system is temporarily inoperative or has to roll for effects as though it had just crossed the next highest damage threshold (using the -0d threshold if the vehicle is otherwise undamaged).

EXAMPLE: Trying to prevent them from escaping to hyperspace, an adventurer with a blaster pistol barricades themselves in the engine room of a space pirate's ship. This ship masses 250 tons, so it has 24 Hits. It also has a damage limit of 0, so normally it is impervious to simple penetration hits. The adventurer needs to beat a difficulty of 14 (the ships' Hits minus ten) in order to do any damage. They take some extra time to look around, find a likely conduit junction and take aim. Their skill roll is a 15. This is enough to get a sabotage effect, but only enough for one point. For this shot, the ship's Damage Limit is raised to 1 (instead of 0). The blaster bolt rips into the critical wiring junction and does 1 Hit to the ship, temporarily disabling the hyperdrive. The charred wires short out, causing minor damage in dozens of different circuits, each of which has to be tracked down in order to get the system working again.

Maintenance - The usual part of a vehicle that requires maintenance is the powerplant, which includes the wheels, propellors, control surfaces and anything else involved with manuevering the vehicle. The maintenance process needs to be done at a default interval of around 1,000 hours of operation. This is about forty days of non-stop operation, or about 100,000 kilometers of highway travel for a normal automobile.

The time and cost of routine maintenance is the same as cosmetically repairing 1 Hit on the vehicle. Not counting the quality of the facility and other modifiers, this will take a time level of the vehicle's Hits plus 16. This time and cost does *not* have to be paid all at once. In fact, it may be more realistic to spread it out over the thousand hours.

EXAMPLE: An Atomic Era car with 10 Hits and no other repair modifiers will require a maintenance time of 10 Hits plus 16, equals a time level of 26, or 2 hours. It will have a cost of:

Modifier	Repair cost
Atomic Era vehicle	+4
Repair constant	-20
Vehicle hits	+10
Modifier total	-6
Total	125 Credits

This two hours and 125 Credits could be done all at once, or as say four half-hour oil changes and 32 Credit routine checkups every 250 hours.

If a vehicle does not get maintenance at or around the maintenance interval, it takes 1 Hit, and if you are using hit locations (page 3.13), this hit is to the engine. Among other things, taking 1 Hit means the -0d damage threshold has been crossed, so *any* attempt to start the engine will require a roll. In addition, if you fail to give a vehicle the necessary maintenance, the interval for the next necessary maintenance is *halved*.

Note - This might explain while navies are so obsessed with keeping their ships in top shape. Fixing any Hits lost to poor maintenance costs a fortune...

Bad luck - Sometimes bad things happen to good vehicles for no apparent reason. Things break. If the gamemaster is feeling vicious, once during every maintenance interval, they can roll 3d+0. If you hit a difficulty of 18, then for absolutely no foreseeable reason, a random system in the vehicle takes 1d+0 Hits (see Hit Locations, page 3.13). The difficulty is reduced by 1 for each missed maintenance interval. Russians seem to have vicious gamemasters...

Note - Since pouring time and money into constant maintenance is no fun from a role-playing standpoint, the rules here for vehicle maintenance requirements are kind of lenient. Especially for high-performance vehicles, maintenance requirements can be extreme. As a real-world example, a modern corporate jet might require one person-hour of maintenance for each two hours of operation. A commercial helicopter might requires two person-hours of maintenance for each one hour of operation! Military high-performance vehicles can require several person-hours of maintenance for each hour of operation!

Vehicle supplies - If a vehicle (or gadget!) is "lived in", it will need to carry supplies. This could be primitive as firewood and water casks, or advanced as hydroponics additives or spare oxygen for the life support system. This may also include maintenance supplies. Supplies will take up 1 hexagon of space (half a ton) per 50 person-days. That is, 1 hexagon of supplies supports 1 person for 50 days, 50 people for 1 day, or anything in between. For practical purposes, you can count this as a size level of +9. How efficient the supplies *actually* are depends on the tech era and the vehicle.

Tech Era	Efficiency
Primitive Era	-4
Basic Era	-2
Industrial Era	+0
Atomic Era	+2
Post-Atomic Era	+4
Advanced Era	+6

Modifiers	Amount
Early or late part of an era	±1
Land vehicle	+0
Water vehicle	-1
Air vehicle	-1
Sealed environment vehicle	-4

Supplies cost like any other gizmo, but you may pay extra for more efficient supplies (or pay less for less efficient ones). If you apply +2 to the supplies cost, you count it as one tech era more advanced. You can do this once at Industrial Era and earlier, and sealed environment vehicles can do it one extra time for each era *past* Industrial Era. Similarly, you can -2 to cost for supplies to make them count as the previous tech era. Obviously, if you are doing something like historical re-enactment, you can get supplies appropriate to the tech era of the vehicle, but normally you can not go more than one era lower than the vehicle itself.

EXAMPLE: You are making up a supply list for an Atomic Era space capsule. One hexagon normally is enough for a size of +9 in person-days. Atomic Era is +2, but space vehicles drop it by -4, down to a size of +7, or 23 person-days. If we need to support three people for a week (or 21 person-days), this will take up about a full hexagon of supplies. If we use the best supplies available (and pay twice as much for them), we can drop this to half a hexagon of supplies. On the other hand, if we were stocking an Atomic Era motorhome for a one week road trip for three people, the same normal supplies would only take up about a quarter of a hexagon.

EABA

ALTERED SCALES - **EABA** normally works on a one-second (Time level 0) turn scale. While this is fine for individual human action, it is not really appropriate for a lot of vehicle combat. If you are using **Stuff!** as the front end for a vehicle combat system of your own creatiom or as an add-on to some other role-playing game, you can alter the time and distance scales to get a better framework for movement and combat.

Distance - *What is the maximum range of any weapon likely to be used in the conflict?* Find the Distance level this is, and subtract 10. This will be the size of each hexagon, and gives a maximum range for that weapon of 32 hexagons. This lets you play on a tabletop or one of those roll-up hex maps.

Time - *How many seconds does it take the slowest mobile unit to traverse one of the distance hexagons?* This Time level becomes the time increment per turn, so even the slowest unit can move one hexagon.

EXAMPLE: A sailing ship game has weapons with a maximum range of 2 kilometers. This is a distance level of 25, so the game scale is 25 - 10 = distance level of 15 (64 meters per hexagon). Ships that with a minimum breeze can move a paltry 1 meter per second will take a minute to cross this distance, so the time level per turn becomes 12.

Weapons - The biggest change to weapons is how the altered scales affect their Accuracy and the size modifier of a target. For every two points in the Distance level (round down), the size modifier for everything else is reduced by 1. Similarly, movement penalties are reduced by the Distance level, with the note that they can't go to less than zero, and a moving target (or firer) always takes at least a +1 penalty unless that movement is something completely passive like drifting in space.

EXAMPLE: If someone is shooting at a ship which normally had a **EABA** size modifier of -6 (6 points easier to hit) it would instead be altered by half the distance scale (half of 15, round up), and is now a difficulty of +2 (2 points *harder* to hit). Now, a "range" of 11 "hexagons" in the system (actually about 700 meters) is normally a target number of 10. Shooting at *this* ship at *this* range would require a roll of 10 plus 2, or 12 or better.

Weapon Accuracy is *reduced* by the distance level in the turn scale, but *increased* by the time level. Amounts of less than zero simply become zero. Then, apply another +1 to Accuracy if the weapon can fire twice during the time scale, and another +1 each time this is doubled (most autofire weapons would be an *additional* +3 and autoburst weapons an *additional* +1). If a weapon can't fire every turn, it does not lose Accuracy, but it can't fire every turn. Accuracy always applies if the time scale of the turn is more than one second (it presumes you are going to aim).

Weapon Accuracy is reduced by the shift in range level.

EXAMPLE: A cannon for this sailing ship might have an Accuracy of 4. This is reduced to -11 by the distance scale of 15, but increased by 12 for the time scale, making the final Accuracy a 1. The weapon has the "takes a minute to reload" modifier, so it only fires once in a one minute turn and gets no benefit from rate of fire. If we continue from the previous example, the final number to hit based on range, time, Accuracy and target size will be an 11 or better, using the skill of whoever is aiming the cannon.

FINAL THOUGHTS - We've said it before, and we'll say it again. *Use only the rules you need*. This chapter is a good example why. It's seventy pages long, and three-quarters of those pages are the advanced rules. It is almost inconcievable that you will ever need all of them for a single vehicle. Some sections may be more useful than others (like body armor), but look at the game purpose of your vehicle and work from there. Sometimes, you don't even need the vehicle design part to get what you need. If you a building a passenger liner, you just look at the size of the quarters required to get an idea of the vessel's final size, Hits, crew and damage limit. It's performance may be irrelevant, since any military attacker (or pirate) can outrun it, so why go to the effort of designing that part? Or, as part of a plot you want to get an idea of how long it will take to repair a vehicle. The armor or weapons do not matter, only its size and Hits, and maybe if it has a dangerous and unsheilded power source that needs to be taken into account. *Don't do more design work than you have to.*

LET'S SEE IF IT WORKS - We'll demonstrate a lot of the advanced rules by starting with something high tech, and then doing something low tech.

Free Trader - This is a 200 metric ton interstellar freighter using Post-Atomic Era technology, and with the capability to depart orbit from planets of Earth-normal gravity or less. A ship of this size and tech is *not* going to be able to carry a reasonable amount of cargo, re-entry *and* cram in a hyperdrive. We're going to settle for being able to reach escape velocity from orbit, carry cargo and hypertransit.

Power: Since we have just said it has to be able to get out of orbit (rather than launch from a surface), we are going to design the power plant so that we end up with a .2g acceleration, which will get us from orbital velocity (8,000 meters per turn) to escape velocity (11,000 meters per turn) in about half an hour. We know that our ship is supposed to have a loaded mass of 200 tons, so we just have to figure the Strength we need for a final acceleration of 2 meters per turn. We use a high-efficiency, low thrust fusion drive, that looks something like this:

Item	Strength
Post-Atomic Era	+36
8 hexagon power plant	+18
Not air-breathing	-3
Fusion modifier	+10
250x fuel efficiency	-21
Modifier total	+40
Total	13d+1

This gives an acceleration of:

Halved power plant	+20
200 ton vehicle	-23
Modifier total	-3
Total(see page 3.5)	-1d+0

Since this ship only operates in a vacuum, we don't need to figure out its top speed, because it doesn't have one.

Next, we install a basic hyperdrive. This is designed as a weapon, with a final damage of at least +54(18d+0).

Item	Damage
Post-Atomic Era weapon	+36
64 hexagon weapon(32 tons)	+18
Average technology	+0
Vehicle weapon	+0
Modifier total	+54
Total	18d+0

Now we need a fusion reactor to power the hyperdrive and presumably everything else.

Item	Strength
Post-Atomic Era	+36
32 hexagon power plant	+24
Fusion modifier	+10
1000x fuel efficiency	-27
Modifier total	+40
Total	14d+1

If you have a power plant the same power output as the hyperdrive, it takes a time of +24(one hour) to charge up for a jump, +2 time for each 1d less than this. We have 4d less, so it will take +8 time, or a time of +32(16 hours) to save up enough energy for a hyperspace transit.

We'll need fuel for both the reactor and main thruster. The reactor has its built-in fuel supply, which with the fuel efficiency becomes 5,000 hours , or about 7 months at full output, so we'll leave that as is. The main thruster has built-in fuel good for 1,250 hours, or 52 days, so we leave that as well.

We need to figure out the minimum crew complement so we can put in some quarters. To do this, we have to decide how many hexagons the final vehicle is going to be. We decide on 400 hexagons, erring on the large side, since this is supposed to be a cargo vessel of some kind. The guidelines on page 3.39 say we'll need 1.5 crew per shift, so we decide on six sets of quarters, giving us room for a few paying passengers. The guidelines of page 3.39 say this should be at least 216 hexagons, and we leave it at that. The bridge or other controls are the vehicle's size minus 15. A 500 hexagon ship is size +16, which means it has a bridge of size +1, or a measely 3 hexagons of controls.

There are some other things we need, like sensors, weapons, supplies and armor. We can't do long range sensors yet, since we haven't hit the **Gadgets** chapter, but we can set aside 8 hexagons for it, and if we don't use it all, add it to cargo space. Our ship owner wants a long range starship cannon with a damage of say 7d+0, enough to make someone notice, and with an explosive effect to represent something like a plasma beam that can alter a ship's damage limit.

Post-Atomic Era weapon	+36
8 hexagon weapon	+9
Increased range	-12
Explosive damage(lethal)	-3
Average technology	+0
Vehicle weapon	+0
360° turret	-9
Modifier total	+21
Total	7d+0 lethal explosion

We throw in 200 shots of "plasma cartridges" for the weapon, for another 8 hexagons of volume. The cost of the weapon will depend on how much Accuracy the ship owner wants to buy. We're just going to use basic vehicle cost rules for it.

Supplies will take up 1 hexagon for 50 man-days of supplies. We put in 4 hexagons worth.

Armor is about the last major item. We do something like this:

Post-Atomic Era base	+21
400 hexagon vehicle	-26
32 tons armor	+15
Modifier total	+10
Total	3d+1

And the ship has a damage limit of -1. So, the ship looks something like this (items with a "*" will be costed as gizmos for cost purposes):

Item	Size	Mass
Structure	-	40 ton
Fusion engine	8 hexagon	4 ton
Hyperdrive*	64 hexagon	32 ton
Main reactor	32 hexagon	16 ton
Quarters	216 hexagon	22 ton
Bridge	3 hexagon	-
Main sensor	8 hexagon	4 ton
Weapon & ammo*	16 hexagon	8 ton
Supplies*	4 hexagon	2 ton
Armor	-	32 ton
Total	351 hexagon	164 ton

This leaves us 36 tons and 49 hexagons for cargo of some kind, though to be honest, we probably want a backup reactor, a secondary sensor, maybe some mass to carry a shuttlecraft, and so on, which may end up eating up our already meager cargo room.

The cost of the ship is based on the 600 you get from adding its size and mass (size of +17) and tech era(+8), for a cost of +25, or 5,600,000 Credits. Since it is not usable in an atmosphere, it is not really a "flying vehicle", but if you want to add that +2 to cost to represent more expensive components for spacecraft, you can.

Modifier	Levels
Vehicle size & weight	+17
Post-Atomic Era	+8
Final cost level	+25
Final cost	5,600,000 Credits

To this, we add 84 hexagons of gizmos (size of +11), with a tech era modifier of +8 and a gizmo modifier of +4, for a gizmo cost of +23, or 2,800,000 Credits for the hyperdrive, plasma cannon and supplies, for a total ship cost of 8,400,000 Credits.

Modifier	Levels
Gizmo size	+11
Post-Atomic Era	+8
Gizmo modifier	+4
Final cost level	+23
Final cost	2,800,000 Credits

Note that this could have any number of tweaks for a gameworld, like limited production, the aforementioned flying vehicle modifier and so on.

For combat purposes, this ship is a sitting duck. A .2g main drive isn't going to outrun anyone, and it can dodge enemy fire about as well as well, a freighter. On the bright side, it does have a damage limit of -1, so normal beam weapons aren't likely to do anything. The ship also has a mass of 200 tons, which gives it 25 Hits.

Operationally speaking, it can run the main engine for 52 days before refueling, the main reactor is good for 208 days of use at full power, and with a full load of 12 people (two per set of quarters), basic supplies are good for 17 days. It takes 16 hours to save up energy for a hyperspace transit, and the ship has a "hyperspace speed" of about 1 light-year per 8 days.

The maintenance cost for this ship is standard (no touchy components), and comes out to a time level +41, and cost of +11 (16 days and 45KCr) for each 1000 hours of operation (40 days). This seems to be an indication that the ship could needs a dedicated engineer, who does "maintenance" as their normal job. It also means that this ship costs its owners about a thousand credits a day to keep all those expensive components in top condition.

Steampunk Scout Walker - A small, Victorian Era, steam-powered mecha. It will *not* be designed like an oversized body armor. Rather, it will just use the normal vehicle rules and make a few design assumptions. We'll say we have a total mass of 16 tons (Mass level of +31), and that all the tech is Industrial Era.

Power: We know this beast will need all the power it can get. We'll design up a 2 ton steam engine and see how good we can make it.

Early Industrial Era	+22
4 hexagon power plant	+12
Touchy x 1	+3
Warmup required	+1
Fuel modifier	+0
Modifier total	+38
Total	12d+2

With this number in hand, and knowing the final vehicle mass, we can get the top speed:

Power plant Strength	+38
16 ton loaded vehicle mass	-12
Extremely enhanced suspension(legs)	-9
Modifier total	+17
Top speed	16m/turn(58kph/36mph)

And acceleration:

Half power plant Strength	+19
16 ton loaded vehicle mass	-12
Extremely enhanced suspension(legs)	-9
Land vehicle penalty	-9
Modifier total	-11
Acceleration	1m/turn

So, it's sort of like a locomotive. It can get up to a pretty good speed, but it takes a while to get there.

Now we have to make some assumptions about vehicle size. Let's say it has a crew of three, for about 3 hexagons of seating. We'll put in a turreted weapon that takes up 4 hexagons, we have a 4 hexagon steam turbine, and we toss in 1 hexagon of gizmos, for a total of 12 hexagons. This will let us get the unarmored vehicle mass, so we can figure out how much armor we can put on, and how effective that armor will be. So, the mass at the moment is:

Vehicle structure	1.2 tons
Power plant	2.0 tons
Weapon	2.0 tons
Crew	.3 tons
Gizmos	.5 tons
Subtotal	6.0 tons

This leaves us 10 tons for armor. Given the size of the vehicle, it looks something like this:

Early Industrial Era	+7
10 tons armor	+10
Land vehicle	+3
12 hexagon vehicle	-11
Total	+9(3d+0)

This isn't a lot of armor, but then again, the Victorian Era didn't seem to be big on safety and protecting its soldiers. However, we pull +4 from the top, and +2 from the back and bottom, and rearrange this as +2 to the front and +1 to each side:

Front armor	3d+2
Right side	3d+1
Left side	3d+1
Top	1d+2
Bottom	2d+1
Rear	2d+1

We'll use the quick weapon design table on page 3.9 to come up with our 4 hexagon weapon:

Early Industrial Era	+22
4 hexagon weapon	+6
360° turret weapon	-9
Autofire	-3
Total	+16(5d+1)

So, we have a heavy machine gun, and we can store the ammunition in some of the gizmo space. Our walker has a cost for the vehicle of:

Modifier	**Cost**
Vehicle size + mass	+6
Early Industrial Era	+3
Military vehicle	+4
Final cost level	+13
Final cost	90,000 Credits

And gizmos:

Gizmo size	+2
Early Industrial Era	+3
Gizmos	+4
Final cost level	+9
Gizmo cost	23,000 Credits

For a total cost of 113,000 Credits. We end up with a vehicle that's about the size of an APC stood on its end. It has 18 Hits, a damage limit of 5, and is armed with a 5d+1 machinegun in a full 360° turret.

Suggested Engine Parameters

Primitive Era Powerplants

Type	Basic modifiers	Basic output(1 hex)	Advanced modifiers	Adv. output(1 hex)
Animal(all tech eras)	none	+6	none	+6[1]
Animal(leveraged)	none	+4	leveraged(+6)	+10[1]
Sails	none	+6	none	+6
Windmill	none	+4	leveraged(+6)	+10

Basic Era Powerplants

Type	Basic modifiers	Basic output(1 hex)	Advanced modifiers	Adv. output(1 hex)
Animal(leveraged)	none	+6	leveraged(+6)	+12[1]
Sails	none	+6	none	+6
Windmill	none	+6	leveraged(+6)	+12

Industrial Era Powerplants

Type	Basic modifiers	Basic output(1 hex)	Advanced modifiers	Adv. output(1 hex)
Animal(leveraged)	none	+8	leveraged(+6)	+14[1]
Steam engine(oil fueled)	durable(-3)	+21	warmup time(+1) 2x fuel efficiency(-3)	+19
using coal as fuel			fuel modifier(-1)	+18
using wood as fuel			fuel modifier(-2)	+17

Atomic Era Powerplants

Type	Basic modifiers	Basic output(1 hex)	Advanced modifiers	Adv. output(1 hex)
Animal(leveraged)	none	+10	leveraged(+6)	+16[1]
Gasoline engine	none	+30	none	+30
Diesel engine	durable(-3)	+27	none	+27
Sports car engine	touchy(+3)	+33	none	+33
Jet turbine	touchy(+3)	+33	warmup time(+1) $^1/_2$x fuel efficiency(+3)	+37
Rocket engine	touchy(+3)	+33	$^1/_{1000}$x fuel efficiency(+30) not air-breathing(-3)	+60
Ion engine	durable(-3)	+27	500x fuel efficiency(-27) not air-breathing(-3)	-3
Atomic reactor	none	+30	500x fuel efficiency(-27) warmup time(+2) not air-breathing(-3) fuel modifier(+12)	+13
Solar panels	none	+30	solar power(-24)	+6
Electric motor	none	+30	$^1/_4$x fuel efficiency(+6) not air-breathing(-3) no on-board fuel(+1)	+34

Post-Atomic Era Powerplants

Type	Basic modifiers	Basic output	Advanced modifiers	Advanced output
Animal(leveraged)	none	+12	leveraged(+6)	+18[1]
Fusion reactor	none	+36	warmup time(+1) 500x fuel efficiency(-27) fuel modifier(+10) not air-breathing(-3)	+17

Advanced Era Powerplants

Type	Basic modifiers	Basic output	Advanced modifiers	Advanced output
Animal(leveraged)	none	+14	leveraged(+6)	+20[1]
Antimatter reactor	none	+42	warmup time(+1) 500x fuel efficiency(-27) fuel modifier(+16) not air-breathing(-3)	+29

[1]Assumes maximum (sprinting) level of exertion. A "walking pace" would be a -8 penalty on output. See page 3.21 for details.

Suggested Vehicle Parameters

Primitive Era Vehicles

Type	Speed modifiers	Decel. modifier	Armor modifiers	Armor mod. + Tech era
Wagon	enh. suspension(-3)	+3 row	land vehicle(+3)	+6
Sailing ship	water vehicle(-9)	+1 row	water vehicle(+6)	+9

Basic Era Vehicles

Type	Speed modifiers	Decel. modifier	Armor modifiers	Armor mod. + Tech era
Wagon	enh. suspension(-3)	+3 row	land vehicle(+3)	+6
Sailing ship	water vehicle(-9)	+1 row	water vehicle(+6)	+9

Industrial Era Vehicles

Type	Speed modifiers	Decel. modifier	Armor modifiers	Armor mod. + Tech era
4WD vehicle	enh. suspension(-3)	+3 row	land vehicle(+3)	+12
Normal automobile	none(+0)	+3 row	land vehicle(+3)	+12
Sports car	lim. suspension(+3)	+3 row	land vehicle(+3)	+12
Steam locomotive	totally lim. suspension(+12)	+3 row	land vehicle(+3)	+12
Steamship	water vehicle(-9)	+1 row	water vehicle(+6)	+15
Airplane	flying vehicle(+3)	-3 row	none	+9
Submarine(submerged)	water vehicle(-6)	+1 row	water vehicle(+6)	+15
Submarine(surfaced)	water vehicle(-9)	+1 row	water vehicle(+6)	+15
Tank	very enh. suspension(-6)	+3 row	land vehicle(+3) sloped armor(+6)	+18

Atomic Era Vehicles

Type	Speed modifiers	Decel. modifier	Armor modifiers	Armor mod. + Tech era
Helicopter	flying vehicle(+3)	-3 row	none	+15
Jet airplane	upper atmosphere(+9)	-3 row	none	+15
Diesel locomotive	totally lim. suspension(+12)	+3 row	land vehicle(+3)	+18

Post-Atomic Era Vehicles

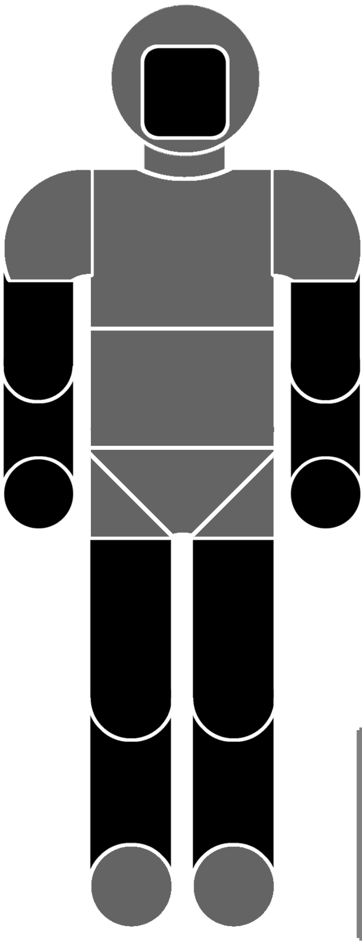
Type	Speed modifiers	Decel. modifier	Armor modifiers	Armor mod. + Tech era
Aircar		-3 row	none	+21
Orbital shuttle	upper atmosphere(+9)	+0 row	none	+21
Combat walker	extr. enh. suspension	+3 row	land vehicle(+3)	+24

Body Armor Materials[1]

Type	Tech Era	Base/Max[2]	Mass[3]	Cost[3]	Notes
Wood	Early Primitive	+3/+6	+0	-3	-1d vs. firearms
Leather	Early Primitive	+4/+7	-1	-1	-1d vs. firearms & blunt
Hardened leather	Primitive	+4/+7	+0	-2	-1d vs. firearms
Bronze plate	Primitive	+9/+12	+7	+2	-1d vs. firearms
Iron/leather scale	Primitive	+7/+10	+4	+2	-1d vs. firearms
Iron-faced wood	Primitive	+5/+8	+3	+1	-1d vs. firearms
Iron plate	Late Primitive	+10/+13	+7	+3	-1d vs. firearms
Iron mail	Late Primitive	+8/+11	+4	+3	-1d vs. firearms & blunt
Mild steel	Early Basic	+11/+14	+7	+5	-1d vs. firearms
Steel	Industrial	+14/+17	+7	+7	
High-impact plastics	Atomic	+15/+18	+0	+5	-1d vs. firearms
Ballistic fabrics	Atomic	+13/+16	-1	+6	-1d vs. melee
Adv. steels	Atomic	+19/+22	+7	+7	
Aluminum alloy	Atomic	+15/+18	+3	+6	
Titanium alloy	Atomic	+16/+19	+3	+7	
Cermets	Late Atomic	+17/+20	+3	+7	
Adv. ballistic fabrics	Late Atomic	+15/+18	-1	+7	-1d vs. melee
Cermet shearmatrix	Early Post-Atomic	+18/+21	+0	+7	

[1]All of these assume the armor has +1 worth of padding, which is included in the listed stats. Apply -1 to cost and protection without it.
[2]Assumes a maximum 20mm torso thickness for armor, which can easily be prohibitively heavy to wear or carry.
[3]Remember that the body area covered will affect both mass and cost. See page 3.47 for details.

DESIGN PAGE 2 - If you are viewing this page as a pdf, it has forms that allow you to generate body armor on the fly. However, if you are doing power armor, you'll have to do the machinery separately.



	Helmet	Body armor	Boots
Era:	Atomic Era	Late Atomic Era	Early Atomic Era
Covers:	Skull & neck	Whole torso	Foot
Thickness:	-6	-5	-4
Material:	Lightweight	Normal	Very lightweight
Coverage:	Normal coverage	Normal coverage	Two of this item
Mod #1:	Ballistic	Ballistic	Flexible
Mod #2:	Rigid	Rigid	Low grade
Mod #3:	Padded	Padded	Normal
Mod #4:	Normal	Hardened	Normal
Mass:	Mass adjust. of +0	Mass adjust. of +0	Mass adjust. of +0
Cost:	Cost adjust. of +0	Cost adjust. of +0	Cost adjust. of +0
Armor lev.:	9	14	5
Mass lev.:	-12	-2	-12
Cost lev.:	-3	4	-4

Autocalc off | Reset form

Name	Armor	Covers	Weight	Cost	Notes
Helmet	3d+0	5-6	0.8kg	250Cr	Atomic Era
Body armor	4d+2	9-12	7.9kg	1260Cr	Late Atomic Era
Boots	1d+2	17-18	0.8kg	198Cr	Early Atomic Era

Material presets	Armor glossary	Covers
Level II BP	Armet	Head & neck (rigid)
Level III BP	Visor	Face (rigid)
Level IV BP	Gorget	Neck (rigid)
Level IV+ BP	Pauldron	Shoulder (rigid)
Flexible leather	Spaulder	Upper arm (rigid)
Hardened leather	Vambrace	Lower arm (rigid)
Reinforced leather	Gauntlet	Hand (rigid)
Mail armor	Cuirass	Chest, abdomen, sometimes hips (rigid)
Plate armor	Hauberk	Torso, sometimes upper legs (flexible)
'Elvish mail'	Chausses	Upper legs (rigid)
Future 1	Greaves	Lower legs (rigid)
Future 2	Sabaton	Feet (rigid)

DESIGN PAGE 3 - If you are viewing this page as a pdf, it has forms that allow you to do many aspects of vehicle design right here on the page, and then print off your finished specs. It will not cover *all* the advanced topics, but will give you the basics to work from.

Insert vehicle name here

Middle	Atomic Era	10	d+	0
Powerplant of 1 hexagon		0	d+	0
Normal size		0	d+	0
Normal durability		0	d+	0

Advanced powerplant modifiers

Air-breathing(+0)	0	d+	0
Normal environment(+0)	0	d+	0
No warmup required(+0)	0	d+	0

Fuel type modifiers — Petroleum preset

Mod. toxic	Shielded	0	d+	0
Mod. toxic bypr.	Reg. cont.	0	d+	0
No bonus		0	d+	0
Some refining	No bypr.	0	d+	0

Other modifiers

Normal power	Extr. exer.	0	d+	0
1x fuel efficiency		0	d+	0
Normal powerplant		0	d+	0
Normal suspension		0	d+	0
One terrain use		0	d+	0

Vehicle parameters

Vehicle mass of 1 ton	0	d+	0
No mass adjustment	0	d+	0
Normal vehicle (ground)	0	d+	0
Usable vol. of 2 hexagons	2.0		
No volume adjustment			
Enter military carried in veh.	1		
No armor			
No armor adjustment			
Normal armor			
No extra fuel carried			
Enter total weapon volume	0.0		
Enter total gizmo volume	0.0		

Insert vehicle name here

WWII tank
Steamship
Aircar
Wagon
4WD truck
Fighter jet

Front:	1 d+ 0	- +
Right:	1 d+ 0	- +
Left:	1 d+ 0	- +
Top:	1 d+ 0	- +
Bottom:	1 d+ 0	- +
Rear:	1 d+ 0	- +

Available: 0d+ 0

Reset armor
Reset speed
Reset form
Autocalc on

Dmg. lim./Hits: 7 / 10

Top spd:	53 m/s	**Endurance:**	5.00 hr
Stall spd:	--- m/s	**Crew+pass:**	1 + 0
Accel:	5 m/s	**Warmup time:**	0.0 hr
Decel:	7 m/s	**Cargo vol.:**	0.00
Maint.:	1,000.00 hr	**Cost:** (0)	24,000 Cr
Size modifier:	0	**Mass:**	0.80 ton

Notes:

Enter other vehicle info here...

GADGETS

"Concern for man himself and his fate must always form the chief interest of all technical endeavors, concern for the great unsolved problems of the organization of labor and the distribution of goods - in order that the creations of our mind shall be a blessing and not a curse to mankind. Never forget this in the midst of your diagrams and equations."

- Albert Einstein

INTRODUCTION - *What is a "gadget"?* For most of the time, it is something other than a gun or a vehicle or critter that has some game use, and which quite often is small enough to carry around with you. Most gadgets with particular game effects, (especially those used in combat!) can be covered by the **Weapon** or **Vehicle** design rules. You can duplicate some of the effects in those chapters with the rules in this one, but you will not get the same *exact* results. The chapters specific to a class of item will do a better job of it, just like this chapter will do a better job of creating mundane gadgets than the gadget notes in the paranormal powers chapter of the main **EABA** rules.

The subset of rules that follows is not meant to supplant the paranormal power section of **EABA**, but instead is a useful tool to just toss "ordinary" items together, not just for **EABA**, but for any game system. It allows a gamemaster in a campaign without paranormal powers to have a quick and dirty way to make things up, not based on "power effects", but on technology. And besides, with a title like **Stuff!**, we *have* to include a section for generic gadgets. And, as for the other sections, you aren't supposed to use this for mundane stuff that you can guesstimate from what you see at the local hardware store. While you *can* make up a cordless power drill or toaster with these rules, is it *really* a worthwhile use of your time to do so, and will having designed stats for the item make an adventure so much better that it's worth the effort you put into it? Only design what you *need* to design...

Like other aspects of **Stuff!** design, gadgets start with a base amount determined by tech era, and then you apply modifiers for the nature of the item. In this case, you get a base size for the gadget based on the technology used, then you apply modifiers based on what you want the gadget to do. Some gadgets will end up with a minimum size that is independent of tech era, depending on the nature of the item. For instance, if a gadget is supposed to be handheld, then it has to be big enough that it doesn't get lost in your pocket lint...

Abilities that would make a gadget smaller are positive numbers, while those that make a gadget larger are negative numbers. The total modifier for the abilities of the item is then compared to the appropriate gadget size to get a result that comes out to +0.

EXAMPLE: A gadget that has a total modifier of +30 would be balanced by a size offset of -30 to make the total +0. This gadget would be 1 millihex in size.

Each 3 points in modifiers alters the final size of the gadget by a factor of 3. The final cost of the gadget is based on the size, tech era and a few other modifiers. The table that follows lists the basic modifiers and row shifts. When we're done this, we'll move on to the advanced design modifiers.

Overall notes - Mechanical items generally can't be built at a tech era more than two eras past where they were introduced. By "built", we mean the design parameters. Advanced Era societies might still use scissors, but the principle of a pair of scissors can be improved only so far. Yes, they might have molecular-edge diamond blades, but they're *still* scissors, and the basic concept can only be improved by so much. Most simple mechanical tools date to the Primitive Era, or Basic Era at the latest. This means that the size of such an item will never be less than if it were built at the Industrial Era for Primitive Era concepts, or Atomic Era for Basic Era concepts. However, while there may be a minimum size, you can often use the actual era the gadget was built at to determine its weight. A pair of Advanced Era scissors might be the same *size* as an Industrial Era pair, but could *weigh* far less and still be equally useful...

HOW DOES IT WORK? - *Pretty easy, actually*. You start with the row for the tech era of the gadget, and then you simply apply row shifts based on what the gadget does until you get a final result. This will give you the size of the gadget in hexagons or millihexes, and from that, its weight. With things like weapons, making it bigger makes it inherently more powerful. With gadgets, you take the total modifier from what it does and find the smallest possible box it will fit in (compare it to the modifiers for its size until gadget and box cancel each other out).

EXAMPLE: If we wanted a Late Atomic Era gadget that could record and play about a CD's worth of information (in this case an information level of +52), we might do it like this. Add up all the modifiers appropriate to the gadget:

Modifier	Amount
Atomic Era gadget	+30 bonus
Late part of an Era	+2 bonus
Mature technology	+2 bonus
+20 information stored	-5 penalty
Removable storage system	-1 penalty
Limited input/output device	+2 bonus
Total(gadget size of 1 millihex)	+30 bonus

This is not where we explain *how* each modifier works, but you can see *what* each modifier does. The goal is to have a gadget with a total modifier of +0, the last modifier being the one for the size of the gadget. In this case, these modifiers give us a gadget of 1 millihex (about .5 kilograms), which can store an information level of +52 on removable bits of some kind (like a CD). The gadget has no power supply and limited input/ output capability, so it would be a component that is added to some other sort of gadget. In this case, you can think of it as a computer's CD-RW drive. If you said it could only play back information, gave it an output device, increased the information capacity by +6, and added a power supply (battery), then you would have a portable DVD player.

Note! - The Size of an object is normally used as a targeting modifier on the **EABA Universal Chart**, but it can also be the physical volume of an object. *Because of how volume changes with dimension, Size for targeting and Size for volume will not be the same* (a cube with each side twice as long has *four* times the area on each face, but *eight* times the volume). A person is about 2 meters tall, for a *targeting* Size of +0. However, a person has a Size of about -7 for gadget design purposes involving a person-sized *volume*.

Technological Era	Gadget effect
Primitive	+12 effect
Basic	+18 effect
Industrial	+24 effect
Atomic	+30 effect
Post-Atomic	+36 effect
Advanced	+42 effect
Early part of an Era	-2 penalty
Middle part of an Era	no adjustment
Late part of an Era	+2 bonus
Early technology	-2 penalty
Normal technology	+0 bonus
Mature technology	+2 bonus

Gadget size	Offset
Gadget of .002 millihex(1g)	-57 penalty
Gadget of .004 millihex(2g)	-54 penalty
Gadget of .008 millihex(4g)	-51 penalty
Gadget of .015 millihex(8g)	-48 penalty
Gadget of .03 millihex(16g)	-45 penalty
Gadget of .06 millihex(32g)	-42 penalty
Gadget of .12 millihex(64g)	-39 penalty
Gadget of .25 millihex(125g)	-36 penalty
Gadget of .5 millihex(250g)	-33 penalty
Gadget of 1 millihex(500g)	-30 penalty
Gadget of 2 millihex(1kg)	-27 penalty
Gadget of 4 millihex(2kg)	-24 penalty
Gadget of 8 millihex(4kg)	-21 penalty
Gadget of 16 millihex(8kg)	-18 penalty
Gadget of 32 millihex(16kg)	-15 penalty
Gadget of 64 millihex(32kg)	-12 penalty
Gadget of 125 millihex(62kg)	-9 penalty
Gadget of 250 millihex(125kg)	-6 penalty
Gadget of 500 millihex(250kg)	-3 penalty
Gadget of 1 hexagon(500kg)	+0 bonus
Gadget of 2 hexagons(1 ton)	+3 bonus
Gadget of 4 hexagons(2 tons)	+6 bonus
Gadget of 8 hexagons(4 tons)	+9 bonus
Each doubling of space	+3 bonus
Each 25% extra space (max +50%)	+1 bonus
Each 25% less space (max -25%)	-1 penalty

Note! - One thing that is *vitally* important to remember when dealing with modern gadgets in the real world is the absolutely frenetic pace of technological advancement in the past few decades, years and even months. Over the course of even part of the Atomic Era, some technologies will arise, peak, and then fade away. The invention, rise, peak and decline of magnetic tape as a storage medium is *entirely* within the middle portion of the Atomic Era. Or consider that flash memory MP3 players went from 32 megabytes of storage to 4 gigabytes (a factor of x125) in the course of only seven years (meaning that both would be identical in terms of tech era!). So, trying to use these rules to mimic the course of our *actual* technological progress on a decade-by-decade basis is doomed to failure.

Stuff!

Attributes/skills	Amount
Has an Attribute or skill	+0 bonus
each +1 in Strength	-1 penalty
each -2 in Strength	+1 bonus
each +1 in Agility	-2 penalty
each +1 in Will	-2 penalty
each +1 in Health	-2 penalty
each +1 in Fate	-2 penalty
each +1 in Awareness	-2 penalty
each +1 in AI Awareness	-4 penalty
limited use of Attribute	+3 bonus
each +1 in a skill	-1 penalty
each skill after the first	*-1 penalty*
programmable skills	*-1 penalty*
Each -2 penalty offset	-1 penalty
Facilitator	-2 penalty
size of object	-(Size/2) penalty
Affects an Attribute or skill	-18 penalty
size of affected item	-(Size/2) penalty
only boosts Attribute/skill	+3 bonus
only penalizes Attribute/skill	+12 bonus
each +1 in Strength	-2 penalty
each +1 in Health	-2 penalty
each +1 in Agility	-4 penalty
each +1 in Awareness(full)	-4 penalty
each +1 in Awar.(cognitive)	-3 penalty
each +1 in Awar.(sensory)	-2 penalty
each +1 in Will	-3 penalty
each +1 in Fate	-4 penalty
limited use of Attribute	+3 bonus
each +1 in a skill	-2 penalty
each -1 in a skill or attribute	-1 penalty

Information	Modifier
Information base effect	+(era/2) bonus
Each +1 information stored	-1 penalty
Each +4 time differential	-1 penalty
Records/plays info.(active)	-14 penalty
Records/plays info.(passive)	-7 penalty
Can only record information	+2 bonus
Can display information	+4 bonus
No input (or no output)	+3 bonus
No input *and* no output	+4 bonus
Limited input/output(each)	+2 bonus
Removable storage system	-1 penalty
Recording medium only	+(era/6) bonus
Instantaneous recording type	+15 bonus

Communication	Modifier
Communication bonus	+special
Each +1 range level	-special
Signal arc	-special
Output device	-special
Extraordinary range	-special
Special cases	+special

Mitigation	Amount
Mitigation penalty	-(era/2) penalty
Area protected	-(size/2) penalty
Wind and/or rain protection	-1 penalty
Waterproof	-1 penalty
+10° of insulation	-1 penalty
each doubling of insulation	-1 penalty
±10° temperature compensation	-2 penalty
heating only	+2 bonus
cooling only	+1 bonus
each doubling of compens.	-1 penalty
Sealed environment	-1 penalty
.5 atm pressure difference	-1 penalty
1 atm pressure difference	-2 penalty
each 25% incr. in pressure	-1 penalty
each doubling of pressure	-3 penalty
Life support	-3 penalty
+time levels support	-special

Other modifiers	Amount
Extra +1 Armor	-1 penalty
doubling of extra Armor	-1 penalty
Usage time level of 4	+1 bonus
each +4 time levels	+1 bonus
Requires gestures	+1 bonus
Requires concentration	+1 bonus
Transferable user	+0 bonus
Non-transferable user	+2 bonus
Implanted user	+4 bonus
Reliable gadget	+0 bonus
Unreliable gadget	+1 bonus
Very unreliable gadget	+2 bonus
Hazardous gadget	+1 bonus
Larger than life	-special
Targeting limit	+1 bonus
Fudge factor	±special

About the numbers - Each 3 points of modifiers doubles or halves the size of the gadget. This means that gadget capability and size can change a lot over the course of a tech era or with a few key modifiers. The difference between an old vinyl LP record and an MP3 player that holds ten thousand songs is one tech era. The difference between a computer that fills a warehouse and one that fills your pocket is one tech era.

The biggest factors that will influence the size of a given capability are tech era and whether or not it is a mature use of an existing technology. For instance, one tech era plus using the "mature tech" modifier will by itself make a new gadget six times smaller than its predecessor. In addition, some of the modifiers multiply with tech era. For instance, information content goes up by a factor of x500 per tech era. Compare a Gutenberg Bible (Late Basic Era) to a full set of encyclopedias on a single CD (Atomic Era).

One thing this compressed scale means is that if you *really* try, you can come up with gadgets that are far more capable than they should be at a particular tech era. This is where both market forces, practicality and gamemaster fiat come into play. Maybe you can design an Industrial Era portable media player, but every time you take a step the needle scratches the itsy-bitsy phonograph records it uses. Or maybe you can make an auto-chef to prepare your food, but it costs more than a year's wages for a real chef, or a clockwork chess player that costs a fortune and still doesn't play very well. Or maybe the gamemaster says that you are simply limited to a certain maximum level of effect because of technological limits. Or, maybe the gadget uses too many batteries to be easily portable.

About the tables - Each boldfaced heading is a class of effect, like "Mitigation", or "Information". All modifiers under that heading add together and are considered a *single* gadget. Gadgets that do things from multiple categories are considered to be separate gadgets that add together after they are complete. Indented modifiers are conditional, and *require* that you have a non-indented modifier to use them.

EXAMPLE: You can see "each +1 in Strength" is a subcase of "has an Attribute or skill". A gadget that had a Strength of 3 and an Agility of 3 would have a modifier of -9 for those two Attributes.

EXAMPLE: A gadget that has an inherent Awareness, affects the Agility of the user *and* offsets a Health penalty is a collection of modifiers that all fall under the "Attributes/skills" heading, so this would count as a *single* gadget.

However, *italicized* indented modifiers are required if you use the non-indented modifier above it.

EXAMPLE: If a gadget is a "facilitator", then you *must* have a modifier for the biggest object the gadget can be used on.

The "use modifiers" and "general modifiers" can be applied to most gadgets and these count as part that particular gadget function.

EXAMPLE: If you have an information gadget and communication gadget as a single item, and the information gadget had preparation time and the communication gadget required gestures, then these modifiers would apply only to the appropriate function for determining the size of each sub-gadget.

If a gadget has more than one "effect", there are guidelines on page 4.35 to figure out how big the combined gadgets are as a single larger and more expensive gadget. A lot of the time, it will simply be an increased cost rather than noticeably increased size (a car with a DVD player is not bigger than a car without one, but it *might be* more expensive). The "general modifiers" category is *not* a separate gadget, and these modifiers apply to one or more of the component gadgets.

EXAMPLE: You might have a computer gadget with a warmup time and a replaceable battery, combined with a mitigation gadget to make it waterproof and more durable, but the mitigation part does not have a warmup time nor require a battery.

Tech Era - This is the general tech era of the gadget, using a scale you should be familiar with by now. There are a few special things to consider about tech era when building gadgets. First, there is the previously mentioned note about exactly how advanced a gadget can get. A pair of scissors is a pair of scissors, there's only so much you can do to improve on the concept.

Second, more than other items of technology, gadgets can be specific to one particular field of scientific development, and can be ahead or behind the curve of overall technological progress. Computers might be ahead of personal transport technology, or cybernetics might be behind other forms of medical implants. As a gamemaster, you need to look at where a given field lies compared to the rest of the gameworld.

Third, this section has the modifiers of "early", "normal" and "mature" technologies. "Early" is when a technology is commercially available and mostly bug-free, but expensive and maybe a bit bulkier than it could be. This is for "early adopters". A "normal" technology is when the gadget becomes common enough to have a lot of market penetration, or have its core technology spun off into other gadgets. And a "mature" technology is one where it is universally available, often quite cheap, and frequently the subject of low-quality knockoffs. You can take an intermediate value of +1 or -1 to give a full spread of -2 to +2 from "early" to "mature" use of a technology.

EXAMPLE: A home DVD recorder would be a good example. At an "early" level it was a fairly expensive(>1,000Cr) set-top box. At a "normal" level, it had some added features, or was a little smaller and is a bit cheaper. Now it is getting close to a "mature" technology, and you can get a variety of cheap (<200Cr), small models at department stores.

In addition to affecting the size of a gadget, the early, middle and mature modifiers may affect the final cost of the gadget. Early models are going to be more expensive than normal, and not just because of their increased size, while mature technologies have so many manufacturers that competition has driven prices lower than you would expect for just their size.

ATTRIBUTES/SKILLS - A gadget with this modifier set either has Attributes or skills that the gadget can use independently or under someone's direction, has the ability to boost or penalize an Attribute or skill on whatever it is in, on or attached to, or alters or modifies skill use in some other way.

Attributes/skills	Amount
Has an Attribute or skill	+0 bonus
each +1 in Strength	-1 penalty
each -2 in Strength	+1 bonus
each +1 in Agility	-2 penalty
each +1 in Will	-2 penalty
each +1 in Health	-2 penalty
each +1 in Fate	-2 penalty
each +1 in Awareness	-2 penalty
each +1 in AI Awareness	-4 penalty
limited use of Attribute	+3 bonus
each +1 in a skill	-1 penalty
each skill after the first	*-1 penalty*
programmable skills	*-1 penalty*
Each -2 penalty offset	-1 penalty
Facilitator	-2 penalty
size of object	-(Size/2) penalty
Affects an Attribute or skill	-18 penalty
size of affected item	-(Size/2) penalty
only boosts Attribute/skill	+3 bonus
only penalizes Attribute/skill	+12 bonus
each +1 in Strength	-2 penalty
each +1 in Health	-2 penalty
each +1 in Agility	-4 penalty
each +1 in Awareness(full)	-4 penalty
each +1 in Awar.(cognitive)	-3 penalty
each +1 in Awar.(sensory)	-2 penalty
each +1 in Will	-3 penalty
each +1 in Fate	-4 penalty
limited use of Attribute	+3 bonus
each +1 in a skill	-2 penalty
each -1 in a skill or attribute	-1 penalty

EXAMPLE: A "triscanner" might *boost* the user's science skills, a factory robot might *have* Strength, Agility and an Agility skill or two, and a personal computer might *have* a limited Awareness and programmable Awareness-based skills. A pair of leg irons will be a gadget that penalizes Agility and Health (for movement purposes), while a set of wrenches and screwdrivers are part of a "gadget" that facilitates your use of an automotive repair skill.

Note! - The "limited use of Attribute" is assumed to be under *each* Attribute heading such as "each +1 in Strength". That is, you can't have a "limited use of an Attribute" modifier unless you are also using a modifier involving that Attribute.

So, the gadget has one or more Attributes normally associated with an adventurer. The gadget can also have a particular skill bonus up to the limits of the Attribute (like for an adventurer), or an ability to offset a specific penalty associated with a skill or Attribute use. This is a very broad and useful category that covers everything from handcuffs to binoculars to lockpicks. *Or, even a set of handcuff-binoculars with built-in lockpicks...*

You basically decide *which* Attribute(s) are going to be used in the gadget, how they are going to be used and add levels for each. Each Attribute will affect the size of the gadget differently, as will the way that Attribute is used. We'll get into the minutia in a minute.

If a gadget does not have an Attribute, it can only successfully do tasks that do not require *any* roll on that Attribute. If a gadget with an inherent Attribute allows transparent use of another Attribute through the gadget at no bonus or penalty, you have to take the "facilitator" modifier for each Attribute used (described in detail in a few pages). This is a -1 penalty that just reflects some extra sophistication in the device.

By transparent use of an Attribute, it means that a person can use one of their own Attributes in conjunction with a different Attribute inherent to the gadget. For instance, using your Agility in combination with the gadget's inherent Strength. A simple test is that if you can use a skill or other Attribute in combination with the gadget's inherent Attribute, then the gadget is a facilitator.

EXAMPLE: A car jack has Strength (it lifts stuff), but it is a very limited sort of Strength, and the user of the gadget has no way to use their own Agility in concert with the jack. A hoist might give the ability to lift stuff and maybe move it around a little,which would be a use of the "facilitator" modifier, but the user's Agility would be penalized like they were lifting the object themselves. That is, as you reach the limits of the hoist's Strength, the user's effective Agility or skill with the hoist is going to be reduced by the "encumbrance" penalty. A robot hoist with a powered swing arm might have its own Agility, which would also be penalized based on the Strength of the hoist. Each of these improvements (jack to hoist to powered swing arm) adds modifiers that make the gadget bigger and more expensive.

If a gadget only has partial use of an Attribute, you can only choose one aspect of how that Attribute can be used. For instance, something with partial use of Awareness could either detect things *or* make decisions, but not both (aside from a simple yes/no based on whether it detected something). If a gadget has Agility for purposes of using one skill, then limit the Agility to "usable only with that skill". There are also modifiers in the "General modifiers" section that can be used to further limit this type of gadget.

If a gadget has multiple Attribute or skill effects with some limited and others not, you apply the "limited use" modifier on each Attribute that is limited in some way. You may *not* have "limited use" on an Attribute at a level which makes the gadget smaller.

EXAMPLE: A 0d+1 in Will with a "limited use" modifier is a total of a +1 bonus, making the gadget smaller. This is not a legal design strategy for a gadget.

The exception to this is Strength. Small gadgets *can* have negative Strengths, and have that Strength be limited in some way, provided that Strength is somehow reasonable for that gadget.

Each of an adventurer's Attributes will function differently in gadget form:

Strength: The gadget has some sort of inherent Strength that can be used to lift objects or provide a counter-force to offset something else with Strength or mass. This gives results about the same as a normal vehicle power plant when other modifiers are taken into account. This is the only Attribute that can be bought at *negative* levels, for very small lifting capacities. In this case, you get a *bonus* instead of a penalty, but only *half* value, rounding towards zero (e.g. a Strength of -9 would be a +4 modifier). You cannot take a negative Strength in a gadget unless it is reasonable for the gadget to have a way to use it. That is, you cannot use a negative Strength simply as a dodge to make the gadget smaller.

A limited use of Strength would be a gadget that can only support weight, or lift or push it in a fairly constrained way. For gadgets, most uses of Strength will be limited.

EXAMPLE: Both a forklift and a car jack are limited uses of Strength. The forklift will also be a facilitator, since the forklift operator can use skill or Agility to precisely lift or position objects with the forklift.

For Strength *added* to something, this is some sort of force multiplier which is either just a time multiplier (like a hydraulic jack) or something like an exoskeleton. If the added Strength is limited, it could be for a specific, overall purpose like lifting capacity, or for a limited aspect of whatever it is amplifying, like only for arms or legs.

Agility: The gadget has some sort of inherent Agility that can be used to apply any Strength it has, or used as the basis for Agility rolls or Agility-based skills. Most of the time, Agility is going to require some degree of Strength, even if it is a negative level of it. Note that robots and robotic vehicles are covered in more detail in the **Vehicles** chapter. A limited use of Agility might be restricted to a specific task or skill use, or reflect a limit in the gadget as to how it can express its Agility. For instance, a robot arm with a drill on the end can't pick up anything except may drill bits.

EXAMPLE: A robotic surgical arm will probably have full use of Agility, while an assembly line robotic arm would likely be a limited use.

If the Agility adds to something else, this is almost certainly some sort of high-tech gizmo that works in concert with the user's nervous system. A cybernetic nervous system that gives the user lightspeed reflexes would be an example. Gadgets that add to Agility would be very uncommon. Gadgets that offset penalties associated with a particular Agility skill would be more likely (like a gyrostablized targeting system for a weapon).

Awareness: The gadget has some sort of autonomous decision-making capability, sensory ability or both. A timer is an Awareness of 0d+1, a simple conditional response is an Awareness of 0d+2, and anything more than that may require an Awareness roll. A limited use of Awareness means the gadget may be limited to detecting things, or making decisions or performing calculations.

EXAMPLE: An Advanced Era handheld med-scanner might have an Awareness of 1d+1, a skill roll in a particular science of +1d, and a -2 offset to counter range penalties when using the skill. This might look like:

Modifier	Amount
Advanced Era gadget	+42 bonus
+4 Awareness	-8 penalty
Limited use of an Attribute	+3 bonus
+3 in a skill	-3 penalty
Offsets 2 points of range	-1 penalty
Total(gadget size of .5 millihex)	+33 bonus

This is a size of about .5 millihex, or about 250 grams (about the size of a cell phone and a bit denser). The same gadget at the Atomic Era would have a final size level of -21, or 8 millihexes (4 kilograms). This gadget would likely take further modifiers to note the fact that it consumes energy, whether it requires a user or can operate on its own, etc.

Gadgets with Awareness do *not* have artificial intelligence. If you wanted to do this, you would have a -4 modifier per +1 Awareness and -1 per +1 in an Awareness skill, with a minimum Awareness of +3 (1d+0) and at least a +3 in a skill roll in some common language so it could communicate. It is probably not going to be technologically possible until the Post-Atomic Era.

EXAMPLE: A Post-Atomic Era starship AI might have an Awareness of 2d+2 and four skills at +2d (language and 3 other skills). This would be:

Modifier	Amount
Post-Atomic Era gadget	+36 bonus
+8 AI Awareness	-32 penalty
+6 in a skill	-6 penalty
3 extra skills	-3 penalty
Total(gadget size of 3 hexagons)	+5 bonus

Less any other modifiers (power consumption, etc.), this gadget will have a size offset of +5, making it about 3 hexagons in size, with a mass of 1,500 kilograms. The same gadget in an Advanced Era ship would only be 375 kilograms.

Note - If you want a gameworld to have more portable AI's (like humanoid robots), you can put in a fixed modifier to get "brain" size down to a level you deem reasonable for your game's tech era.

If a gadget enhances the *user's* Awareness, it enhances all of it for a -4 penalty per +1. Enhancing just cognitive ability is a -3 penalty per +1and enhancing just the senses is a -2 penalty per +1. A limited use of enhanced Awareness would be something like cognitive ability for a class of skills, or enhanced Awareness for one particular sense. Again, note that it is not too far-fetched to think of a gadget that can enhance a sense (like a hearing aid), or perhaps enhance cognitive ability, but a gadget that does both would certainly be higher-tech than we are at right now.

Will: Uncommon for an inherent Attribute in a gadget, but might be applicable for an artificial intelligence or gadget that enhances or limits the user's Will. A limited use of Will would be something that only affects one possible use of Will.

EXAMPLE: You could make a "behavior control" gadget that had inherent Will for the purpose of helping the user overcome a psych problem, or in a more sinister vein, control someone into doing things they would rather not.

A gadget that enhances Will would be some sort of thing that gives you increased willpower, courage, determination, etc. This is uncommon for a gadget.

Health: Uncommon for an inherent Attribute in a gadget, because an Attribute in a gadget is normally for the *gadget*. Few gadgets *need* Health, since they run on batteries or discrete charges if it needs power. But, it might apply for gadgets that enhance or limit the *user's* Health. A limited use of Health might be something that can only affect endurance, movement or recuperative ability.

EXAMPLE: A gadget that has a limited use of added Health might be something like exoskeleton legs that increase the user's running speed. A walking machine might have a limited use of inherent Health for movement purposes. A walking machine that you sit in and control with your own Agility would also have the facilitator modifier . An autodoc might be a gadget that enhances the user's Health for recovering from injury.

Fate: Normally not allowed in a tech gadget (how do you use technology to enhance luck or magical power?). If your gameworld is such that this *is* possible, then you have to choose modifiers that give gadget sizes that seem reasonable for the effect generated.

EXAMPLE: As a contrived use of several modifiers in this category, we want to make an automatic pancake flipper. This requires a Strength of -6 to be able to flip up to .5 kilogram pancakes with no encumbrance penalty (a Strength of -6 has a full lift of 3 kilograms). We also give the flipper a +5 Agility and a +5 skill in "pancake flipping" (total skill roll of 3d+1), and an Awareness of 0d+2 to decide when pancakes need to be flipped and removed from the griddle. All of these Attributes are limited, and cannot be used for other purposes.

Modifier	**Amount**
Atomic Era gadget	+30 bonus
Strength of -6	+3 bonus
Limited use of an Attribute	+3 bonus
Agility of +5	-10 penalty
Limited use of an Attribute	+3 bonus
Awareness of +2	-4 penalty
Limited use of an Attribute	+3 bonus
Pancake flipping skill of +5	-5 penalty
Total(gadget size of 5 millihex)	+23 bonus

This gives us a gadget with a size of 5 millihexes and a weight of 2.5 kilograms. This ignores any power supply or other general modifiers on this sort of gadget. We can imagine it as a robotic arm with a spatula sitting next to the stove. If we wanted to make it a Post-Atomic Era gadget, we would just give it +36 for its tech era, resulting in a gadget of 1.25 millihex, or we could say that since this is mostly a mechanical device, and possible at say the Basic Era, then it can't get any smaller than an Atomic Era device. In this case, we would just increase its Attributes and skills to make it more capable and the same size.

On the other hand, if we wanted it as an Industrial Era gadget, we would give it +24 for its tech era modifier, which would result in a gadget with a final size of 20 millihexes, or 10 kilograms. A lot bigger and clunkier, but still concievably electric powered. The most primitive version of the gadget (Basic Era) would only have a +18 tech era modifier and would be a gadget of 80 millihexes, or 40 kilograms. Almost the size of a person, it would be a clockwork contraption of wood and wrought iron.

Skills: If a gadget has skills, it is usually a single skill or a set of related skills appropriate to the function of the gadget. An autodoc would have medical skills, or a sophisticated calculator might have built-in calculus or geometry routines. Skills in a gadget add to the appropriate Attribute in the gadget to get a total skill roll, just like skills work for adventurers. These skill levels only apply to the Attributes of the gadget. The user of the gadget does not get the bonus, they get a gadget that can work indepdently or utilize a skill that the user does not possess. If the skills are inherent to the device, neither the skills nor the level can be changed. The form of the device follows from its skills, like in the pancake-flipping bot from a previous example.

However, if a gadget has *programmable* skills, it means that the total skill levels it has can be altered, or modules pulled out and replaced with different but usually related skill sets or computer programs or whatever. As individual items, these "skill packages" will have a separate cost, and each one will probably have a size of the final gadget modifier with an additional -9 (one-eighth the size of the gadget). The actual information content of the skill package may have negligible size compared to the gadget, so this is a guideline rather than a rule. A gadget with programmable skills is larger than one without because in most cases the gadget will require larger, less specialized hardware to utilize these varying skills.

EXAMPLE: A computer would be a gadget with a limited Awareness (problem solving), with the Awareness representing the sophistication and speed of the computer. It's ability to hold several programmable skill levels represents the computer's storage capability.

A gadget with several inherent skills can use them together or in combination. If multiple skills use the same Attribute, you take a -1d to each skill roll for each extra skill if skills are used simultaeously (this is like multiple major actions for adventurers). A gadget that has programmable skills can use one at a time, or can use several, so long as any penalty for multiple skill use is taken.

EXAMPLE: A computer that is running several programs at once will run each of them slower than if were running only one. For instance, if it has a an Awareness of +4, a skill bonus of +4 and two programmable skills, it has a a skill roll of 2d+2 for one skill, or can roll 1d+2 for both skills if they are used at the same time (-1d penalty on each for one extra skill used). The reduced chance of success could be offset by adjusting the difficulty for taking more time.

Penalty offset: This does not give a gadget an Attribute or skill roll, but simply offsets a penalty on a particular type of roll, which may be a roll the gadget makes, or a roll the user of the gadget makes. A gadget can offset more than one penalty simultaneously. A set of binoculars offsets range penalties. A set of night vision binoculars offsets range penalties and darkness penalties. Devices that assist cognitive Awareness might offset time penalties, letting you do what you normally know how to do, just a bit faster.

Offsetting penalties is akin to Accuracy for a weapon, and is handled the same way. The chart below lists the maximum possible benefit at a given tech era, which is simply double the Accuracy limit for a mounted weapon (see page 2.22). If you make a gadget that affects weapon Accuracy or combat penalties, the maximum offset allowed is half the amount listed below.

Tech Era	Maximum offset
Early Primitive	-6
Primitive	-8
Late Primitive	-10
Early Basic	-12
Basic	-14
Late Basic	-16
Early Industrial	-20
Industrial	-22
Late Industrial	-26
Early Atomic	-30
Atomic	-36
Late Atomic	-42
Early Post-Atomic	-50
Post-Atomic	-58
Late Post-Atomic	-68
Early Advanced	-80
Advanced	-94
Late Advanced	-110

This lets you have ludicrously powerful penalty offsets at high tech eras, at the cost of making the gadget ludicrously large.

EXAMPLE: An Advanced Era society wants to make a telescope that offsets 94 points of range penalties. Not even counting specific arc bonuses, it would be able to see objects about 1 light-day in every direction like they were at arm's length. With a very narrow arc bonus, it would be able to see similarly well out to 10 light-years. Of course, this gadget would also be something like many *million* hexagons in size (several kilometers on a side), and we'll not even begin to speculate on the cost...

Facilitator - We mentioned facilitators before. These have two uses. The first is to allow transparent use of one of your Attributes in combination with an Attribute inherent to the gadget. A telepresence robotic surgical arm would be an example. The other use is to be a gadget that allows you to use a skill you would otherwise not be able to. In other words, a tool or toolkit. *It's hard to pick locks without lockpicks*.

For a facilitator, the Size of the largest object the gadget can be used on affects the size of the gadget. This modifier is a penalty of half the Size of the object worked on, rounding nearest (a Size of 7 rounds to -4, and a Size of -7 rounds to +4).

EXAMPLE: A set of tools is a facilitator for an auto repair skill. A set of tools to work on a bulldozer is larger than a set of tools to work on a motorcycle.

If you have to use a facilitator that isn't big enough for the job, you take a penalty on skill rolls of double the Size difference.

EXAMPLE: If you have to work on a Size 4 vehicle and all you have are tools for a Size 0 vehicle, your skill roll will be at +8 difficulty. So, you better hope it was an easy task to begin with...

A gadget does not have to have or affect an Attribute in order to be a facilitator. It can simply be a gadget with a tech era and a facilitator modifier, along with an adjustment for the maximum size of whatever you can use the gadget on. A gadget of this type will only be a facilitator for a single skill. This is the way you would design up a gadget that is a tool which a skill *requires* in order to be useful.

A facilitator might be one item, or it could be a set of items. The specific function of each of these items might apply to more than one skill, but the overall focus of the gadget is usually for one skill or closely related set of skills. Every tool-using profession has its own unique items.

Note - Sometimes what you might think of as a facilitator is really just an Attribute boost. A tire iron *could* be a facilitator for a specific sort of repair, but if you were strong enough, you *could* loosen lug nuts with your bare hands. So, a tire iron is really just a boost to Strength with a few other modifiers thrown in. However, you should not be wasting a single second of your finite lifetime using this system to design a tire iron...

If the facilitator modifier is applied once (-2 penalty), you can do basic tasks related to the skill or apply another Attribute through the gadget at no penalty. If the modifier is applied three times(-6), you can do advanced tasks related to the skill, and if it is applied six times(-12) you should be able to do just about anything related to that skill. This would be the difference between a set of tools for routine maintenance and a set of tools that lets you tear an engine apart and put it back together. In these cases, the modifier represents a set of gadgets rather than a single gadget that does it all, a tool box full of different tools rather than one very big and complex tool...

A facilitator gadget can offset penalties if it has that modifier, but it cannot increase skills unless it also has the "affects an Attribute or skill" modifier. Gamemasters should keep in mind the subtle difference between a penalty and an increase in difficulty. For instance, take two otherwise equal car engines, where one is nasty and dirty and in a cramped engine compartment. The engines are equally difficult to work on in terms of mechanical *complexity*, but one would have penalties that *could* be offset by more or better tools. On the other hand, a simple engine and a complex engine have different *inherent* difficulties, and there are no penalties that can be offset simply by having more tools. If you have enough tools for the complex engine, you have a bunch of tools that you simply won't be needing for the simple one.

EXAMPLE: We want to make an Atomic Era set of lockpicks, suitable for locks up to a few kilograms in size (a lock Size level of -18).

Modifier	Amount
Atomic Era gadget	+30 bonus
Facilitator	-2 penalty
Maximum lock Size level of -18	+9 bonus
Total(gadget size of .2 millihex)	+37 bonus

This gives us a final size of about .2 millihexes, or about 100 grams (.1kg), and represents a set of different lockpicking tools and probably a small case to store them in.

EXAMPLE: We want to make an Industrial Era set of tools, suitable for basic maintenance on cars and trucks up to several tons in weight.

Modifier	Amount
Industrial Era gadget	+24 bonus
Facilitator	-2 penalty
Maximum vehicle Size of +4	-2 penalty
Total(gadget size of 10 millihex)	+20 bonus

This gives us a final size of 10 millihexes, or about 5 kilograms. If we wanted enough tools to tear the car down to the smallest bits, it would be:

Modifier	Amount
Industrial Era gadget	+24 bonus
Facilitator x 6	-12 penalty
Maximum vehicle Size of +4	-2 penalty
Total(gadget size of 100 millihex)	+10 bonus

This gives us a final size of 100 millihexes, or about 50 kilograms. It is assumed these tool sets include the basics of what is required for that level of repair, but this does not include anything that isn't bought. So, there are no tools in either kit that boost skill or Attribute rolls. As a side note, you can say that certain repair or maintenance tasks on a gadget have a minimum requirement in terms of Attribute rolls. That is, yanking off bits of a bulldiozer might require beating a target number of 13 with your Strength roll. So if your Strength plus any gadget bonus cannot beat a 13, then you can't do it, *even with the tools*. In the case of the tools above, a person with a Strength of 6 would not be able to do whatever needed to be done, since their Strength roll of 2d+0 could never hit a target number of 13. If the gadget description had a "boosts Strength" of +1 or more, then a target number of 13 is possible for a person with a Strength of 6, since it would be adjusted to 7, and a 2d+1 roll can just barely eke out a 13.

Facilitating tools are generally bought at the *lowest* tech era applicable to the object of the skill being used in terms of their size, but at the highest tech era applicable to the object in terms of cost.

EXAMPLE: Automobiles are an Industrial Era (maybe Late Industrial Era) technology. So, tools to work on automobiles are also Industrial Era tech. However, if you buy tools that can work on Atomic Era automobiles, they will cost like an Atomic Era gadget. This is because you've got little Atomic Era bits in your toolbox to deal with specific needs of Atomic Era engines, in addition to plain old Industrial Era wrenches and the like. If we wanted a set of lockpicks (a previous example) that would work on Industrial Era skeleton key locks as well as modern tumbler locks, we would have to buy the lockpick set as an Industrial Era gadget, and it would be significantly larger. Since we didn't, it only works on Atomic Era locks.

Affects an Attribute or skill - The previously listed modifiers for Attributes and skills assumed that these Attributes and skills were inherent to the gadget, like Strength in an electric winch. A gadget *affecting* an Attribute or skill modifies the level the *user* has.

If the gadget cannot operate as an Attribute, but *can* enhance that Attribute or a skill in the gadget's user, then you use this modifier. You usually apply half the size level (round up) of whatever is being boosted as a penalty on the total. Items with a Size level of less than zero make a gadget smaller, those larger than zero make it bigger. A normal person has a size level of -7, for a +4 modifier.

As for Attributes inherent to a gadget, there are different modifiers for boosting different Attributes, but penalizing Attributes or skills is always a -1 penalty per point, regardless of the Attribute or skill . Also note the "limited use", "only boosts", and "only penalizes" modifiers. If you have none of these, you can buy both positive and negative modifiers in the same gadget. If you have "only boosts", you get a small bonus, but the gadget can have no negative effects. If you have "only penalizes", you get a large bonus, but the gadget can have no positive effects.

EXAMPLE: If we wanted one of our previous gadget examples to be a "pancake-flipping exoskeletal training arm", we would have something like the modifiers below. Since it only affects an arm rather than a whole person, we flip back to the body armor section (page 3.47) and see that one arm is a size of about 6 levels less than a person, making it a "boosted item" of Size -13.

Modifier	Amount
Atomic Era gadget	+30 bonus
Affects an Attribute or skill	-18 penalty
Size of affected item	+7 bonus
Only boosts Attribute/skill	+3 bonus
Pancake flipping skill of +3	-6 penalty
Total(gadget size of 24 millihex)	+16 bonus

This gives us a gadget with a size of 24 millihexes and a weight of 12 kilograms. This would get you an exoskeleton arm that gives anyone wearing it a skill roll in "pancake flipping" of their Agility plus 1d. A silly example, but you get the idea.

The maximum benefit a boosting gadget can give for the whole Attribute is equal to half the user's existing level in that Attribute. The maximum benefit for part of an Attribute is equal to the user's existing level in that Attribute. The maximum benefit that can be gained in a skill is the level of the user's Attribute, though this level can be compared *after* any boost given by the gadget.

EXAMPLE: If a gadget were designed to enhance the Strength of a person by +2d, it would require a person with 4d+0 Strength to get the full effect. If used by a person with a 2d+0 Strength, it could increase their ability to a maximum of 3d+0 Strength. A gadget designed to increase just the arm Strength of that person could boost a normal 2d+0 arm Strength to 4d+0.

If a further increase is required, you normally apply a time modifier to the use of the Attribute (taking longer to use it gives you a higher effective level). Each +1 bonus on the size of the gadget is a +4 time modifier and each +1 in time can equate to a +1 in the Attribute. It would be uncommon to ever claim a time benefit of more than +20 time levels. The boost to an Attribute from extra time levels is not subject to normal limits on how much a person's Attribute can be boosted, but it is subject to limits on the nature of the boost.

EXAMPLE: An Industrial Era floor jack that can lift 5 tons (Strength of +26) would normally be a fairly large gadget, but a smaller hydraulic jack helps enhance the Strength *of the user* by taking extra time to get extra lifting capacity.

Modifier	Amount
Industrial Era gadget	+24 bonus
Affects an Attribute or skill	-18 penalty
Size of affected item	+4 bonus
Only boosts Attribute/skill	+3 bonus
limited use of an Attribute	+3 bonus
+3 Strength	-6 penalty
+16 time levels	+4 bonus
Total(gadget size of 40 millihex)	+14 bonus

So, we have a gadget with a final size of 40 millihexes, or 20 kilograms. A person with a Strength of 7 or more can use this jack to lift something as though they had a Strength of 7 (their own Strength), +3 (the boost from the jack), +16 (the time level over which they lift it), or a total Strength of +26, for a lift of 5.1 tons. However, a time level of +16 is 4 minutes, so jacking up a 5 ton vehicle is going to take a little while. A person with a higher Strength *could* jack the weight up faster, or could take the same amount of time to jack up something even heavier.

Only penalizes Attribute/skill: If If a gadget is meant to harm or reduce an Attribute, then you use this modifier. Any positive levels in the Attribute, skill or ease of use instead become penalties. Like for boosted Attributes, you usually apply the size of whatever is being penalized. Note that if an Attribute is penalized, it automatically decreases the maximum level at which skills based on that Attribute can be used. So, if your Agility is reduced to 1d+0, you cannot use any Agility skill at a level of more than +1d. If your Agility were reduced to 0, then you could not use any Agility skills at all! Attributes can be penalized in limited ways, and this modifier would apply individually to the Attributes in question. You could have a gadget that is an overall penalty to one Attribute, and a limited penalty to another.

EXAMPLE: An Industrial Era set of "hobble chains" is designed to be a -3 penalty to Strength, and a -3 to overall Agility, and -3 to Health as relates to running speed. All of these penalties are limited to use of those Attributes as they apply to the legs. This would be:

Modifier	Amount
Industrial Era gadget	+24 bonus
Affects an Attribute or skill	-18 penalty
Size of affected item	+4 bonus
Only penalizes Attribute/skill	+12 bonus
-6 Strength	-3 penalty
limited use of an Attribute	+3 bonus
-3 Agility	-3 penalty
limited use of an Attribute	+3 bonus
-3 Health	-3 penalty
limited use of an Attribute	+3 bonus
Total(gadget size of 12 millihex)	+19 bonus

This gives us a set of chains with a size of 12 millihexes (6 kilograms), and they hinder the ability of the wearer to effectively use their Strength, Agility and Health as relates to movement (-2d to kicking damage, -1d to use of Agility when running or kicking, and -1d to Health for determining move rates). The inherent Armor of these chains might need to be enhanced with other modifiers (which we'll get to later), or a strong person might be able to break the gadget and be free to act normally. If this was an Atomic Era set of restraints, the same capacity would only have a mass of 1.5 kilogram, and if it were some Advanced Era set of restraints, it would only be about 90 grams!

Last note - Remember that we've just covered *this* subset of gadget modifiers. There will be general purpose modifiers that can apply to most of the design examples, to make them more or less useful, and usually larger or smaller as a result.

INFORMATION - An information gadget is one which records, plays or stores information. A book is an information gadget. So is an MP3 player, or a DVD player. A radio is a communication gadget, not an information gadget, but communication and information gadgets are often combined.

Information	Modifier
Information base effect	+(era/2) bonus
Each +1 information stored	-1 penalty
Each +4 time differential	-1 penalty
Records/plays info.(active)	-14 penalty
Records/plays info.(passive)	-7 penalty
Can only record information	+2 bonus
Can only play information	+4 bonus
No input (or no output)	+3 bonus
No input *and* no output	+4 bonus
Limited input/output(each)	+2 bonus
Removable storage system	-1 penalty
Recording medium only	+(era/6) bonus
Instantaneous recording type	+15 bonus

Base effect: An information gadget has an inherent bonus on its size of half the bonus for tech era.

EXAMPLE: An Atomic Era gadget has a +30 modifier for tech era. So, the "information gadget" modifier is +15.

The sum of tech era and base effect modifiers is the default amount of information the gadget stores, which is modified by the type of the storage.

Tech Era	Modifier	Info base	Info
Primitive	+12	+6	+18
Late Primitive	+14	+7	+21
Early Basic	+16	+8	+24
Basic	+18	+9	+27
Late Basic	+20	+10	+30
Early Industrial	+22	+11	+33
Industrial	+24	+12	+36
Late Industrial	+26	+13	+39
Early Atomic	+28	+14	+42
Atomic	+30	+15	+45
Late Atomic	+32	+16	+48
Early Post-Atomic	+34	+17	+51
Post-Atomic	+36	+18	+54
Late Post-Atomic	+38	+19	+57
Early Advanced	+40	+20	+60
Advanced	+42	+21	+63
Late Advanced	+44	+22	+66

The final gadget size is determined by the sum of all the modifiers.

An information gadget has the default ability to hold an information level equal to the base effect for its tech era. An ability to display or record this information will make the gadget bigger, and the quality or flexibility of the display or recording ability will adjust the size as well.

EXAMPLE: An Industrial Era gadget can as a default store an information level of +36. If the gadget can display the information, it would be larger. If it were simply the medium on which information were stored, it would be smaller.

Extra information: Each +1 information stored beyond the base for the tech era is a -1 penalty to the size of the gadget, and each -1 information stored is a +1 bonus. This is slightly more efficient than having a doubling of information take double the size. You actually get closer to three times the information stored for double the size using this modifier.

This is where the tech era bonus comes into play. A one tech era difference in an information gadget is not only an increase of +6 because of the tech era, and +3 for the "information gadget" modifier, but a gadget of the same size can also have the "extra information modifier" modifier nine times, for +9 more information!

Time differential: The default is that a gadget's information takes +1 time level to play or transmit for each +2 information level involved (round down). Each -4 Time levels used to transfer this information is a -1 modifier. For rates of information output like speech, the default is quite sufficient, but if you need to transfer 1 second's worth of CD audio (information content of +28) in 1 second (Time level of +0), then you need to pay for a time differential!

Output designed for human reading takes a time level of the information level minus the Awareness of the person going through the information (or Awareness minus -1d if you want to slow it down for "full understanding" instead of "scanning").

If the gamemaster wishes, they can put an upper limit on information transfer of one use of the modifier at the Basic Era, and one extra use each era after that. So, the Atomic Era CD player in the previous example would be limited to a maximum data transfer rate about the same as a 64x drive.

Note - Information gadgets are a case where tech era is not necessarily appropriate as a means of determining how densely information can be packed into a given volume of gadget. Sometimes you have to assign a tech era to a given class of information gadget, regardless of when it was *actually* invented or used. To recreate particular information storage technologies, see below. The 1 millihex column is how much information you would be able to store if counting the listed technology as just the blank recording medium (a modifier on the gadget of era/6).

Tech Era	1 millihex	Info tech
Primitive	+8	
Late Primitive	+14	Clay tablets
Early Basic	+21	
Basic	+27	Early books
Late Basic	+33	
Early Industrial	+38	Printing press
Industrial	+46	Vinyl LP
Late Industrial	+52	Microfilm
Early Atomic	+59	Magnetic tape
Atomic	+65	CD
Late Atomic	+71	DVD
Early Post-Atomic	+78	
Post-Atomic	+84	
Late Post-Atomic	+90	
Early Advanced	+97	
Advanced	+103	Human brain
Late Advanced	+109	

EXAMPLE: If you took about one hundred sheets of normal paper, you could print 160,000 words (an Information level of +34) on it with no problem, and this 100 sheets of paper would be about 1 millihex. A stack of blank CD's that totalled 1 millihex would hold somewhere around an information level of +65. And even though materials liike vellum or papyrus predate the Basic Era, you would use Basic Era numbers if you wanted to get a passably accurate size for something like a hand-printed Bible.

For reference, note that the Library of Congress circa 2006CE has an information content in terms of word count (not pictures) of about +81, and the possible number of interconnections in the human brain are theorized to have a total information storage capacity of over +100! In this design system, each fraction of a tech era gives 8x the information density available (+6 information), but practically speaking, a given technology may last quite a while and then be superceded by something two fractions of a tech era ahead of it.

EXAMPLE: A book with an information content of +39 (a Bible), read by a person with an Awareness of 9, would take a time level of +30 to scan (8 hours) and a time level of +33 to really read it (24 hours). A person with an Awareness of 7 would take twice this amount of time. A CD audio player might have the default information transfer rate, and could play its +53 information content in a time level of +26 (about 2 hours). A CD drive in a computer might take the increased transfer rate twice (-8 time levels), which would allow it to transfer the same information in a time level of +18, or 8 minutes. This would be about a 16x drive.

Records/plays info: The gadget is capable of recording and playing information in a human-readable format. The "active" version of the modifier (-14 penalty) means the gadget has some sort of internal technology that allows this, and the gadget can have modifiers to affect the speed of recording and playback. The "passive" version of the modifier (-7 penalty) means that the gadget relies on outside technology or action in order to be read or recorded onto.

EXAMPLE: An active playback gadget would be a CD player. A passive playback gadget would be a book.

While an active record/play gadget can be designed as "play only" or "record only", a passive record/play gadget is almost always a record and play gadget. Even if a book is already printed, you can still write on it between the lines and in the margins. Back when vellum was used for writing and people didn't need what was written on it anymore, they would sand off the old printing and re-use it. *Yes, vellum was that hard to come by.* *One* sheet of genuine calfskin vellum manufactured today will cost you about 20 Credits!

Record only: If you take the "records/plays" modifier, you can say the gadget is only capable of recording information,for a +2 bonus. A pencil or stylus would be a low tech example. A film camera would be a higher tech example, and would have a total information capacity based on the quality of the film and the size of the roll. An item like a blank CD is *not* a gadget that can record. Rather, it is the medium recorded onto, which is a different modifier.

A gadget that contains no information but is used for recording information would be bought as an information gadget with a negative information modifier that balances out its tech era bonus.

EXAMPLE: A normal pencil would be something like this:

Modifier	Amount
Basic Era gadget	+18 bonus
Information gadget	+9 bonus
-18 information	+18 bonus
-4 time differential	+1 bonus
Records/plays info.(passive)	-7 penalty
Can only record information	+2 bonus
Total(gadget size of .08 millihex)	+41 bonus

This is a gadget that can record information, but only under outside direction. The rate of information recording is 4 levels less than normal, so you can write about 20 words per minute with it. Close enough for such a trivial example.

Display only: If you take the "records/plays" modifier, you can say the gadget is only capable of playing information,for a +4 bonus. A record player or movie projector would be an example. A portable radio is a communication device, not an information device, but it would not be uncommon for a portable radio to have a CD player or other inherent information device, with or without recording capabity.

EXAMPLE: A portable CD player (information level of +53) would be something like this:

Modifier	Amount
Atomic Era gadget	+30 bonus
Mature technology	+2 bonus
Information gadget	+15 bonus
+8 information	-8 penalty
Records/plays info.(active)	-14 penalty
Can only play information	+4 bonus
Limited output device	+2 bonus
Removable storage system	-1 penalty
Total(gadget size of 1 millihex)	+30 bonus

Remember that the base information level of this gadget is the tech era bonus (+30) plus the information gadget modifier of half that (+15), for a total of +45. In this example, the limited output device means the CD player only does audio, instead of audio, video and computer data, and the removable storage system refers to the fact that you can easily switch CD's in and out of the player. Since the default playback rate is +1 time per 2 information levels, a CD with +53 of audio information will play back in a time level of +26, or 2 hours.

No input/output: The device still has output or input, but it has no inherent means of displaying or utilizing this information. A set-top DVD player is a good example. It can only display information, but *also* has no output device. You have to hook it up to a television to utilize the information it is trying to play. A CD player with no speaker (headphone use only) is another example.

EXAMPLE: A set-top DVD player might be something like this:

Modifier	Amount
Late Atomic Era gadget	+32 bonus
Information gadget	+16 bonus
+11 information	-11 penalty
+4 time differential	-1 penalty
Records/plays info.(active)	-14 penalty
Can only play information	+4 bonus
No input *and* no output device	+4 bonus
Removable storage system	-1 penalty
Total(gadget size of 1.25 millihex)	+29 bonus

This gives us a .6 kilogram box than can play removable DVD's. The normal playback time for an Information level of +59 is a Time of +29, but we have a +4 time differential, so it only takes a Time of +25 (about 1.4 hours), or an information content of +34 per second, about what normal television is.

A DVD player/recorder would qualify for the +3 version of the modifier, since it has to be provided with an input signal of the proper type to record anything. A film camera would qualify for the +3 modifier, since it includes everything it needs to record with no external assistance, but has no means to transmit the information. The film has to be removed and developed in order to display the information.

Limited input/output: A gadget with limited output can do what a device with full input or output can do, but at a -3 penalty to quality or ability to be utilized or analyzed. An example might be a digital camera with an electronic viewfinder. You can preview your pictures on it, but cannot see the full detail you would on a larger screen. A digital camera would *not* have the "no output" modifier, since it can transmit *full quality* information to an external device via a cable or removing the memory card. It is just that reviewing information using only the digital camera that is penalized.

A limited form of input or output can also represent that the gadget can only deal with a subset of the possible information types that a full device could handle. A CD player that only handled audio CD's and could not be hooked up to a computer or video system would be an example.

Removable storage: This is just a mechanical penalty that is taken if the means of storing information is easily replaceable, like changing memory cards in a digital camera, putting a new disk in the CD player or new records in a record player.

Storage medium only: If the gadget is *just* the recording medium, you apply a modifier equal to one-sixth the base effect for the tech era, rounding nearest (e.g. an Atomic Era removable storage device would have a +5 modifier). If the recording medium is human-readable (like paper), then it can also be the output device.

Note - Most forms of human-readable recording mediums will take the "storage medium only" modifier and the "record/play(passive)" modifier. A printed book can still be written in, you just write in the margins. Paper, printed or not, can still be used to "record and play" new information. A device like an e-book reader would not get the "storage medium only" modifier, since it is more than just a passive recording medium. Similarly, photographic film can only be used once for its *intended* purpose, though there is nothing to stop you from writing on a photograph.

For all practical purposes, the Early Industrial Era is the last point at which the maximum possible information density is discernable to an unaided human, and that's pushing it, since microscopic writing done with a diamond stylus on glass was sold as a curiousity in the late 19th century. This points out another quirk of primitive information storage systems. Often, you can get a bonus to the information density by taking extra time to *write* the information. That guy with the diamond stylus and a microscope was not writing very fast, but the information density was probably about the same as microfilm, which is at least thousand times more space-efficient than conventional printing.

EXAMPLE: A CD is on the **EABA Universal Chart** as holding an information level of +53. If we assume this is an Atomic Era gadget, it would look like:

Modifier	Amount
Atomic Era gadget	+30 bonus
Mature technology	+2 bonus
Information gadget	+15 bonus
+8 information	-8 penalty
Storage medium only	+5 bonus
Total(gadget size of .04 millihex)	+44 bonus

This gives us a .04 millihex gadget (20 grams), which is close enough to a CD to be useful for game purposes (an actual CD by itself is around 18 grams).

EXAMPLE: A mass-produced book is an Early Industrial Era technology (Basic Era would be hand-copied books). So, if you want to store the default informationof **EABA** (information level of +32) in an Early Industrial Era gadget, it would look like this:

Modifier	Amount
Early Industrial Era gadget	+22 bonus
Information gadget	+11 bonus
-1 information	+1 bonus
Records/plays info.(passive)	-7 penalty
Storage medium only	+4 bonus
Total(gadget size of .75 millihex)	+31 bonus

This gives us a book of .4 kilograms (about .8 pounds), which is surprisingly close to the mark for such a simple design system. You could run it off with tiny print and on very lightweight paper and make it half that size or less. If you wanted to store **EABA** on a Late Atomic Era re-writable computer chip, it would be:

Modifier	Amount
Late Atomic Era gadget	+32 bonus
Information gadget	+16 bonus
-16 information stored	+16 bonus
Recording medium only	+5 bonus
Total(gadget size of <.01 millihex)	+69 bonus

It would be not quite microscopic. Consider that a 4 gigabyte flash drive has a chip smaller than your thumbnail and would hold several thousand copies of the **EABA** text, and this miniscule gadget size is not unreasonable...

Instantaneous recording: This is a special modifier that only applies to a storage medium whose nature combines with the inherent biology of the user, such that the information is transmitted at an extremely rapid rate. For instance, reading is a learned ability. Looking at a photograph instantly tells you if it is a picture of you or a friend or a stranger. The modifier means that the information can be stored in a much more compact form. You don't have to combine squiggly shapes into words, and then string those words together to generate advanced concepts. *You just look...and know*. In **Stuff!** terms, the old saying "a picture is worth a thousand words" really means "a picture can be read as fast as a thousand words."

EXAMPLE: A full-page color photograph has an information content of about +36. The info could be stored as a roll of Late Industrial Era punched paper tape, data that could be read and analyzed by a machine or transmitted over data lines, or it could be stored as a color image on a sheet of paper:

Modifier	Amount
Late Industrial Era gadget	+26 bonus
Information gadget	+13 bonus
-3 information	+3 bonus
Records/plays info.(passive)	-7 penalty
Can only play information	+4 bonus
Instant. recording medium	+15 bonus
Total(gadget size of .004 millihex)	+54 bonus

The photograph is printed on "paper", but once developed, you can't put a new picture on it, so it is bought as a passive display gadget only. You end up with a 2 gram item. The Late Industrial Era paper tape data storage would be just the recording medium, since once punched, the paper tape cannot be recorded on again. The paper tape is not a instantaneous recording medium. It would end up being something like:

Modifier	Amount
Late Industrial Era gadget	+26 bonus
Information gadget	+13 bonus
-3 information	+3 bonus
-8 time differential	-2 penalty
Storage medium only	+4 bonus
Total(gadget size of .04 millihex)	+44 bonus

It would end up being about the same as eleven sheets of paper's worth of tape (a narrow strip about 3.5 meters long), depending on any other modifiers you used.

EABA

This particular modifier only works for single units of information. While we may process sound as efficiently as we process images, sound by its nature takes time to listen to. While it may have a lot of meaning in *context*, the *actual* information content of a short "beep" is negligible. Humans would use this modifier for pictures. Alien races with different senses might apply this in different ways. A human might need a computer and analysis kit to figure out a pheremone, while the alien species who communicates with scent can read volumes from a single whiff.

Note - As mentioned earlier, people can scan text in a time of the information level minus their Awareness. However, we have evolved to process abstract visual information at a rate that Late Atomic Era computers still have not caught up with. A person can process images and make conscious or instinctive decisions based on that information at the rate of maybe +50 information in one second (look at how much you have to analyze in one second of driving a car). However, anything more than about +30 starts to get "downsampled" to a level we can process, which is why the rapid, individual frames of animation, television or motion pictures look like continual motion.

Information notes - *There is a big difference between information and content*. If you scribble down a phone number, you have copied the information, but not the content. *At least not in **EABA** terms*. The *content* would be an exact duplicate of the *image* of the original number. *Like a photocopy*. The **EABA** information scale is listed in "words". This page is somewhere around 600 words, for an information level of +18 (so if your Awareness is 7, it should take you about 42 seconds to scan it). If you extract the text and save it as unformatted computer data, it would be an information level of +18. If you saved it with the visual formatting of the page, like a pdf file, it would be larger, and if you saved the page as an image file, it would be larger still. A one-page written description of a crime scene is less information than a one-page photograph of the same location.

All of this makes a difference in how much "information" is being stored or played back. For instance, a photocopier is orders of magnitude less efficient than a computer printer, since the computer printer simply outputs the formatted information, while the copier duplicates the entire content of the original, smudges and all. On the other hand, an analog medium like an old vinyl record does not store as much information as a CD would, but it plays it back in smooth, continuous waveforms that are very efficient to imprint onto a record. The CD has to approximate these same waveforms by playing back individual slices at a rate we cannot distinguish from continuous sound, much like we cannot discern the individual frames of a motion picture. We suppose the ultimate audiophile disc would be an analog format that is read by laser and directly amplified without any digital-to-analog conversion.

Since most of the information that we interact with is in the form of images and sounds, here are some guidelines when it comes to converting "words" to information levels.

Information	Info level
One page of text or visual material	+18
One second of audiovisual material	+18

Modifiers	Amount
Formatted text	+6
Very simple image(b&w copier)	+10
Simple image(greyscale)	+14
Image(color)	+16
Complex image(good color)	+18
V.complex image(perfect color)	+20
Single frame black & white TV image	+3
Single frame color TV image	+7
Single frame high def TV image	+11
Some enlargement(large TV)	+2
Much enlargement(theater screen)	+4
Three-dimensional information	+6
Passable animation(1 second)	+5
Full animation(1 second)	+8
Low loss compression	-4
Medium loss compression	-8
High loss compression	-12
Extreme loss compression	-16
Music reproduction, 1 second	+10
Analog format sound reproduction	-16

EXAMPLE: A one-page (+18) complex image (+18) with medium loss compression(-8) would be an information level of +28. One second of speech (+18) recorded in an analog format (-16) would be an information level of +2.

Because each ±1 represents about a twenty-five percent change in item size and each ±3 doubles or halves it, an unnecessary or missed modifier can make a *big* difference in gadget size. A few guidelines are below:

Tech type	Qualities
Paper (text)	Record & display(passive) Storage medium only
Paper(photo)	Display only(passive) Storage medium only Instant. recording medium
Phonograph	Recording medium only
CD/DVD	Recording medium only
Flash drive	Recording medium only
CD audio	Display only(active) Limited (or no) output device Removable storage system
DVD video	Display only(active) Limited (or no) output device Removable storage system +4 time differential
Hard drive	Record & display(active) No output device
CD-RW drive	Record & display(active) No output device Removable storage system
DVD-RW drive	Record & display(active) No output device Removable storage system At least +4 time differential
Flash MP3	Record & display(active) Limited (or no) output device
Media player	Record & display(active) Removable storage system
Digital camera	Record & display(active) Limited output device Removable storage system
Film camera	Record only(active) No output device Removable storage system

Not all types of information can historically be written and read and duplicated with equal ease. It is possible to make a high-speed printing press to generate copies of information, but have to settle for manual typesetting to record that information. Similarly, you can read a book a lot faster than you can transcribe one (a pencil is a slow recording tool).

To put it in common frames of reference, the following should help:

Information type	Info level
1 page text	+18
1 page formatted text	+24
1 page b&w photocopy	+22
1 page greyscale photocopy	+24
1 page color photocopy	+28
10 x 15cm greyscale photograph	+28
10 x 15cm color photograph	+34
1 megapixel digital camera, 1 image	+30
5 megapixel digital camera, 1 image	+34
Black & white television, 1 second	+29
Television, 1 second	+33
High-def television, 1 second	+37
Digital feature film, 1 second	+50
CD music, 1 second	+28
MP3, 1 second	+22
Low quality analog music, 1 second	+6
High. quality analog music, 1 second	+12
Accepable quality analog speech	+0

EXAMPLE: A very complex image for a motion picture would be an information level of +50 for 1 second. For a 2 hour film (a time level of +26), the total information level would be +76, which is somewhere around 2 terabytes of data. With some compression and decrease in picture size, this would fit onto the +59 information content of a DVD (or two). On the other hand, a lower quality pirate copy for viewing on a computer monitor would be perhaps an information level of +53, which would fit on a CD.

In camera terms, a good picture from a 5 megapixel camera would be a very complex image with low-loss compression, while a good film camera would be a very complex image, but of one-quarter page size (a -4 modifier). For television, the *perceived* image quality is what you get once the animation modifier is factored in. The analog speech and music numbers are suitable for use with radio-based communication gadgets.

EXAMPLE: A CD holds an information level of +53. This would be +25 time levels of CD-quality music (1.4 hours), +20 time levels of television (15 minutes), +31 time levels of MP3-quality music (11 hours), over 20,000 pages of formatted text or over 100,000 pages of raw textual data.

Note - If we use this system to go out on a limb and project future information storage, you get a change in information density of about x8 per *fraction* of a tech era. Using one "CD+" (an information level of +54) to represent about 1 gigabyte of data, then you get the following:

Tech era	"CD capacity"
Early Industrial	250 kilobytes
Industrial	2 megabytes
Late Industrial	16 megabytes
Early Atomic	128 megabytes
Atomic	1 gigabyte
Late Atomic	8 gigabytes
Early Post-Atomic	64 gigabytes
Post-Atomic	256 gigabytes
Late Post-Atomic	2 terabytes
Early Advanced	16 terabytes
Advanced	128 terabytes
Late Advanced	1 petabyte

Double each value if it is a "mature tecnology". It's not perfect, but it's fun to play with. If you think this progression is extreme, consider that a DVD already holds x8 the data of a CD (x16 for double-layer DVD's), and a 4 gigabyte flash memory card (2 grams) holds information at x2 the density of a double-layer DVD. That gets us up to 32 gigabytes per CD equivalent, and that is just when this was published in 2006CE. Estimates of human memory capacity vary, but about 1 petabyte (1,000,000 gigabytes) is a number to play with, and if this is so, then everything you will ever remember in your entire life will fit on a Late Advanced Era CD, with room to spare...

Considering that you can already cram a solid month's worth of songs with zero repeats into a handheld media player (60 gigs), the implications for both the real world and any science-fiction gameworlds should be examined. *For instance, has anyone in the world with a full 60 gigabyte MP3 player spent the 20,000 Credits it would take to legally acquire that many songs?* By the time you get to the Post-Atomic Era, information storage will be so cheap and easy that collected information will probably *never* be thrown away. A month of video surveillance will fit on one CD equivalent (or less). Firearms can mount tamper-proof cameras that hold thousands of photographs, snapping a picture every time the trigger is pulled. A chip under your skin could act as ID, passport, credit card, door key and medical history. Think of how society and governments will use and misuse technologies that allow extremely high information densities.

COMMUNICATION MODIFIERS - A gadget with these modifiers is a communication device of some kind, from a telegraph to a cell phone.

Communication	Modifier
Communication bonus	+special
Each +1 range level	-special
Signal arc	-special
Output device	-special
Extraordinary range	-special
Special cases	+special

If you just want a quick, simple two-way comm gadget, use the default bonus and a -1 penalty per 3 range levels. The range level of the gadget will be its range plus that of whatever it is talking to. Everything else in this section is detail you may not want or need.

Communication bonus: Comm gadgets get an overall bonus based on tech era:

Tech era	Modifier
Primitive	+1 bonus
Basic	+2 bonus
Industrial	+3 bonus
Late Industrial/Early Atomic	+4 bonus
Atomic	+5 bonus
Late Atomic	+6 bonus
Early Post-Atomic	+7 bonus
Post-Atomic	+8 bonus
Late Post-Atomic	+9 bonus
Early Advanced	+11 bonus
Advanced	+13 bonus

Range: Communication devices have a signal strength or quality, which really just equates to a certain penalty to size giving +1 or more range levels. The reliable communication range between two gadgets is the sum of their range levels. This range calculation is different than it may have been presented in other **EABA** supplements, but that's because we hadn't fully quantified the system yet... A weak transmitter can be offset by a high quality receiver, and a poor receiver can pick up distant signals from a powerful transmitter.

EXAMPLE: A 3 point transmitter and a 20 point receiver have a total range level of 23 (1 kilometer). A 20 point transmitter and a 20 point receiver have a total range level of 40 (362 kilometers).

The penalty taken for a given range level depends on the amount of information you are trying to pump through the gadget, and its "utility".

Information is simple. You add the information level transmitted or received to the range level desired. It takes more circuitry to create or decipher a television image than it does simple sound. It requires more gadgetry to decipher a noise-free stereo music broadcast than it does to deliver a scratchy voice-only transmission, and it takes more for simple voice than it does for a dit-dah-dit morse code transmission.

"Utility" is a nebulous sort of thing, and because it can make a huge difference in a comm gadget's range, it should be considered carefully. Most communication gadgets will operate on some part of the electromagnetic spectrum, low-band radio through high gigahertz satellite comm systems. The "utility" of a system is a measure of how broad a frequency range it can cover, and how well it interacts with *other* communication systems.

To get the size penalty for a gadget's range, you take the range level desired, add the total information level per second, and divide this by the utility of the gadget, rounding nearest. If the gadget is a full transceiver, the utility is reduced by 1. If it is just a transmitter or just a receiver, the utility is the normal value. The minimum allowed utility modifier is 1. So, a gadget with a normal utility of 1 can only be a transmitter *or* receiver, but not both, since this would drop its utility to zero. If a gadget is a full tranceiver, but has different transmit and receive information rates, use the average of the two rates.

EXAMPLE: A television image is an information content of about +33. A television receiver with a range of 6 and a utility of 3 would take a size penalty of (6 + 33)/3 = -13. You could also say it was the range level/3 plus the information level/3, but you might get different rounding amounts that way. If the gadget were able to transmit and receive television signals, the utility would drop from 3 to 2, and the size penalty would be (6 + 33)/2 = -20.

If a gadget is just designed to detect the presence of a particular type of signal, count it as having an information level per second of -8. Similarly, if all a transmitter does is broadcast a carrier signal or constant tone, it has an information level of -8.

EXAMPLE: A homing beacon with a utility of 4 and a range level of 20 would have a size penalty of (20 - 8)/4 = -3.

The default utility of 1 means the gadget has a fairly broad range and is fairly indiscriminate about the type of signals it can pick up or transmit. Very few gadgets would have a communication range this broad, if for no other reason than going to a utility of at least +2 range per -1 size penalty is so much more efficient. The *maximum* range benefit for utility at a given tech era would be a gadget that only operates on a small number of exact frequencies, and does it in a way that is completely incompatible with any gadget that isn't meant to operate on those exact frequencies in the same manner.

Think about any communication gadget in your immediate environment. *If you, all the gadgets, an electronics tech and a full set of tools were teleported to a desert island, how long would it take to get all those gadgets to talk to each other?* The best "utility" of a communication gadget can be no more than 1 at the Primitive Era and +1 each era after that. A gadget does not have to use the maximum benefit, but it will be the smallest gadget possible for a particular purpose if it does. If a communication gadget has multiple, separate functions of identical utility, count the overall utility as 1 point less.

EXAMPLE: An AM radio has +3 range per -1 size penalty, as does an FM radio. An AM/FM radio would have +2 range per -1 size penalty.

The utility of a gadget is effectively a tech era-dependent way of making a specific-purpose gadget smaller. So, rather than a shortwave radio that picks up a dozen different bands, you have a tiny FM radio built into your MP3 player. Instead of a general purpose walkie-talkie, you have a cell-phone with a push-to-talk function that only works in conjunction with a service provider. Some examples are below:

Gadget	Modifier
Multi-band receiver	+2 range per -1
AM/FM radio receiver	+2 range per -1
AM radio receiver	+3 range per -1
FM radio receiver	+3 range per -1
AM or FM transmitter	+3 range per -1
CB radio	+2 range per -1
Television receiver	+3 range per -1
Television transmitter	+2 range per -1
FRS radio	+3 range per -1
Laser comm. system	+3 range per -1
Sat. dish TV receiver	+4 range per -1
Cell phone	+3 range per -1
GPS system	+4 range per -1

Typical communication rates for common systems are below:

Communication	Info rate
Telegraph	-4
GPS signal	-4
Voice	+0
Mediocre music	+6
Fax machine	+12
Dial-up internet	+12
High speed internet	+20
Black & white television	+29
Compressed TV images	+29
Color television	+33
High-def television	+37

As a quick note, the difference in dial-up and high-speed internet speeds gives the same size gadget if dial-up is Atomic Era and high-speed is Late Atomic Era, and both signals have a utility of 4. If you have adventurers who need to tinker with gadgets, a gadget with more utility (smaller range bonus) can sometimes be modified to interact with gadgets of less utility, but *not* the other way around. You can also say that "utility" represents the tech level of signal processing, and that if a tech era can't make a gadget capable of a certain utility modifier, they have no means of eavesdropping on that type of gadget. Ignore the transceiver penalty of -1 when figuring this out.

EXAMPLE: Cell phone frequencies and methods are a utility of 4, and CB radios a utility of 3 (before any tranceiver penalty). If you have an Industrial Era short-wave receiver with a utility of 2, you might be able to eavesdrop on CB radios, but could not do the same to cell phone calls, since an Industrial Era gadget can't have a utility of more than 3. If you had an Atomic Era shortwave you might be able to, since it has a broader range and can pick up signals up to a utility of 4. But, it would be useless for listening if Post-Atomic Era aliens invaded and were using "subspace radios" with a utility of 5.

Remember that utility is a general guide. Your shortwave radio is never going to pick up smoke signals, and laser receivers do not pick up radio transmissions. Also keep in mind that each +2 in transmitter strength/receiver sensitivity is a combo of transmitting power and receiving sensitivity sufficient to *double* the range of the gadget. So, between equal gadgets, a +1 range level in each of the gadgets doubles the overall range. In real-world terms (not necessarily game terms), each +2 range in one gadget about doubles transmitter power.

ADVANCED TOPIC: VERY LONG RANGE

If it makes a difference for your gadget, you can say the *maximum* effective range level for a pair of gadgets is double the bonus for the tech era of the most advanced of the gadgets. This range level is adjusted up by any antenna bonus. The maximum *difference* in effective range level between the gadgets after antennas are taken into account can be no more than the bonus for tech era.

EXAMPLE: An Atomic Era space probe has a small transmitter whose signals are picked up by very sensitive Earth-bound receivers. Since the bonus for Atomic Era gadgets is +30, this would mean that the maximum comm range, *regardless of receiver quality*, is going to be a range level of 60 (350,000 kilometers). Furthermore, after antenna modifiers are taken into account, the difference between the transmitter and receiver can be no more than +30.

So,if we had a space probe transmitter and ground receiver, with a parabolic dish antenna on both ends (+32 range), the maximum range level we can possibly get with this combination would be +92 (double tech era bonus, plus antenna). In order to get this, we need a transmitter and receiver pair that have no more than 30 points of difference after antennas on each are taken into account. In this particular case, the combination that gives the smallest transmitter power would be a transmitter with a range of 31, of which +16 is from the antenna, and a receiver with a range of 61, +16 of which is from its antenna. If our space probe only had a transmitter strength of +10, it would be +26 after the antenna, and the maximum range any receiver could pick it up from would be +86 (+26 plus double the tech era bonus).

You can see that in extreme cases like this, small modifiers can make a very large difference. The difference in range you get from a "coherent" antenna and a "near-coherent" one is +4, or four times the effective communication range.

If a communication gadget has an information rate of more than +0 (voice), the gamemaster may allow +1 range for each -4 to the information rate. You can decipher morse code beyond voice recognition range, or pick up the audio from a television signal at ranges past where you can get a good picture.

Note - If you want to use these rules as part of a backdrop for "technomagic", then you can assign various "utility" ratings to various sorts of paranormal energies for purposes of detecting them.

If it makes a difference, a person's eyes or ears are considered to be a receiver quality of their Awareness. If they are looking for a particular signal, they can add double their Awareness to this quality, and if they are listening for a signal, they can add their Awareness. A shout is assumed to be a transmitter with a Strength of the person's Health.

EXAMPLE: A person with an Awareness of 8 is looking for a signal flash from a distant hilltop. Since they are looking for a particular signal, they add 16 (double their Awareness) to their "receiver quality", making it 24. This means that even if the signal flash had a transmitting range of 0, they would still be able to spot it at a range level of 24 (1.4 kilometers). Note that if this is a Primitive Era setup (tech era bonus of +18), then you will want a transmitting range of at least 6, since you are only allowed the tech era bonus of +18 as the difference between the two.

EXAMPLE: The same person is listening for the beating of war drums 2 kilometers off, a range level of 25. They get to add their Awareness to their receiver quality, making it a 16. The effective range for this is still far less than the range, so the war drums are going to need a transmitting range level of at least 9 to get a total range level of 25.

This is not meant to supplant the normal **EABA** perception rules, but is a way to let people interact with primitive communication systems like heliographs and war drums. For things like perception, it is not unreasonable to have a person roll their Attribute and use the result as their range level for communication purposes.

The useful range for a pair of communication gadgets can be affected by conditions and barriers to the type of signal used. Apply the penalty to the final range level for the pair. For many radio-frequency devices the following are reasonable:

Communication barriers	Range level
Inside a small building	-1
Inside a large building	-3
No line of sight	-2
Underground/underwater	-6
Deep underground/underwater	-12
Jamming/interference	- level

No line of sight usually means *nearby* obstacles. Any line of sight blocked by the curvature of the earth would take the underground modifier.

EXAMPLE: A pair of normal handheld walkie-talkies have a range level of perhaps 12 each, for a total range level of 24 (1.4 kilometers). If we said one of them was in an underground parking garage and one was on the surface, this is a 6 point penalty on range, which means it would drop to a range level of 18, or 175 meters. If both were outside, but there was a 30 point jammer transmitter running 1 kilometer away from the closest walkie-talkies (a range of 23), then the walkie-talkies would suffer a 7 point penalty (jamming strength minus the range), dropping useful range from 24 to 17, or 125 meters.

A thing that can't really be taken into account here is any infrastructure needed to overcome a particular communication barrier. For instance, a cell phone works best if there is a line of sight to the relay tower. This requires a relay *tower*, not a box sitting on the ground somewhere in the woods or in the middle of a flat roof. This sort of support structure can easily be hundreds of times the size of the actual communication gear. On a smaller scale, if a directional antenna for a portable gadget is not incorporated into the gadget itself, the gadget should take a -2 penalty to size to represent the extra cables or mounting hardware for the system.

Signal arc: The default for a transmitter/receiver is a 360° arc. If it has a smaller arc, it has a greater effective range with no extra energy needed to power the gadget. But, it *does* require proper aiming to get the bonus. *If not properly aimed, it takes a penalty to effective range instead!* A directional antenna will increase the size of the gadget by one-quarter the range bonus (round nearest):

Arc	Range level	Modifier
360°	+0	+0 bonus
180°	+1	+0 bonus
120° fan	+1	+0 bonus
120° cone	+2	-1 penalty
60° fan	+2	-1 penalty
60° cone	+4	-1 penalty
30° fan	+3	-1 penalty
30° cone	+6	-2 penalty
15° fan	+4	-1 penalty
15° cone	+8	-2 penalty
5° fan	+6	-2 penalty
5° cone	+11	-3 penalty
near-coherent	+16	-4 penalty
coherent	+20	-5 penalty

Remember that a bonus to range because of a directional antenna does *not* increase the power consumption of the gadget.

The difference between a "fan" and a "cone" is that a signal from a fan is limited only in one direction, while a cone is limited both horizontally and vertically. A fan might be what you would get from an array of vertical antennas, while a cone would be like what you get from a dish antenna.

"Near-coherent" is a good approximation of a commercial microwave dish like a satellite TV system. There is a very small room for aiming error that is barely within the range that a person using something to brace against can aim it accurately, and a solid mechanical mounting is required.

"Coherent" would be things like lasers, masers or the finely tuned systems used for deep space communication. A solid mechanical mount is required for any reliable signal. Both of these last two modifiers can be adjusted up or down a point by especially low or high quality antenna systems. A mass-produced satellite TV dish is probably not as capable as the precison dish mounted on a multi-million Credit satellite.

EXAMPLE: At this point, we have enough info to do a simple design example. It will be a Late Industrial Era shortwave receiver, something using vacuum tubes that takes up a fair amount of real estate on the dining room table:

Modifier	Amount
Late Industrial Era gadget	+26 bonus
Communication gadget	+4 bonus
(Range 16 + info 6)/utility 2	-11 penalty
Total(gadget size of 12 millihex)	+18 bonus

This gives us a 6 kilogram box that might be able to pick up a high-powered radio station at a range level of 53, which after you take various penalties (like -6 for the curvature of the earth), still allows you to listen to overseas stations without too much difficulty. The information level of 6 is sufficient for low-quality music broadcasts, but the radio can pick voices out of the static at longer range, and probably get morse code at ranges where voice communication could not get through.

Note - In the realm of pure speculation, real-world communication gadgets would have about the following range levels (amounts after antenna modifiers are in parentheses):

Gadget	Range level	real-world
Bluetooth	≈0	.001 watt
Cell phone	≈6	.1 watt
AM/FM radio recv.	≈4-8	n/a
Television reciever	≈6-9	n/a
FRS radio	≈11	.5 watt
GMRS radio	≈13	2 watt
CB radio	≈15	5 watt
Cell phone tower	≈19	60 watt
Satellite news truck	≈21(37)	120 watt
Sat. dish TV receiver	≈6(21)	n/a
Sat. TV transmitter	≈21(37)	100 watt
GPS satellite	≈19(26)	50 watt
GPS receiver	≈25(26)	n/a
Local radio/TV station	≈27	1,000 watt
Regional rad./TV station	≈37	20,000 watt

Note that while a satellite TV transmitter and receiver pair only needs a range of 53, it also needs to take into account the potential of being blocked by clouds (-2 range) and up to -3 in "jamming" from solar activity. The information transmitted to GPS recievers is at a fairly slow rate, and is generally an information level of -4. For reference, you can't actually use the numbers above to design a brand-new GPS system in **Stuff!** as small as they actually are. The entire receiver has been crammed onto a single chip, so you are spending more size on the battery and the display than the actual GPS unit. As a **Stuff!** design, a mature tech, Late Atomic Era GPS unit is about .6 millihexes, or double the size of a small cell phone circa 2006CE.

Output device: A communication gadget can be able to receive information but not be able to deliver it in a useful fashion. An example would be a set-top satellite receiver for your television. Unless it has a built-in hard drive, it is *not* an information gadget. It stores no information, it just pulls it from the ether and passes it on to your television. This is not readily quantifiable as a design item. You can generate a size for a receiver capable of picking up TV signals, but the television display can range from the size of your palm to a wall-covering plasma display or compact projection unit. Or, the output from a building-size parabolic dish for deep-space communication might be a monitor on someone's desk.

So, in general you will apply a +0 modifier for the output device if it is a speaker, tiny display or other minimal system. This allows you to make phones, radios or other audio communication gadgets with no extra complexity in the design process. Video other complex information is another matter. It is a fairly safe bet that you should just make up an *information gadget* that can display that amount and type of information. If it turns out to be smaller than your communication gadget, you're fine. If not, then the information gadget is the size you use, and the communication gadget is the size of the actual communication hardware inside it.

EXAMPLE: A black & white television image has an information rate of +29, for a penalty of -8. A gadget designed to display this information would have a minimum size based on the tech era and a -8 penalty. So, if it were a Late Industrial Era television set, it would be a minimum of:

Modifier	Amount
Late Industrial Era gadget	+26 bonus
Information gadget	+13 bonus
+29 information	-29 penalty
Records/plays info.(active)	-14 penalty
Can only play information	+4 bonus
Instant. recording medium	+15 bonus
Total(gadget size of 32 millihex)	+15 bonus

The actual communication part of the gadget would be a size of:

Modifier	Amount
Late Industrial Era gadget	+26 bonus
Communication gadget	+4 bonus
(Range 7 + info 29)/utility 3	-12 penalty
Total(gadget size of 16 millihex)	+18 bonus

So, for a minimum size black & white television at that tech era, it would be a receiver of 16 millihexes, and 16 more millihexes for a small display and speakers. If it were an Atomic Era color television, the information gadget equivalent would be:

Modifier	Amount
Atomic Era gadget	+30 bonus
Information gadget	+15 bonus
+33 information	-33 penalty
Records/plays info.(active)	-14 penalty
Can only play information	+4 bonus
Instant. recording medium	+15 bonus
Total(gadget size of 20 millihex)	+17 bonus

The actual communication part of the gadget would be a size of:

Modifier	Amount
Atomic Era gadget	+30 bonus
Communication gadget	+5 bonus
(Range 7 + info 33)/utility 3	-13 penalty
Total(gadget size of 6 millihex)	+22 bonus

So, for a minimum size color television at that tech era, it would be a receiver of 6 millihexes, and 14 more millihexes for a small display and speakers.

This is a generalization. You *could* give a TV a screen the size of a postage stamp, and thus reduce the output device size even further. Each 3 points (round up) the gadget size is reduced below this minimum level will be a 2 point penalty on trying to use any information the gadget is trying to present to you. The absolute lower limit is a -2 use penalty per tech era.

EXAMPLE: If you use the previous modifiers to cram a television screen into a Late Atomic Era cell phone, using high-speed internet communication rates, you get a minimum size of:

Modifier	Amount
Late Atomic Era gadget	+32 bonus
Information gadget	+16 bonus
+20 information	-20 penalty
Records/plays info.(active)	-14 penalty
Can only play information	+4 bonus
Instant. recording medium	+15 bonus
Total(gadget size of .5 millihex)	+33 bonus

Now, .5 millihexes is still larger than a modern multi-media cell phone (say .25 millihex). The size difference between .5 millihexes and .25 millihex is 3 points. So, you could have that postage-stamp sized television screen, but any communication use that requires a skill or Attribute roll based on that tiny image will be at +2 difficulty (+2 penalty per 3 points of size change).

Remember that all of this only refers to the minimum possible size of the gadget and its output device, not its *actual* size. Depending on the *other* communication modifiers, the final gadget could be *larger* than the minimum, in which case it can have the appropriate output device at no penalty.

Extraordinary range: This modifier covers very unusual forms of communication. Specifically, ones that can bypass things that are normally a barrier to communication. You might apply this to a longwave transmitter designed to pass data to submarines, a quantum entanglement transmitter that can do FTL communications over any distance, a psi-comm that broadcasts thoughts, or whatever. The penalty for this depends on the gameworld and what the gamemaster thinks is appropriate to generate a gadget of a size they think appropriate. A particular extraordinary range modifier is likely to have a minimum tech era or required utility level before it is allowed, in addition to any size penalty on the gadget using it.

EXAMPLE: You might apply a -60 penalty to quantum entanglement FTL transceivers, but this modifier allows them to ignore *all* range penalties. In addition, the gamemaster says that only tech eras capable of comm gadgets with a utility of 6 are capable of making such devices.

In order to be worth buying, an extraordinary range penalty has to be less costly size-wise than simply buying extra range for the gadget. Similarly, it needs to only offset a penalty that not everyone has to bother with, or everyone will just use the extraordinary range modifier.

EXAMPLE: If the range penalty for being deep underwater is -12 (or more!), then a transmitter with the capability to negate this penalty should have a modifier of *less* than -12. Similarly, if all the modifier does is negate this penalty, it needs to be large enough that regular transmitters do not want to take the penalty, and simply buy a lesser amount of increased range levels instead.

Special cases: There is no particular "special case" modifier. This is just a reminder that some of the generic modifiers at the end of this chapter may apply to communication gadgets, often in your favor. For instance, using a cell phone gadget requires using your hands most of the time. Or, the quantum entanglement FTL communicator might only be able to talk to its matched twin.

FINAL NOTES - This subsection will end with a handful of design examples to give you an idea of modifiers and their use.

EXAMPLE: We use the -60 extraordinary range modifier just mentioned to make an FTL starship transceiver system capable of the equivalent of high definition TV signals.

Modifier	Amount
Advanced Era gadget	+42 bonus
Communication gadget	+13 bonus
(Range 0 + info 37)/utility 5	-7 penalty
FTL extraordinary range	-60 penalty
Total(gadget size of 16 hex.)	-12 penalty

So, we have a 8 ton gadget that lets us do high-quality video transmissions over interstellar distances. This does not include any bonuses for general modifiers, nor any penalty for if the antenna is widely separated from the rest of the gadget, etc. Remember that since this gadget is a tranceiver rather than just a transmitter or receiver, the utlity number is dropped by 1 (from 6 to 5), which in this case makes the gadget about 25% larger than just a transmitter or receiver.

EXAMPLE: We make a modern cell phone that can receive high-speed internet communications, allowing it to play compressed video broadcasts or act as a video phone. We'll say that cell phones of this type are either Late Atomic Era, or Atomic Era and a mature technology.

Modifier	Amount
Late Atomic Era gadget	+32 bonus
Communication gadget	+6 bonus
(Range 1 + info 20)/utility 3	-7 penalty
Total(gadget size of .75 millihex)	+31 bonus

This is about .4 kilograms, a few times the current size of such gadgets, and we only got the size this small by min-maxing the rules. The gadget only has a range of 1, but remember that we can get +1 range by dropping the information rate by 4. So, if you drop the information rate by 20, we have a range level of 6 for voice communications. If you are close enough to a cell tower, then you can get the full speed of the connection. In practical use, you could easily get another +2 in general modifiers, dropping the gadget size to .25 kilogram, but have to add .1 kilogram for a battery

MITIGATION - The gadget does something that offsets or reverses something else. A coat mitigates effects of weather. So does a tent. This category also covers effects like armor, though this is better handled using the **Vehicle** rules.

Mitigation	Amount
Mitigation penalty	-(era/2) penalty
Area protected	-(size/2) penalty
Wind and/or rain protection	-1 penalty
Waterproof	-1 penalty
+10° of insulation	-1 penalty
each doubling of insulation	-1 penalty
±10° temperature compensation	-2 penalty
heating only	+2 bonus
cooling only	+1 bonus
each doubling of compens.	-1 penalty
Sealed environment	-1 penalty
.5 atm pressure difference	-1 penalty
1 atm pressure difference	-2 penalty
each 25% incr. in pressure	-1 penalty
each doubling of pressure	-3 penalty
Life support	-3 penalty
+time levels support	-special

Mitigation penalty: There is an overall *penalty* of the base for the tech era, divided by 2 (round towards zero). Note that while it appears to be contradictory to have advanced gear take a larger penalty, all that this modifier does is reduce the effect of higher tech levels. Higher tech eras are *still* better, they just increase at a slower rate. Everything else is in addition to this.

EXAMPLE: An Atomic Era gadget would have a starting total of +15 (+30 for tech era and -15 for a mitigation penalty), and an Industrial Era gadget would have a starting total of +12 (+24 for tech era and -12 for a mitigation penalty).

Size: Half the size level of the item which gets the protection (round towards larger size) will be a *penalty* on the size of the gadget. This means that protected items with a Size of less than 0 will give a *bonus* rather than a penalty. If the gadget protects only itself, assume it has a Size of zero (no modifier). As a reminder, a normal size person has a Size of -7, so a gadget that performs a mitigation function for a person will have a modifier of +4.

Wind/rain protection: The gadget protects or is protected from harmful effects of wind and/or rain to any reasonable level. That is, the -1 penalty can block wind, rain or wind and rain, depending on what the designer wants the gadget to do. For instance, in a hot climate, you might want to block rain, but allow ventilation. The gadget blocks rain or snow, keeps the wind out of any area protected, and so on. A canopy will protect from rain, but not from wind, but a tent will probably protect from wind and rain. Neither wind or rain protection keeps dust or water *completely* out, but a gadget that is waterproof (see below) is also assumed to be dust-proof.

Waterproof: The gadget prevents all water from getting at the item protected. A waterproof area is generally a sealed environment against a negligible pressure differential, and vice versa. Note that a waterproof article of clothing tends to keep sweat in as well as keeping water out.

10° of insulation: The gadget provides 10°C of protection from cold. It does not generate any heat, it just keeps existing heat (or cold) in. For an article of clothing, it alters the comfort range of the wearer by 10°C. Each doubling of insulation just provides extra protection against the cold. How long and how well a given amount of insulation will protect from external temperature extremes involves more variables that we can deal with, but obviously more is going to be better.

Note - Body armors with the "padded" modifier (page 3.48) automatically count as having 5° of insulation. Wearing them makes you feel warmer, which can be a problem in hot climates.

±10° temperature compensation: The gadget has an active means to heat and/or cool the area protected, by the listed amount in either direction (so the minimum gives you +10° heating *and* -10° cooling). Temperature compensation usually means the gadget has to be powered. So, while a gadget with 10° of "heat only" compensation will have a +0 modifier, it will have a mass penalty from the power source needed. A gadget with any amount of temperature compensation *may* (but is not required to) have 10° of insulation at no mass penalty.

Note - A spacesuit that will have long-term exposure to the full range of of outer space extremes is going to need either ±80° or ±160° temperature compensation.

EXAMPLE: An Atomic Era room air conditioner for a room 4 meters across (size level of +2) might be:

Modifier	Amount
Atomic Era gadget	+30 bonus
Mitigation penalty	-15 penalty
Area cooled(i.e. Size)	-1 penalty
±20° temperature compensation	-3 penalty
Cooling only	*+1 bonus*
Total(gadget size of 64 millihex)	+12 bonus

This would be a gadget of 64 millihexes or 32 kilograms, capable of dropping the temperature of a room of the listed size by up to 20°C. The power consumption for the gadget is on page 4.36, but would calculate out to 4d+0.

A gadget with heating *and* cooling properties can take its total temperature range and center it how they want, as long as at least half the range is used on the smaller side. For instance, a gadget with a +20°C and -20°C compensation range can set this to be +10° and -30°C.

Sealed environment: This means the gadget is effectively airtight, though it cannot withstand any real pressure differential. It will keep out toxic gases at the same pressure, is waterproof and dustproof. The difference between a sealed environment and a waterproof one is usually that waterproof items are designed to keep water out, while most sealed environment items are designed to keep air in. The .5 pressure differential (and up) modifiers are also sealed environments. A .5 atmosphere differential would be a high-altitude suit or something capable of withstanding several meters of water pressure. It is worth noting that most spacesuits are pressurized to less than half an atmosphere of an oxygen-rich atmosphere, to reduce the stresses and weight of the spacesuit. That is, they only have half an atmosphere of pressure inside, so the vacuum of space is only a .5 atmosphere differential. A 1 atmosphere differential is protection from vacuum or water pressures up to 10 meters in depth. Each +1 of atmosphere represents an additional 10 meters of depth protection.

Life support: The gadget provides a breathable atmosphere, food and water in the area protected. This is normally good for a Time level equal to the base modifier for the tech era, and each -1 size penalty adds Time levels based on the tech era, rounding extra Time levels down. You do not get any benefit for less than the default duration:

Life support	Modifier	+Time per -1
Full	-3	era modifier/12
Partial	-2	era modifier/8
Minimal	-1	era modifier/6

EXAMPLE: Atomic Era full life support would be good for a time level of +30, and each -1 size penalty would add +2 time to this.

Life support generally requires a waterproof or sealed environment, but you could have a system that just provides fresh air in a normal pressure but non-breathable environment. Partial life support (air *or* water, plus food) is only a -2 size penalty, and just food is only a -1 size penalty. Partial or minimal life support may have inherent size bonuses based on the nature of the life support. It takes time to eat or drink, and it is not a passive activity like breathing. Any such bonuses based on *how* the life support is used should be based on how long it takes per use, rather than the total time spent in the "life support activity", and the modifiers for time and usage are halved, rounding nearest.

EXAMPLE: You make a cache of Atomic Era nutrition bars, enough to last an average person for a week and a half:

Modifier	Amount
Atomic Era gadget	+30 bonus
Mitigation penalty	-15 penalty
Area protected	+4 bonus
Life support (food only)	-1 penalty
+10 time levels duration	-2 penalty
Total(gadget size of 24 millihex)	+16 bonus

You end up with 12 kilograms of food, about a kilogram per day. If you added in usage modifiers (how long it takes to eat) of +4 bonus (4 minutes) from the general modifier section, you would only count it as a +2 bonus. If this cache was food *and* water, the life support modifier would be -2, and the extra time levels would be a -3 modifier. Adding in a breathing mask for full life support would make the life support modifier -3, with the extra time being a -5. The modifier difference between minimal and full systems makes the full system about six times larger.

The life support modifier usually but not always requires power, and this adds to any other power loads in the gadget.

EXAMPLE: An atmosphere recirculator would require power. Life support that just uses slowly depleted air tanks does not use power.

How convenient the full aspects of life support are for the end user really depends on how much space is involved. A long-duration system in an advanced spacesuit is going to be a bit more personally invasive than one in a space shuttle.

EXAMPLE: A Late Atomic Era spacesuit is designed to protect a person from temperature extremes and the vacuum of space.

Modifier	Amount
Late Atomic Era gadget	+32 bonus
Mitigation penalty	-16 penalty
Area protected	+4 bonus
±80° temperature compensation	-5 penalty
Sealed(.5 atm differential)	-2 penalty
Full life support	-3 penalty
Other gadget modifiers	+3 bonus
Total(gadget size of 48 millihex)	+13 bonus

This would be a gadget of 48 millihexes or 24 kilograms, capable of protecting a person from vacuum and temperature extremes for up to sixteen hours (a time level of +32). The vague "other gadget modifiers" are special cases we'll get to next. For instance, the spacesuit takes a while to prepare for use, manual dexterity is reduced in the suit, and the oxygen-rich atmosphere in the suit makes it somewhat hazardous to use. Extra gadget penalties might include that it is slightly armored, as accidental punctures would be very bad. We can tweak the modifiers to get any number of spacesuit variants in terms of protection and mass.

OTHER MODIFIERS - So far, all of the subsections have each been considered a separate gadget. The "other" section is different. These modifiers can apply to any other type of gadget and will add to the modifiers for that gadget to see how big it is. If you have a multiple-purpose gadget and different functions have different "other" modifiers, total up each gadget separately for determining which part is the biggest.

Other modifiers	Amount
Extra +1 Armor	-1 penalty
doubling of extra Armor	-1 penalty
Usage time level of 4	+1 bonus
each +4 time levels	+1 bonus
Requires gestures	+1 bonus
Requires concentration	+1 bonus
Transferable user	+0 bonus
Non-transferable user	+2 bonus
Implanted user	+4 bonus
Reliable gadget	+0 bonus
Unreliable gadget	+1 bonus
Very unreliable gadget	+2 bonus
Hazardous gadget	+1 bonus
Larger than life	-special
Targeting limit	+1 bonus
Fudge factor	±special

Armor & Hits: Gadgets have a default Armor and Hits based on their tech era, the size and the nature of the item. Vehicles are the standard for an item's Hits, having 10 Hits for one ton. Items that work in concert have less Hits than they would as separate items. This is a function of the way **EABA** works. For instance, a pair of one ton vehicles have 10 Hits each, but a two ton vehicle only has 12 Hits total. If we didn't do it this way, a one ton car would have 10 Hits, and a fifty thousand ton battleship would have 500,000 Hits! This is the main reason for the Damage Limit stat, to minimize the bookkeeping for Hits on very large items.

For most non-vehicle items, if there are no other rules to contridict it, assume they have a base of 10 Hits for 1 hexagon, +2 Hits each time this is doubled, or -1 Hit each time it is halved. Size does *not* count consumables that add no strength of the item. For instance, a machinegun with a belt of ammunition would have Hits based on just the machinegun. Items have a *minimum* of 1 Hit. Round size nearest.

Size	Approximate mass	Base Hits
1 millihex	.5 kilograms	0
2 millihex	1 kilogram	1
4 millihex	2 kilograms	2
8 millihex	4 kilograms	3
16 millihex	8 kilograms	4
32 millihex	16 kilograms	5
64 millihex	32 kilograms	6
125 millihex	64 kilograms	7
250 millihex	125 kilograms	8
500 millihex	250 kilograms	9
1 hexagon	500 kilograms	10
2 hexagon	1 ton	12
4 hexagon	2 tons	14
8 hexagon	4 tons	16
16 hexagon	8 tons	18
32 hexagon	16 tons	20
64 hexagon	32 tons	22
125 hexagon	64 tons	24
250 hexagon	125 tons	26
500 hexagon	250 tons	28
1000 hexagon	500 tons	30

If you need more than this, you can figure out the progression on your own.

Items (not vehicles) may have special modifiers on how many Hits they have. This is something you have to determine subjectively for each particular item based on its nature and usage.

Item is	Hits modifier
Fragile due to construction(glass)	-1
Fragile due to delicacy(computer)	-1
Average construction(aluminum, composite, wood)	+0
Durable due to construction(steel)	+1
Durable due to separate items (tool kit)	+1
Durable due to distributed function (blanket) *or*	+2
Item is monolithic (sword)	+1
Item can reasonably take damage and still function	(min. of 2 Hits)

If the functional parts of an item are a mix of different material types, use the average (round down) of the modifiers if they are present in about equal volume or mass, otherwise use the strongest.

EXAMPLE: An aluminum framed pistol with a steel barrel and slide would use steel as the "Hits" modifier, for +1. A polymer frame pistol with an aluminum alloy slide and steel barrel would use aluminum/plastic as the Hits modifier, for +0. A laptop computer is probably fragile, but that could be countered if it was a ruggedized water- and dust-resistant military model. Just use some common sense and it will work out. But practically speaking, if someone drop-kicks your laptop or puts a bullet into your television, having an extra Hit or or two is *not* going to save it.

Gadgets also can have an inherent Armor, which must be penetrated before any Hits are lost from damage. Vehicles will have armor based on their construction, worn armor can be constructed based on tech era, weight and thickness, but gadgets generally only have the Armor that comes from what they are made of and the environment in which they are going to be used.

Gadgets start with a default armor of 1d+0. Remember that gadgets do not take non-lethal Hits from attacks, that part of damage which gets through Armor is just ignored. So, an armor of 1d+0 means you need a Strength of 2d+2 or more to do any damage to it with your bare hands (a punch does Strength minus 1d in half-lethal damage, so a Strength of 2d+2 would do a punch of 1d+2 damage, which gets 0d+2 through 1d+0 armor, which becomes 0d+1 lethal hits and 0d+1 non-lethal hits, and we ignore the non-lethal hits).

If an average person (2d+0 Strength) can break a gadget in their bare hands, it probably has an Armor of 0d+1 or 0d+2. A strong person (2d+2) can break items with an Armor of 1d+0, and it would take an extremely strong person (3d+2) to break something with an Armor of 2d+0.

Armor of an item	Armor
Base amount	1d+0
Each 4 Hits(round down)	+1

Material	Armor
Wood	+0
Soft metal(aluminum)	+1
Hard metal(steel)	+2
Atomic Era plastic or composite	+0
Post-Atomic Era plastic or composite	+1
Advanced Era plastic or composite	+2
Item is hardened or heavy-duty	+1
Item is lightweight or light-duty	-1
Armor and function are combined (like a gun)	+0
Armor and function are separate (like a computer)	-1
Item is inherently unprotected	-1
Item is an inherently weak material	-1

Note! - The armor of a melee weapon is not used when it strikes something, but can be used if it blocks another attack or source of damage, and you can add +1d to its Armor if it parries an attack.

If the functional parts of an item are a mix of different material types, use the average (round down) of the modifiers if they are present in approximately equal volume or mass, otherwise use the strongest.

EXAMPLE: An Atomic Era aluminum frame pistol with a steel barrel and slide would have a base armor of 1d+0. It has less than 4 Hits, so it gets no bonus for that. Like the previous example, you err towards the strongest material if there are multiple materials in about equal quantity, so it gets a +2 for being steel. It's armor and function are combined, which is a +0 modifier, and it is not particularly hardened, so it gets no bonus there. Its armor ends up as 1d+2, and as a durable 2 millihex item, it probably has 2 Hits. A polymer frame pistol of the same type would average the Atomic Era plastic and hard metal numbers for a +1 modifier, which woud make the final Armor 1d+1 instead of 1d+2. In either case, the pistol probably has a damage of 2d+1, so if it shot a similar pistol, it would get 1d+0 damage through the other pistol's Armor. That 1d+0 would functionally destroy the other pistol on any roll except a "1".

Now, back to gadget design. It is not possible to increase the Hits of a given gadget except through making it bigger. However, you *can* increase the Armor. A -1 penalty to the gadget's Size lets you increase its Armor by +1, and each extra -1 penalty lets you double this extra amount (+2, +4, +8, etc). You do not double the overall Armor, just the *extra* amount you are paying for. For most gadgets, if it is waterproof or has any type of sealed environment, insulation or temperature compensation, it counts as +1 armor without having to pay any extra (no more than a total +1 bonus, even if it is insulated, sealed *and* compensated). Most gadgets can get the increased armor modifier up to twice at the Primitive Era, with one doubling per era after that.

EXAMPLE: An Industrial Era gadget could take the modifier up to four times (-4 penalty on Size) for +8 on its Armor value (a bonus of 2d+2).

Note! - Extra armor that requires power (i.e. a force field) will require a modifier and power efficiency of the gamemaster's choice to match the nature of a particular gameworld.

Increasing a gadget's Size through this or any other modifier may alter the number of Hits it has, so it is possible to get an extra +1 to Armor because it made the gadget cross a rounding point in the "each 4 Hits" Armor rating modifier.

EXAMPLE: If we had a 12 millihex gadget (3 Hits) and took extra modifiers that made it a 16 millihex gadget (4 Hits), its Armor would go up by +1.

Usage time: The default for a gadget is that you turn it on, and the gadget effect happens. If this isn't the case, you can get a bonus on the size of the gadget. In general a Time level of 4 to use or get the first effects from the gadget is a +1 bonus, and each +4 Time levels is another +1 bonus. It is very common for handheld gadgets to get a +1 for this. You spend a few seconds pulling a cell phone off your belt, or scanning with binoculars. Longer modifiers might be spending a few minutes to don a spacesuit, waiting a few minutes for a heater to warm up an area, or for a computer to boot up from a cold start. If the usage time modifier only applies the *first* time you turn the gadget on (as opposed to *every* time you use it), the modifier is halved (round down).

EXAMPLE: A computer that takes a Time level of +16 (4 minutes) before *every* use would be a +4 modifier. But if it just takes this time to warm up from a cold start, the modifier is only +2.

The "warmup time" vs. "each use" difference is not there to be abused. It has to be reasonable for the gadget to be "off" fairly frequently, whether because of its function, power requirements, or because perhaps it has an "unreliability" modifier that requires that you restart it after an error.

Usage limits: Some gadgets do what they do in a passive sense, with no user interaction needed. Others require that the user take an active part in the gadget's operation. A gadget that requires active use of one or both hands during its operation gets a +1 bonus, as does a gadget that requires more or less undivided concentration by the user. A gadget with both gets a +2 bonus. *Simply having to flick an on/off switch doesn't count*. A cell phone might require using one hand while using it, but since people can drive fairly well while talking, their full attention is not required. Waving a bioscanner over a patient *and* monitoring the readings requires both the use of hands and concentration, while using a psionic communicator helmet might only require concentration.

User type: The default for a gadget is that it is something that anyone can use, or at least anyone with the same type of manipulators, sensory organs and body size. *Your binoculars are not going to be of any use to thumbless, sonar-using bats*.

If a gadget is transferable, you can hand it to someone else, let someone else get behind the controls, and so on. *This is the default*. If a gadget is non-transferable, it means that ownership and use of the gadget is *exclusive*. In addition to any time delay required to use the gadget as part of the transfer, ownership or use of the gadget's abilities cannot usually be accomplished under the normal circumstances in which the gadget would be operational. A non-transferable user may also mean that a user has to meet certain specific criteria in order to use the gadget.

EXAMPLE: You *can* let someone else wear your spacesuit, but you *cannot* trade spacesuits with someone else while you are on a spacewalk. This is a non-transferable gadget. A spacesuit that no one else can wear because it was custom-made for your exact body shape would also count as a non-transferable gadget, but you would not take the modifier twice.

EXAMPLE: Your artificial leg isn't going to be of any use to someone who has two legs. This is also a non-transferable gadget.

An "implanted user" means the gadget is designed to be incorporated into a living being, and cannot be removed without surgery. Normally, this sort of gadget has a fairly high threshold in terms of the tech era required. Most gadgets you would consider "cyberware" would have this modifier.

EXAMPLE: The artificial liver and lungs that increase your Health are a gadget that is not readily transferred from one person to another. It is unlikely that this is an Industrial Era gadget...

Reliability: Gadgets are assumed to be 100% reliable in normal use. An "unreliable" gadget cuts corners somewhere, using less reliable lightweight components, less protection in the packaging, and so on. An unreliable gadget rolls 3d+0 each time it is stressed. On a roll of 7 or less, it fails to operate, turns off or otherwise ceases doing some function it is supposed to be doing. Being "stressed" means having to operate at maximum capacity, taking damage (even if that damage does *not* penetrate Armor), or crossing any sort of temperature or pressure or environment threshold. The gadget gets cranky if it gets too cold, too hot, too damp, etc. A "very unreliable" gadget is the same, except the 3d+0 roll is 11 or less. If a gadget has a preparation time before use, then it is non-functional for at least that long, otherwise the user can flick a few switches and get it started again. Oddly, striking a cranky gadget will often restart it, just as striking it while it is running will often get it to quit.

At gamemaster option, reliability can refer to the *quality* of the gadget's output. A sensor might provide bad readings, a tome of ancient lore might be riddled with errors, and so on. This sort of reliability would *not* affect gadget size, and is a design flaw that may or may not affect the cost of the gadget.

Hazardous side effect: The gadget is just plain dangerous to use. It might drip toxic chemicals, emit dangerous radiation, or have moving parts that can mangle incautious fingers. The exact nature and level of the hazard depends on the size of the gadget and what it does. A primitive lathe might have unshielded moving parts, while an Advanced Era hyperwave communication array might emit invisible "delta rays". In general, the effect is taken by anyone who interacts with the device, on a *skill roll* of 7 or less on a skill appropriate to the gadget in question. In general, a hazard involves damage. This is either going to be to Hits or to an Attribute. Hazard damage is usually half-lethal, of a level based on the biggest single *negative* modifier in the gadget, with a nature of effect appropriate to that effect. Do *not* count size or inherent modifiers for a type of gadget (like the mitigation gadget penalty).

If you decide that the damage is long-term, you divide it by two, but count it as crippling damage (takes four times as long to heal). *After* you decide if the damage is crippling or not, if the damage is lethal, you subtract 1 point per 1d+0 damage, and if it is non-lethal, you add +1 point per 1d+0 damage (minimum 0d+1 damage). Armor of an appropriate type *can* protect against this damage.

EXAMPLE: A gadget with +12 Strength might have parts that mangle the limbs of the unwary for a 4d+0 half-lethal attack or a 2d+2 lethal one. A communication gadget with +12 range levels might microwave your brain if you get in front of it, for 1d+1 lethal crippling damage to your Awareness, or it might have exposed electrical bits that will shock you for 5d+1 normal non-lethal damage, or 2d+2 in crippling non-lethal damage (zzzzap!).

You can also subtract Size levels from damage if the hazardous effect fills an area of some kind, affecting everyone in the area on the failed roll. This is done before other modifiers to the damage.

EXAMPLE: If the hazardous communication gadget filled an area of Size 6 with its effect, it would have a base damage of 2d+0, halved to 1d+0 for being crippling damage, and dropped to 0d+2 for being lethal damage.

Larger than life: The nature of the gadget is such that it can use "Larger than life" on its own rolls for that aspect of the gadget use, *or* give this ability to the user of the gadget in *one specific part* of its designed role. This obviously does not apply to *all* gadgets. The penalty -15 at the Primitive Era, and is reduced by -3 per era after that (±1 for fractional era). This means that Advanced Era gadgets can have this at no penalty, which the gamemaster may or may not decide to allow, possibly mandating a minimum -1 penalty even at the Advanced Era. Obviously, in order to take advantage of Larger than Life, either the gadget or the user has to have a skill or Attribute roll of 4d+0 or better.

Tech Era	Larger than life
Early Primitive	-16 penalty
Primitive	-15 penalty
Late Primitive	-14 penalty
Early Basic	-13 penalty
Basic	-12 penalty
Late Basic	-11 penalty
Early Industrial	-10 penalty
Industrial	-9 penalty
Late Industrial	-8 penalty
Early Atomic	-7 penalty
Atomic	-6 penalty
Late Atomic	-5 penalty
Early Post-Atomic	-4 penalty
Post-Atomic	-3 penalty
Late Post-Atomic	-2 penalty
Early Advanced	-1 penalty
Advanced	-0 penalty
Late Advanced	-0 penalty

EXAMPLE: You build a bioscanner bed into the sick bay of your Post-Atomic Era spaceship. In addition to giving a +3 bonus to medical skill use, you give it "Larger than life", which allows the attending physician to keep "best four" instead of "best three" when making diagnostic rolls using this gadget. Since this is a Post-Atomic Era gadget, this benefit is a -3 penalty on gadget size (about three times as large as it would be without it).

If the gadget is meant to have some sort of combat enhancing effect, the gamemaster can apply an additional -3 penalty to reduce the potential for abuse.

Era-specific effect: This is some enhancement of a gadget's capability or effect that only becomes possible at a particular tech era. This would not be zero-space improvements like improved software for an electronic device. Rather, it is some change or improvement to the fundamental nature of the device or its packaging that is not covered by other modifiers.

EXAMPLE: Making a gadget's armor rating proof against armor-piercing effects would be an era-specific effect that would work against armor-piercing attacks at that tech era and previous eras.

EXAMPLE: Making a gadget so that it can be easily operated by someone wearing bulky space-suit gauntlets might be an era-specific special effect.

Era-specific effects are generally a -1 penalty, regardless of tech era, but only work when they are interacting with gadgets of the same tech era or *lower*, or oddly enough, with the same tech era or *higher*. Gadgets designed with a facilitating era-specific effect tend to work at their era and forward, while those with a protective or mitigating effect tend to work at their era and backwards.

EXAMPLE: The protection against armor-piercing effects works well at the tech era and against attacks from previous tech eras. The gadget designed for use with a spacesuit probably works at the tech era and with more advanced spacesuits, but cannot interact well with more primitive ones.

Targeting limit: This is a further limiting of an attribute, sensing, communicating or mitigating function of the gadget.

EXAMPLE: A cell phone is a radio transceiver with a high utility number, but most cell phones are also useless without repeater towers. Even though someone else might be in direct range of your phone, if there is no repeater, your phone is unable to contact them. This would be a targeting limit.

EXAMPLE: An umbrella would be a waterproof mitigation gadget that only protects you from water falling from above. Again, a targeting limit.

If a targeting limit is especially severe, you can take a +2 bonus instead of a +1.

Inconvenient gadget: This is a general-purpose modifier that takes into account material limits, bad ergonomics or functional limitations. For the various things that can be done with the gadget, or while wearing or using the gadget, the user takes a -1d penalty on particular tasks, or -3 in penalties split among several tasks.

Fudge factors: If all else fails, a given class of gadget can have a global modifier applied to its cost and/or size to get the results you think are appropriate.

EXAMPLE: Our spacesuit example is fairly complex and the final design uses many of the general modifiers:

Modifier	Amount
Late Atomic Era gadget	+32 bonus
Mitigation penalty	-16 penalty
Area protected	+4 bonus
±80° temperature compensation	-5 penalty
Sealed (.5 atm differential)	-2 penalty
Full life support	-3 penalty
Extra +2 Armor	-2 penalty
Non-transferable user	+2 bonus
Time level of +16 for first use	+2 bonus
Inconvenient gadget	+1 bonus
Total(gadget size of 48 millihex)	+13 bonus

The "inconvenient gadget" we define as a -2 penalty to Agility and -1 to Strength when in the gadget because of the thick, armored fabric. As a 48 millihex item, it has a default of 5 Hits. We add +2 because it has a distributed function, but give it a -1 because any sort of failure is bad in vaccum, making it sort of fragile, for a total of 6 Hits. The default Armor is 1d+0, +1 for sealed environment, +2 for the extra we bought, and +1 because it has 5 Hits, giving the final suit an Armor of 2d+1 and 6 Hits.

MULTIPLE GADGETS - So far, we've described building gadgets as single function items, but mentioned that gadgets can have modifiers from more than one category. This is handled fairly simply. Add up the size of all the individual gadget functions. Then see what the total gadget modifier is for an object of that size. For purposes of Hits, you round the size down to the closest table modifier. For Armor, you use that of the biggest part of the gadget, using the one with the best Armor if more than one subfunction is tied for largest size.

EXAMPLE: If our 48 millihex spacesuit had a 5 millihex radio transceiver in it, the total gadget would be 53 millihexes. Since both 48 millihexes and 53 millihexes round to 64 millihexes on the table on page 4.30, the total gadget has the same number of Hits with or without the radio, and the Armor of the suit plus radio is likely to be that of the suit.

In a case where one gadget is completely inside another, you only count the size of the larger of the gadgets for size purposes, Armor and Hits, but count the total size of the components for figuring the cost of the gadget.

GADGET POWER - The default for a gadget is that is powered, or otherwise has some sort of consumable aspect that limits the duration of its use. Whether or not a gadget uses power, the nature of that power and how much is somewhat subjective. A winch with +10 Strength is going to draw more power than a computer with +10 Awareness. Unless that computer is running off Industrial Era vacuum tubes, in which case the computer will draw a lot more juice than the winch. Some gadgets will have zero power consumption. This is not a modifier on size and is only indirectly an effect on cost (objects that consume no power are generally less complex and thus less costly). It is simply a subjective matter decided on by the designer of the gadget. A blanket can be an electric blanket, or just a blanket. In general, if it emits energy, receives energy, analyzes energy or does anything "active", it consumes energy and requires a power source.

So, like we had to define the "utility" of gadgets designed for communication, we have to define the "efficiency" of gadgets for their power use. This is not a modifier on the size of the gadget, but is the gamemaster's definition of how the gadget tech fits into the gameworld.

Efficiency	Power use
Perfect	no power source required
Excellent	-3d
Very good	-2d
Good	-1d
Average	+0d
Poor	+1d
Very poor	+2d
Abysmal	+3d

EXAMPLE: If you had a gadget with a total calculated power use of 3d+1 and it had "poor" efficiency, it would take 4d+1 power.

Gadget function	Typical efficiency
Strength	Very poor(+2d)
Agility	Poor(+1d)
Awareness	Very good(-2d)
Will	Excellent(-3d)
Health	Average(+0d)
Fate	unknown
Skill boosts	as Attribute
Heating	Average(+0d)
Cooling	Good(-1d)
Life support	varies
Transceivers or transmitters	Good(-1d)
Receivers	Excellent(-3d)

The default power use is based on three things, all of which involve something approaching real math:

A = The largest negative modifier associated with the gadget's function. *This does not include overall category factors like the -(era/2) penalty for mitigation gadgets*. If the two largest modifiers are within 1 point of each other, use the largest and increase it by 2, and if the two largest modifiers are different by 2 points, use the largest and increase it by 1. That is, make it even more negative. In general, an italicized modifier adds to the modifier it is part of. So, if a gadget has temperature compensation with "cooling only", you add the total temperature compensation and cooling together to get the A value.
B = Any modifier for the size of the area protected or affected by the gadget.
C = The modifier for the actual final size of the gadget.

The gadget's maximum power use (everything running at maximum capacity) will be 24, minus A, minus B, plus C. Please remember that there may be subtraction of negative numbers (which adds) and addition of negative number (which subtracts). *Sorry folks, can't make it any easier than that*. If the gadget is being used at significantly less than maximum capacity, power use can be reduced by 1d (half maximum), and if it can have a "standby" mode, power use would be reduced by 3d (one-eighth maximum).

Do not count any duration except the default if life support is one of the applicable modifiers. This duration refers to supplies and consumables. The gadget may still require a separate power supply. Do not count any contribution of information level, either by itself or in combination with another factor.

A gadget can have a final power use of 0d+0 or even negative amounts. This does *not* mean the gadget generates power, it just means it uses small amounts. The relevant gadgets (a .1kg powercell and 2.0kg fuel cell) are repeated to the right.

Listed powercell Strength is for *rechargeable* powercells. Disposable ones have +1d output.

Powercell(.1kg)	Strength	Energy
Early Industrial	*-2d+2*	*6*
Industrial	-2d+0	10
Late Industrial	*-1d+1*	*16*
Early Atomic	*-0d+2*	*25*
Atomic	0d+0	40
Late Atomic	*0d+2*	*65*
Early Post-Atomic	*1d+1*	*100*
Post-Atomic	2d+0	160
Late Post-Atomic	*2d+2*	*250*
Early Advanced	*3d+1*	*400*
Advanced	4d+0	640
Late Advanced	*4d+2*	*1000*

Fuel cell(2kg)	Strength	Energy
Early Atomic	*3d+1*	*400/hr*
Atomic	4d+0	640/hr
Late Atomic	*4d+2*	*1,000/hr*
Early Post-Atomic	*5d+1*	*1,600/hr*
Post-Atomic	6d+0	2,500/hr
Late Post-Atomic	*6d+2*	*4,000/hr*
Early Advanced	*7d+1*	*6,300/hr*
Advanced	8d+0	10k/hr
Late Advanced	*8d+2*	*16k/hr*

Fuel cells can be refilled with 1kg of fuel when empty and restored to full capacity.

Both powercells and fuel cells can produce their listed power for five hours. Remember that to determine the lifetime of a battery or fuel cell, you compare the output of the power source to the power consumption of the device. Power requirements of more or less than this amount will alter their useful life. Fuel cells *cannot* produce more than their rated power, but batteries can, but for shorter periods:

Load vs. power	Power good for:
-3d	40 hours(35)
-2d	20 hours(33)
-1d	10 hours(31)
+0d	5 hours(28)
+1d	2 hours(26)
+2d	1 hour(24)
+3d	30 minutes(22)
+4d	12 minutes(20)
+5d	6 minutes(17)
+6d	3 minutes(15)
+7d	90 seconds(13)
each ±1	±25% closest value

As mentioned in the vehicle rules, you get double the duration of power at the same output level each time you double the number of powercells or fuel cells, and you get +1d output each time you double the number of powercells or fuel cells.

EXAMPLE: One Atomic Era powercell has an output of 0d+0. If you needed 1d+0 output for five hours, you just use two powercells. If you needed 1d+0 output for ten hours, you would use four.

With all this in hand, you can see how much extra mass a portable gadget requires for its power supply. *Of course, if you just plug the gadget into the wall, all of this is irrelevant...*

EXAMPLE: Continuing to use our spacesuit example, we look at the applicable modifiers as relates to power usage:

±80° temperature compensation	-5 penalty
Full life support	-3 penalty
Area protected	+4 bonus
Gadget size of 48 millihexes	-13 penalty

If we look at this in terms of A, B and C factors:

A: The two largest negative modifiers were "±80° temperature compensation"(-5) and "full life support"(-3), which combine to total "A" value of -6.

B: The modifier for the area protected is +4, for a "B" value of +4

C: The final size modifier for the gadget itself is -13, for a "C" value of -13.

This means the power use is 24, minus -6, minus 4, plus -13, equals +13, or 4d+1 power use when all systems are running full blast, and we need this to last for up to sixteen hours (the default life support duration for this gadget). Since heating is one of the functions, we use an Average(+0d) efficiency.

Late Atomic Era *non-rechargeable* powercells have an output of 1d+2 for five hours, +1d output per doubling of powercells. Late Atomic Era fuel cells have an output of 4d+2 for five hours. We need to do three doublings to get a powercell output of 4d+2, or use the default fuel cell output of 4d+2. This is 0d+1 more than required by the suit (4d+1), so it will last 25% longer than the default duration. This gives us 6.3 hours of life support for either .8kg of batteries or a 2.0kg fuel cell, with double duration by doubling the battery/fuel cell size. Fuel cells can be refilled with half their weight in new fuel, while batteries have to be replaced. So, at this level of tech, the most efficient power for the suit is a disposable battery pack, though you might be able to make your own fuel cell fuel...

EXAMPLE: In the Attributes section, we made a pancake flipping robot:

Modifier	Amount
Atomic Era gadget	+30 bonus
Strength of -6	+3 bonus
Limited use of an Attribute	+3 bonus
Agility of +5	-10 penalty
Limited use of an Attribute	+3 bonus
Awareness of +2	-4 penalty
Limited use of an Attribute	+3 bonus
Pancake flipping skill of +5	-5 penalty
Total(gadget size of 5 millihex)	+23 bonus

If we look at this in terms of A, B and C factors:

A: The largest negative modifier by far is "Agility of +5" (-10), for an "A" value of -7.
B: There is no modifier for any area affected by the gadget, so the "B" value is +0.
C: The final size modifier for the gadget itself is -23, for a "C" value of -23.

This means the power use is 24, minus -7, minus 0, plus -23, equals +8, or 2d+2 power use when it is doing its pancake-flipping thing, +1d for the poor efficiency of an Agility gadget for a total of 3d+2. If we decided to run this off a single disposable Atomic Era powercell (output of 1d+0), it has an output 2d+2 less than the power requirement. This is -1 up from the listed +3d amount, so one powercell will last 37 minutes.

EXAMPLE: At the end of the Communication section we made a Late Atomic Era cell phone:

(Range 1 + info 20)/utility 3	-7 penalty
Gadget size of .75 millihex	-31 penalty

If we look at this in terms of A, B and C factors:

A: This is the range level divided by the utility (ignore the information level), for an "A" of 0.
B: There is no modifier for any area affected by the gadget, so the "B" value is +0.
C: The final size modifier for the gadget itself is -31, for a "C" value of -31.

This means the power use is 24, minus 0, minus 0, plus -31, equals -7, or -2d+1 power use. However, as a transceiver, the power use is normally Good(-1d), which drops this to -3d+1. Even one rechargeable powercell at this tech era (0d+2) exceeds the power requirement by 4d, so one powercell would run this phone for 80 hours "talk time". If we used one-eighth of a powercell (≈.01 kilograms), this drops power output to -2d+1, which would still give us 10 hours "talk time", and 80 hours of "standby" use.

Charges? - All of this is useful, but what if the gadget uses discrete charges rather than having a continual energy drain? A first aid kit has a limited number of bandages, a breathing mask has replaceable filters, or a flare gun has a number of cartridges, each of which shines brightly for a certain amount of time. None of these require powercells, but all have a "power" requirement. For defining a gadget, a "charge" is everything needed to meet the power needs of a gadget for the listed amount of time. Once a charge is used up, it cannot be recovered/restored unless the "easily replaceable" modifier is taken. When the gadget runs out of charges, it is disposed of. If the gadget still has an applicable efficiency modifier, subtract the full dice in it from the charges modifier.

Charges	Modifier
1 use	+6 bonus
2-3 uses	+5 bonus
4-7 uses	+4 bonus
8-15 uses	+3 bonus
16-31 uses	+2 bonus
32-63 uses	+1 bonus
64-124 uses	+0 bonus
125-249 uses	-1 penalty
easily replaceable charges	-1 penalty
each +4 Time levels	-1 penalty
state-based duration	-8 penalty

EXAMPLE: You could make a single-use rescue flaregun as a communication device with no information rate aside from "hey! I'm here!" If you said the flare gun had one use, and each use lasted for 1 minute (Time level of +12), then the gadget would have a +3 bonus for this. If we say that as a transmitter it has a Good(-1d) efficiency, we can subtract -1 from the charges modifier, making it a +4 bonus instead.

If the charges are easily replaceable, the total modifier applies to the rest of the gadget, and the result is the size of the pack of "charges". The overall gadget size remains the same, and the pack of charges is a fraction of the complete gadget size. If the pack of charges is larger than the gadget, then you do it the other way around. The gadget size is a subset of the size of the pack of charges. If the size of the charge pack is a +0 modifier, it means the gadget *is* its pack of charges. You swap charges by swapping gadgets, the depleted gadget sent back to somewhere for refilling.

If a gadget has an inherent time level aspect (like life support), and this is powered by "charges", you only take a -1 penalty each 6 Time levels instead of per 4 Time levels.

EXAMPLE: If we make a flaregun with a five-round clip of replaceable flares, each of which lasts for 1 minute (Time level of +12), and use the Good (-1d) efficiency, then a clip of five flares is the size of the gun with a +1 bonus (+4 for five uses, -3 for extra Time levels, -1 for easily replaceable, and +1 for the efficiency). So, if the gun was 1 millihex, .75 kilograms of that is going to be the clip of flares.

EXAMPLE: If we wanted to equip our spacesuit example with a single replaceable pack that included all the life support supplies, batteries and so on, we might have a gadget with 1 charge that lasts for a Time level of +30 (8 hours). This would be a total modifier of +0 (+6 for one use, -5 for extra time levels, -1 for easily replaceable), making it the exact same size as the spacesuit. Since we knew the spacesuit was 48 millihexes, this means the charge-based suit is also 48 millihexes. When the life support pack runs out, it has to be swapped for a fresh suit, with the old suit sent to techs to have its systems refilled and refurbished. It is lighter than the suit that is run off of powercells by 3.2 kilograms, but is far less convenient in the long run.

GADGET COST - The last thing you need to do is figure the cost of your gadget. This is pretty straight-forward, and is a subset of the rules for vehicle accessories. In fact, if your gadget is going to be mounted in a vehicle, just count it as a vehicle gizmo and add it to the size of any others already installed. Otherwise, simply start with the gadget size, apply whatever the difference is between that and 1 millihex or 1 hexagon, whichever is more convenient. Gadgets that fall in between exact sizes apply a +1 cost on the smaller of the sizes they fall between. This gives the base gadget cost.

Gadget parameters	**Cost**
Gadget of 1 hexagon	+2
Gadget of 1 millihex	-18
Each halving/doubling of size	±2

EXAMPLE: A gadget of 2.5 millihexes will have a base cost of -15 (-18 for 1 millihex, +2 for a doubling of size to 2 millihex, and +1 more for an intermediate size between 2 and 4 millihexes.

Then, apply modifiers for the tech era, and the nature of what the gadget actually does:

Tech era	Cost
Primitive	+0
Basic	+2
Industrial	+4
Atomic	+6
Post-Atomic	+8
Advanced	+10
Early/late part of an era	±1

Functional	Cost
Vehicle gadget	as vehicle
Worn gadget	+1
Handheld gadget	+2
Very complex gadget	+8
Complex gadget	+6
Average gadget	+4
Simple gadget	+2
Very simple gadget	+0
Stationary gadget	+0
More than one function	+1
Mass production	-2
Average production	+0
Limited prod.(luxury/security)	+2
Limited production(military)	+4
Very limited production(research)	+8
Used or obsolescent	-2
Well-used or obsolete	-4
Totally outdated	-6

EXAMPLE: A handheld .5 millihex Atomic Era gadget like a cell phone will have a Cost level of:

Parameters	**Cost**
Gadget of 1 millihex	-18
One halving of size	-2
Atomic Era	+6
Handheld gadget	+2
Very complex gadget	+8
Total(250 Credits)	-4

In terms of complexity, if it takes multiple people with college degrees to design the gadget and multiple factories to produce the components going into it, it is a very complex item. *Examples: Computers, radar systems,complex robotics.*

The limits of purely mechanical complexity would be a complex gadget, as are fairly simple (relatively speaking) electronic devices. *Examples: fancy mechanical wristwatches, radios, televisions.*

A gadget of average complexity covers most sorts of mechanical gadgets, or electrical gadgets involving motors, switches, bulbs and readouts, but few or no logic/decision-making circuits. *Examples: power tools, mechanical clocks.*

A simple gadget is usually below the limit for gadgets using electricity. Simple gadgets would often be manually powered equivalents of average gadgets. *Examples: hand drills, mechanical pumps.*

A very simple gadget is one which you can make with hand tools and a bit of common sense, though some technical training wouldn't hurt. Such gadgets will often have few or no moving parts. *Examples: hammers, pry bars, scissors.*

It's fairly safe to say that "leading edge" tech has a complexity modifier of +2 more than the tech era *cost* modifier, up to a maximum of +8. So, if you are working at the Primitive Era (+0 Cost), it would be hard to come up with a gadget that was anything more than "simple" (+2 Cost). Remember that there is also an intermediate state of complexity when a gadget has more than one function.

EXAMPLE: Our oft-used spacesuit in its final form (with a radio added) would be:

Parameters	Cost
Gadget of 1 millihex	-18
5+ doublings of size	+11
Atomic Era	+6
Worn gadget	+1
More than one function	+1
Very limited production	+8
Very complex gadget	+8
Total(350,000 Credits)	+17

From different perspectives, the cost can vary widely. If Atomic Era space travel was a commercial enterprise, we might use "limited production" in place of "very limited", and this would cut costs by a factor of four. If space travel became commercial in the Late Atomic Era, *this* suit might be the equal of "limited production", but *also* be "obsolescent", halving cost again. On the other hand, Late Atomic Era spacesuits would be +1 cost over Atomic Era models, but their reduced bulk *might* offset this.

EXAMPLE: The silly pancake-flipping robot, if we assume it is a mass-produced kitchen appliance:

Parameters	**Cost**
Gadget of 1 millihex	-18
2+ doublings of size	+5
Atomic Era	+6
Stationary gadget	+0
Mass production	-2
Average gadget	+4
Total (175 Credits)	-5

This gives us a reasonable cost. Some might say its decision-making capability makes it complex instead of average, but that's a judgement call.

FINAL NOTES - Like all the other chapters, this one can be min-maxed or abused, just like any other rule-, case- or equation-based system. That's not the point. It's for coming up with reasonable stats for something that you can't otherwise figure out for your gameworld, or to give stats like Armor and Hits to things that you can find other details on elsewhere.

As you go back and re-read this chapter, and figure out exactly how you are going to use it, keep in mind the following:

1) ***How much of this chapter do I need?*** If Joe Hero is hiding behind a 250 kilogram industrial meat slicer when the bad guys open up on him with submachineguns, you don't need to design up an industrial meat slicer. You just look at the Armor and Hits of a piece of steel machinery of 500 millihex *(the answer is about 2d+1 Armor and 9 Hits)*.
2) ***Is the gadget important enough to be worth designing?*** If it is unique and important to the plot, probably. Likewise if it is something the adventurer relies on or uses on a regular basis. But once you have an idea how things work in your campaign, getting the numbers about right is sufficient. If a "throwaway" gadget that crops up turns into a regularly used gizmo, then design it. Otherwise, wing it.
3) ***Is there a social aspect to the gadget?*** Just like people might look askance at adventurers toting guns and wearing body armor, there might be a social aspect to any gadgets they are flaunting. Cybnernetic datajacks, bionic limbs, Bluetooth earpieces and obnoxious ringtones. These can affect reaction rolls, or how an adventurer is seen to fit within a culture or society.
4) ***Is the technology appropriate?*** While **EABA** defines cultures in broad tech era terms, not all aspects of tech advance at the same rate. The way things are measured in **EABA**, some technology circa 2006 is probably Late Atomic Era, while the rest is Atomic Era, and some places are manufacturing at an Early Atomic Era or before. And those ±1's and ±2's for that tech era difference can make a *big* deal. If you don't agree, you're welcome to compose a rebuttal on a desktop computer running at 25MHz with a 10 megabyte hard disk...

WORLD BUILDING - That's pretty much what this book does. You can use it to build just about any aspect of a gameworld you want. **Stuff!** can be a player tool, a gamemaster tool, or both. Players can design their own body armor, create firearms and customize vehicles. Gamemasters can do the same for antagonists, create ecosystems and large or small scale societies.

This is the last chapter in the book for designing and building "objects", so we would like to add a few words about how gadgets and societies and technologies shape each other.

Stuff! is designed for **EABA**, but the results are readily translated into a number of other systems. But, **Stuff!** and **EABA** are grounded in the real world, where things operate in a way that we are familiar with. That means **Stuff!** generates things that are supposed to be plausible for the world we are all familiar with. But, a lot of gameworlds have one or more features that simply don't make sense if you view them from "normal" reality.

EXAMPLE: Any anime universe with gigantic anthropomorphic robots. These contraptions make absolutely no sense unless wars are won based on a vote of who has the coolest looking stuff.

*So, can you make **Stuff!** work with gameworlds where one or more things are not in tune with conventional reality?* Yes. It takes a little effort up front, but once you do, everything works just fine. Since **Stuff!** is a rule-based system, with a lot of things based on constants and simple addition and subtraction, you just alter the constants to make a *particular* way of doing things the *most* efficient way of doing things in that gameworld.

EXAMPLE: If you want the best war machines to be giant robots, you go to the part of the **Vehicles** chapter dealing with power trains and alter the penalty for a walking vehicle so it is *less* than that for a tracked vehicle. This instantly means that legged vehicles are faster *and* have better cross-country mobility than tanks, so that is what people will design and build. More importantly, if you let *players* design and build stuff, they will design and build stuff that fits into the way the rest of the gameworld does things (players not being known for gravitating towards inefficient gadgets and gizmos for their adventurers).

Similarly, if you want a world not too much more advanced than ours, but with human-sized AI robots, you throw in a fixed modifier for gadgets with Awareness that reduces their size. If you want a world where no one wears armor, you make it too heavy to wear for Armor values that stop common weapons, *or* increase the effectiveness of weapons *or* insert a weapon technology that armor is useless against or far less effective against. So, you could have powered armor that stops cannon rounds, so space marines carry vibro-cutlasses because that *particular* melee weapon is more effective than beam weapons or bullets. If you want a Victorian setting with huge flying machines, throw in a constant for a powerplant that only provides power for *vertical* thrust and call it Cavorite or liftwood or anti-gravity fluid or whatever.

Or, if you want a particular military tactic in a fantasy world, adjust the creature design modifiers so there is a wierd cavalry mount that makes that tactic effective, and then design a geographical region or political system that limits the armies using that creature to a particular area. Or, if you want an interstellar empire that is still based on a feudal system, you adjust the modifiers for how many people can be effectively governed for a given political system such that an oligarchy becomes the *only* way to manage that many people.

The idea is that in a given gameworld, things are done the way they are because it is the most effective way of getting things done in the long run. So, starships in a one fictional universe have engines out on thin little pylons because it is more efficient, and force fields and inertial dampers are much more efficient than physical armor, while another universe might have compact spherical designs because they have no forcefields and armor is the only possible protection.

There will of course be local and probably short-term exceptions. Some stuff *will* be made because of political connections, or based on faulty assumptions, or preconceptions of how things *ought* to be (like putting the engine in the front of a car because you put the horse in front of the wagon). But in the end, if there is economic or military competition, the smarter or more efficient design has a better chance of prevailing in the end.

Reset | Autocalc on

DESIGN PAGE 4 - If you are viewing this page as a pdf, it has forms that allow you to do most of the aspects of gadget design right here on the page, and then print off your finished specs. It may not cover *all* the advanced topics, but will give you the basics to work from.

Gadget name					
Middle	Atomic Era		10	d+	0
Normal use of technology			0	d+	0
Gadget of 1 millihex(500g)			-10	d+	0
No change in gadget size			0	d+	0

Attribute/skill modifiers				
No Strength	0	0	d+	0
No Agility	0	0	d+	0
No Awareness	0	0	d+	0
No Will	0	0	d+	0
No Health	0	0	d+	0
No Fate	0	0	d+	0
Enter number of +1's in a skill	0	0	d+	0
Enter number of skills	0	0	d+	0
Skills are normal		0	d+	0
No penalty offset		0	d+	0
Not a facilitator	0	0	d+	0
No effect on attributes/skills		0	d+	0
Enter size lev. of item affected	0	0	d+	0
No boost/penalty on Strength	0	0	d+	0
No boost/pen. on Awareness	0	0	d+	0
No boost/penalty on Agility	0	0	d+	0
No boost/penalty on Will	0	0	d+	0
No boost/penalty on Health	0	0	d+	0
No boost/penalty on Fate	0	0	d+	0
No boost/penalty on skills	0	0	d+	0

Information modifiers				
Not an information gadget	0	0	d+	0
Enter record/playback speed	0	0	d+	0
Records & plays(active)		0	d+	0
Normal output device		0	d+	0
Information stored as device		0	d+	0
Normal recording medium		0	d+	0

Communication modifiers				
Gadget not a comm. device	0	0	d+	0
Enter communication speed	0	0	d+	0
Normal range	0	0	d+	0
Transceiver		0	d+	0
No output device modifier	0	0	d+	0
360 degree arc, range is	+0	0	d+	0

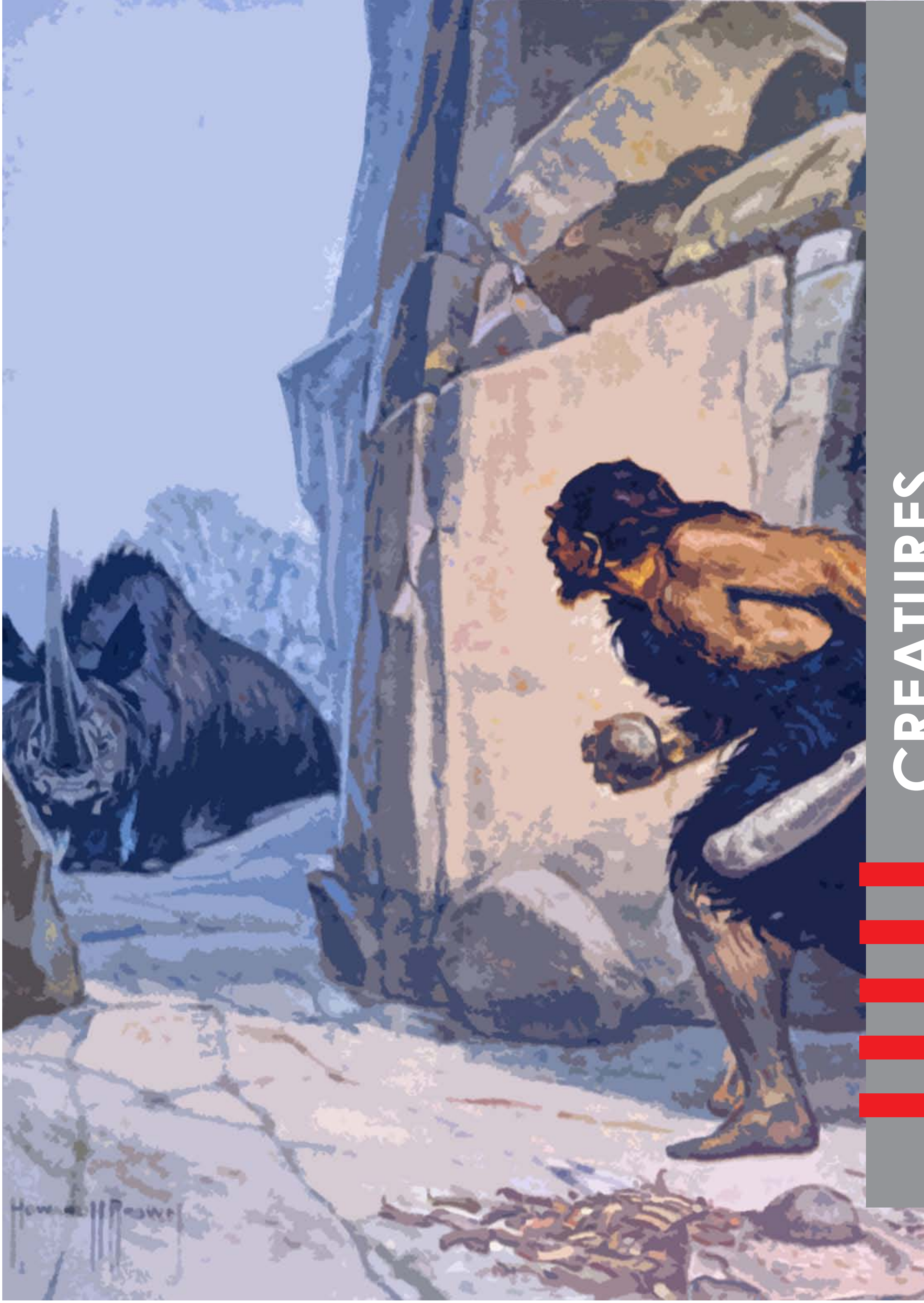
Mitigation modifiers				
No mitigation ability	0	0	d+	0
No environment protection		0	d+	0
No insulation ability	0	0	d+	0
No temp. compensation	0	0	d+	0
Not a sealed environment	0.0	0	d+	0
No life support	0	0	d+	0

Power usage modifiers				
Gadget needs no power source		0	d+	0
Uses external power source		0	d+	0
Integral power	0	0	d+	0

Generic modifiers				
Default armor value	0	0	d+	0
Normal usage time	0	0	d+	0
No physical use limits		0	d+	0
Transferable user		0	d+	0
Gadget is reliable		0	d+	0
Gadget has no special effect		0	d+	0
Gadget has no special effect		0	d+	0
No fudge factor		0	d+	0
No cost fudge factor		0	d+	0

Handcuffs | Radar sys. | Cell phone | Multiscanner | Spacesuit

Name		Mass	Cost
Gadget name		0.5kg	16Cr
Est. power req.	**Energy/hour**	**Armor**	**Hits**
none	n/a	1d+0	0



CREATURES

All things dull and ugly,

all creatures short and squat,

All things rude and nasty,

the Lord God made the lot;

Each little snake that poisons,

each little wasp that stings,

He made their brutish venom,

he made their horrid wings.

All things sick and cancerous,

all evil great and small,

All things foul and dangerous,

the Lord God made them all.

- Monty Python, All Things Dull and Ugly

INTRODUCTION - *All creatures great and small*. Creatures as an important element of role-playing are mainly because they are "monsters", and exist only to be exterminated as pests, because they are an economic resource, or both. A very few, like dogs and horses, are important enough to warrant their own game stats, but the rest are usually "just there". You don't need to know the stats of the animal you know only as the steak on your plate or the leather of your jacket. This section is mainly going to be useful to gamemasters trying to add consistent elements to a game ecosystem, or start one up from scratch. There will be useful notes for fantasy campaigns regarding draft, riding and companion animals as well.

DESIGN PRINCIPLES - Creatures are different than other designed objects, mainly in that they don't have a "cost". Certain things that seem fundamental to biology and physics may require a certain type of ability to make design compromises, such as flying creatures needing to be lightweight, but by and large, you can make up anything you want.

And that's the problem. *No creature exists independent of its environment*. Predators eat, prey are eaten, and so on. In any naturally evolved system, checks and balances will have evolved to prevent one species from completely dominating its environment. A species that completely depletes its food source is not a successful one, since it means the next generation will starve to death.

In the short term, a species *can* dominate an environment, but this is in the scale of human lifetimes, which is only an eyeblink in terms of a species' entire lifetime. As you design a creature, especially alien or unusual ones, remember how it will respond to the environment, and how the environment will respond to it (elephants slowly deforesting an area, etc.).

ATTRIBUTES - Most of a creature's non-Strength stats are going to default to a roll of 2d+0 (a level of 6). This includes Agility, Health, the *perceptive* part of Awareness, and Will. Some will be a function of the gameworld they are designed for, like Fate. Others will depend on the nature of the creature, like cognitive Awareness, and Strength is mostly based on the size of the creature.

Default creature

Strength:	to be determined
Agility:	2d+0
Awareness:	2d+0
Will:	2d+0
Health:	2d+0
Fate:	to be determined

A "default"creature of a given size will have a certain Strength. Things about the creature's biology that suck energy away from physical development will weaken the creature, and things which allow more biological resources be devoted to muscle will strengthen the creature. "Surplus" Strength can be used to buy up the other Attributes as needed.

The principles are the same as that in the weapon design chapter, and you should be comfortable with them by now. The basic modifiers are on the next column, and will be explained in sequential order.

Strength - One hexagon of creature (500 kilograms) will have a default Strength of +6. This is +6 for "animal power plant" and +0 for "1 hexagon power plant". Each doubling of size over 1 hexagon is a +6 to this, and each halving below 1 hexagon is a -3 penalty (and extra size modifiers are halved, rounding down). This is "power plant" Strength, not "adventurer sheet" Strength. A "hexagon" of creature is just a measure for power plant output. It does not reflect space under its legs or the volume needed to spread its wings. It is closer to how big a tub of meat and bone you would have to start with in order to make the creature. A horse that weighs 500 kilograms is a one hexagon creature for design purposes, even though it takes up several hexagons if you lay it out on a map. Think of it as you would an animal power plant for a vehicle. That is, the *actual* volume taken up is usually quadruple the "power plant" size (and probably doubed again for fliers).

EXAMPLE: An *average* person would be around a .1 hexagon (Size of -7 or -8) animal and a horse might be a 1 hexagon animal (Size of -2). Each is far larger in terms of the space they would occupy in a vehicle or a layout.

In general, the natural range of Strength amongst adults of a given type of creature will be no more than 6 points more or less than the average. Other Attriibutes may have different ranges, depending on their use.

Strength distribution	Percentage
+6 more than normal	<1%
+5 more than normal	1%
+4 more than normal	2%
+3 more than normal	5%
+2 more than normal	10%
+1 more than normal	20%
Normal	30%
-1 less than normal	20%
-2 less than normal	10%
-3 less than normal	5%
-4 less than normal	2%
-5 less than normal	1%
-6 less than normal	<1%

EXAMPLE: So, if you have a thousand animals whose average Strength is 15, then maybe ten of them will have a Strength as high as 20, or as low as 10. Ninety percent of them will be in the 13 to 17 range. However, in any sort of wild environment, the weaker individuals may be more likely prey for other creatures and thus be less common than stronger individuals.

Technological Era	Strength for 1 hexagon
Animal power	+6 Strength

Creature size	Amount
.001 hexagon(.5kg)	-30 penalty
.002 hexagon(1kg)	-27 penalty
.004 hexagon(2kg)	-24 penalty
.008 hexagon(4kg)	-21 penalty
.015 hexagon(8kg)	-18 penalty
.03 hexagon(15kg)	-15 penalty
.06 hexagon(30kg)	-12 penalty
.12 hexagon(60kg)	-9 penalty
.25 hexagon(125kg)	-6 penalty
.5 hexagon(250kg)	-3 penalty
1 hexagon(500kg)	+0 bonus
2 hexagons(1000kg)	+6 bonus
4 hexagons(2000kg)	+12 bonus
8 hexagons(4000kg)	+18 bonus
16 hexagons(8000kg)	+24 bonus
32 hexagons(16 ton)	+30 bonus
64 hexagons(32 ton)	+36 bonus
125 hexagons(64 ton)	+42 bonus
250 hexagons(125 ton)	+48 bonus
Each doubling	+6 bonus
Each halving	-6 penalty
Each 25% extra size (max +50%)	+2 bonus
Each 25% less size (max -25%)	-1 penalty

Modifiers	Amount
Adventurer sheet modifier	varies
Gravity	varies
Herbivore	+0 bonus
Omnivore	+2 bonus
Carnivore	+4 bonus
No skeleton	-3 penalty
Endoskeleton	+2 bonus
Exoskeleton	-1 penalty
Instinct intelligence	+1 bonus
Animal intelligence	+0 bonus
High animal intelligence	-1 penalty
Semi-sentient	-3 penalty
Sentient	-4 penalty
Super-sentient	-5 penalty
Tool-using manipulators	-1 penalty
Each 25% extra limbs	-2 penalty
Each 25% less limbs	+1 bonus
Each extra x1 running multiple	-2 penalty
Each x1/2 running multiple	+1 bonus
Each +1 hit bracket	-2 penalty
Each -1 hit bracket	+1 bonus
50 year lifespan	+0 bonus
Each x2 lifespan	-3 penalty
Each x1/2 lifespan	+3 bonus
Inherent armor	varies
Natural weaponry	varies

Note - On this scale, people are considered to be an average of 75 kilograms, which would be a size of .15 hexagons and an adjusted Strength of -2 (+6 base and a -8 penalty for size).

Adventurer sheet - Creatures will have a "power plant" Strength, which is how well they could power a vehicle, but if that's all you need a creature for, just go back to the **Vehicles** chapter and make an "animal" power plant. However, that chapter assumes that all creatures are created equal, and does not take into account that a 2 ton orca could pull the sea god's chariot a lot better than say a 2 ton jellyfish. So, in addition to the way we generate "power plant" Strength in *this* chapter (which does take these variations into account), creatures will *also* have "adventurer sheet" Strength. This modifier will be:

plus Intelligence modifier on Strength
minus half of any *positive* size bonus for Strength
plus 12

This modifier never goes lower than +0, so adventurer sheet Strength is never less than power plant Strength.

EXAMPLE: A person as a power plant of .15 hexagon would be:

Modifier	Amount
Animal power	+6 Strength
.12 hexagon(60kg)	-9 penalty
25% extra size (max +50%)	+1 bonus
Total	-2 Strength

But, a human has an actual character sheet Strength of around 6 or 7. The difference is:

Modifier	Amount
Previous total	-2 Strength
Intelligence modifier(sentient)	-4 penalty
Half of any positive size modifier	+0 bonus
Fixed bonus	+12 bonus
Total	+6 Strength

A lesser primate of the same weight as a human would be signifiantly stronger. They also only have a -3 Strength penalty for their level of intelligence, plus 12, for a +9 bonus...

A big brain consumes a lot of oxygen and nutrients. Between two creatures of equal size, the one that is smarter is also likely to be weaker.

Note - The interactive pdf at the end of this chapter automatically takes this modifier and the +6 "animal power plant" amount into account.

Gravity - There's a reason why giants don't stride the earth. It's the same reason mountains don't jut out of the atmosphere. The materials they are made from are just not strong enough. A huge creature requires more and more material in its skeletal structure, until you reach a point where the creature has to be 100% skeleton just to avoid snapping in two when it bends over. The gravity well a creature lives in will determine how much of its biology has to be devoted to just holding itself together, and this is based on the creature size. The modifiers on the "gravity" table apply only to the Strength from the *size* of the creature (round effects towards zero), and the "additional effect" table applies normally. The net effect of the modifier is to let smaller creatures carry proportionately more, and bigger creatures carry propotionately less.

Gravity	Modifiier
Base effect (based on size)	-1 per +2
	+1 per -4

Additional effect	Modifiier
0g*	+9
.06g	+6
.12g	+4
.25g	+3
.5g	+2
1.0g	+0
1.5g	-4
2.0g	-6
3.0g	-10
4.0g	-12

EXAMPLE: In earth-normal gravity, a creature with +6 Strength for being 2 hexagons in size (1 ton) will take a -3 *penalty* to Strength, for a net +3 effect for carrying capacity (instead of +6). A creature at -12 Strength for being .06 hexagons (30kg) will get a +3 *bonus*, for a net -9 effect for carrying capacity (instead of -12). The 2 hexagon creature in a 2*g* environment will have a -9 penalty to Strength from gravity, for a net -3 effect on carrying capacity, while the .06 hexagon creature has a net -15 effect.

On this scale, a creature weighing 125 tons would only have a default Strength of about +30, enough to lift 12.5 tons, only ten percent of its body weight. Imagine how crimped your lifestyle would be if the biggest load you could stagger around with was only ten percent of normal human body weight! For reference, if you used this modifier on a normal human (a .15 hexagon creature), the modifier on carrying capacity in a 1g environment would be +2.

Most water-bound creatures use the .5g row. A creature that floats in its environment like a jellyfish or a balloon may counts as though it were on the .12g row.Only a creature that is adapted to the delicate life of floating in space can take the zero-g modifier. Note that the maximum acceleration a creature can manage under its own power, or experience without taking damage is related to that amount of gravity.

EXAMPLE: A beached whale can suffocate under its own weight. It would be much the same as if a person were trapped in an environment of several gravities. Your chest would weigh so much that the very act of breathing would eventually exhaust you.

To deal with a creature when it is in a heavier gravity than it is used to, you can often just apply the difference.

EXAMPLE: If you are used to 1g, then being in a 2g environment would be a -6 Strength penalty. If you are used to .5g, then 1g would be a -3 Strength penalty.

SAMPLE CREATURE - At this point, we're going to start designing a horse, applying modifiers as needed until we get to the end of the basic design section.

EXAMPLE: An "average" horse weighs in at about 500 kilograms, which is a convenient 1 hexagon size. This is a base Strength of +6 (+6 for animal power plant, +0 for size). Because it has +0 size modifier, the gravity-based carrying capacity modifier will also be +0 (for a 1g environment).

Diet - A creature living on high-energy foods can afford to power more muscles. Herbivores (plant eaters) are at the bottom, carnivores (meat eaters) are at the top and omnivores (a little of each) are in the middle. Specialized diet types as might be found on alien creatures (photovores, metallovores, etc.) will be in the advanced rules.

EXAMPLE: A horse is an herbivore, for a +0 bonus and no change, leaving us at +6 Strength.

Keep in mind that a creature needs to consume some fraction of its body weight each day (as an average) to stay alive, and that the creature has to be equipped to acquire that food. Carnivores *may* need to be able to go out and kill things, though they may be opportunists that simply take the leavings from other creatures (like vultures), or pick on tiny helpless creatures in great quantity (like an anteater). A creature's normal food consumption is about 1 percent of its body weight per day (this would be its mass level with a -19 modifier). An herbivore might require a level or two more in mass, while a carnivore might use a level less (meat being more efficient energy-wise than plants). A herbivore might graze on and off all day, while a carnivore might eat several day's worth of food in one sitting For a tiger, it is not uncommon for only five percent of a hunting attempts to be successful. This doesn't mean the hunters are incompetent, just that the prey is very wary, and the hunter often goes several days without a new kill.

EXAMPLE: A horse is an herbivore and has a mass of about 500 kilograms (a Mass level of 16 on the **EABA Universal Chart**). A -19 on this would drop it to a mass level of -3, or 6 kilograms of food per day (8-10 kilograms if we apply a +1or +2 modifier for lower quality food).

As a really quick guide, a sustainable pasture for a 1 hexagon herbivore will be about .02 square kilometers (2 hectares) of good quality foraging, but a 1 hexagon carnivore will want about 10 square kilometers of good hunting territory. Lower quality forage (like arid areas) can increase the size of *both* regions several-fold.

Skeleton - What you use to hold things up with. *No* skeleton means something like a jellyfish, starfish or even an octopus. The way the creature moves and lives requires few or no rigid structures. While this obviously conveys a lot of flexibility, it also limits the mechanical leverage the creature can employ. To compensate for the -3 penaltyon Strength, a creature with no skeleton can have +6 on the damage of any special attack it has (see page 5.12). An example of such an attack might be the stinging tentacles of a jellyfish.

An *endoskeleton* is any sort of rigid, internal skeleton. This could be bone, cartilage or something else. It is a framework to which other things can be mounted, housed in or protected by. Most of you should be thankful that your brain has a protective housing. This is the default.

An *exoskeleton* is an external skeleton. It will perform much the same function as the endo-skeleton, but is not as efficient. However, exoskeletal creatures will get an inherent armor. The value of this would be calculated as a very lightweight armor as applied to a vehicle, with a base weight of twenty percent of the creature's weight. Don't fret about figuring it out. The result of that calculation for a 1 hexagon creature is a 0d+0 armor for flying creatures, a 1d+0 armor for land creatures and a 2d+0 armor for water creatures. And this amount stays fairly constant. As creatures get bigger, they have more armor, but it is covering a larger area, and while smaller creatures have less armor, it is covering a smaller area.

The exoskeleton modifier can be taken more than once. Each doubling of the times it is taken it adds +1d to the creature's armor (twice gives +2d, four times gives, +3d, etc). If armor is bought for a exoskeletal creature later in the design process, it will be bought up from the base provided by the exoskeleton.

EXAMPLE: A horse has an endoskeleton, for a +2 bonus, giving us a total of +8 Strength.

Intelligence - How much of the creature's life-support resources go towards powering a brain. Creatures with *instinct intelligence* have a normal cognitive Awareness of 0d+0 and a maximum of 0d+1. *They're frightfully dim*. However, most of what they need to know to survive they are born with, and simply get better at it as they grow older. *Animal intelligence* is the default. The creature has the ability to learn, but only to a small degree. It's cognitive Awareness is 0d+1 with a maximum of 0d+2. Remember that this only limits its ability to acquire intelligence-based abilities, and these are appropriate to the nature of the animal. Being able to tell the difference between a circle and a square to get a food reward, or remember a path through a maze are examples of animal intelligence. *High animal intelligence* is a cognitive Awareness of 0d+2 with a maximum of 1d+1. The creature is capable of some problem-solving ability or do things people would consider "clever". Cats, dogs, horses, squirrels and some of the brighter birds fall into this category. *Semi-sentient intelligence* is a default of 1d+0 cognitive Awareness with a maximum of 2d+0. The creature is capable of abstract thought to some degree, and given time can master aspects of symbolic representation like simple language skills. There would be some overlap between the low end of sentience and the high end of semi-sentience. Higher primates and dolphins fall into this category. *Sentience?* Think humans. This is a default cogitive Awareness of 2d+0 and a maximum of about 4d+0. *Super-sentient?* We have nothing to compare it to in the real world, but assume a default cognitive Awareness of 3d+0 and a maximum of 6d+0. Whatever they are, they're damn smart, and an ordinary human genius barely has the brainpower to get a minimum passing grade in their schools.

Note - The lower on this intelligence scale, the more the creature is ruled by "animal instinct". A human who sees a fire will call for help. A smart gorilla is not a natural language user. Their response is going to be more of the instinctual one. If you need to make a roll of some kind, apply a 2 point difficulty shift on whatever Will task needs to be made to "act rationally" for each level below (or above) basic sentience. This can combine with other modifiers like loyalty of the creature to an owner, etc.

EXAMPLE: We'll say our horse is a reasonably bright breed, and give it high animal intelligence, which is a -1 penalty, dropping its Strength to +7.

Tool-user - The ability to pick up and use small items with finesse comes at a slight overall biological penalty. The basic modifier gives the ability to use hand-held items with half the creature's limbs (round down). To have the ability to use tools in *all* the creature's limbs, the modifier would be taken twice. Normally, a creature can only use one tool at a time, regardless of how many it can hold. If you want to have a multi-tasking creature, apply an extra -1 penalty per extra tool (or Agility skill) that can be used simultaneously at no penalty (it takes a bigger brain to manage two tasks at once).

EXAMPLE: While a horse can figure out how to open latches with its lips, it is not a tool-user and takes no modifier.

Limbs - Creatures have a default of four limbs. For game purposes, a limb is something that can use tools, move the creature or strike for damage. A cats' tail may be expressive, but it is not a limb. Each extra limb is a -1 penalty, and each limb removed is a +1 bonus (fish have no limbs, for +4). Extra limbs give more ability to hold or use tools. It also provides redundancy in the event of damage. If you don't have at least half your locomotive limbs intact (round up), it will be difficult to move at all. Having fewer limbs lets you concentrate your musculature into fewer but more powerful limbs. If you have no limbs, like a snake or fish, then your movement is affected by normal damage penalties, while for limbed creatures, hits to non-motive limbs do not necessarily affect movement speed.

All limbs are *not* created equal. The default is that half the limbs are specialized for movement, and half for other purposes. This applies even to animals you normally consider straightforward quadrupeds. For instance, you don't think of a rabbit bounding along by the power of its front legs. Normally, the limbs closest to the mouth are less associated with mobility. They might be required for full mobility, but are less specialized for the task.

If certain limbs are not required at all for mobility (like a human's arms), this reduces the creature's mobility with the remaining limbs.

In **EABA** terms, half the limbs do punching damage (Strength roll minus 1d) and half do kicking damage (Strength roll). The main mobility limbs have the animal's Health for determining normal movement rate, while the other limbs have normal Agility for skill use. For a creature to be "limb-symmetrical" is a -1 penalty on Strength. It means that all limbs are equally usable for all purposes, but is also means that all limbs are required for normal full mobility. A four-legged tool user can hold a tool in any hand/paw, but they could not run at full speed at the same time.

EXAMPLE: Our horse is going to have the default limbs. It will be more powerful at kicking with the hind legs, and can see where it is kicking better with the front ones, so the rear legs get better damage, while the front ones have a better chance of success. So, no Strength modifier.

Running - Normally, creatures have a walk speed based on their full Health dice, which is a default of 2d+0, for a walk speed of 2 meters per turn. This is a running multiple of x1. Increasing this means the creature is trading in limb strength for limb speed. Increasing the running multiple by 1 is a -2 Strength penalty. Conversely, slowing a creature by giving it shorter, more powerful limbs is a +1 bonus to Strength each time the multiple is halved.

EXAMPLE: We know from the **EABA** rules that a horse has a running multiple of x3. This is a -4 penalty to Strength. Last time we checked, Strength was at +7. A -4 penalty will drop this to +3.

The **EABA** rules have walk, run and sprint movement, corresponding to basic movement, movement times two, and movement times three. Skills like Running can increase the base movement rate.

Multiples also applies to damage penalties. A creature with x2 running speed loses 2 from base movement speed on a -1d penalty. But, a creature with a x1/2 running speed only loses 1 from base movement speed on a -2d penalty.

Lifespan - The default lifespan for a creature is 50 years. While larger creatures *generally* live longer than small ones, this is not always the case. If a creature's average lifespan is halved, it gets a +3 bonus, and, if it is doubled it gets a -3 penalty, with increments of 25% being a +1 bonus or -1 penalty.

EXAMPLE: A horse has about a 25 year lifespan, so we take a +3 bonus, which raises the total Strength to +6.

In adventurer terms, lifespan equates to the Elderly category of the Age Trait (**EABA**, page 2.11).

Blessing/Curse - A creature that has the inherent ability or limits of these **EABA** Traits would take a -3 penalty for each level of a Blessing, and +3 for each level of a Curse. This is very much a "gamemaster option" ability.

Inherent armor - Creatures can have hard shells, thick fur or other natural protection. Generally, a creature can take a 0d+1 armor to represent a thick hide or fur as a "freebie". A "freebie" is in the advanced rules, and it is a trait that by itself does not have a Strength penalty or bonus, but which a creature can only have a certain number of. Generally, creatures will get one freebie for +3 of Strength and each time this is doubled, with a minimum of one freebie.

Inherent weaponry - Normally, creatures do half-lethal damage with whatever they use to attack or defend themselves with, doing a minimum of 0d+1 for any creature which can reasonably put a hurting on a person (ouch!). A human fist or kick is an example. A form of natural weaponry that can do *lethal* damage with a -2d penalty (with a usual minimum damage of 0d+1) is a "freebie". This could be a bite, a horn, claw or whatever (though a lethal claw *and* bite would be *two* freebies). You need to decide the type of damage for purposes of special armor effects (a horn might penetrate armor differently than a claw). Lacking *any* conventional weaponry would net you a spare freebie.

Final - That ends the basic design for creatures. The Strength you have at this point is the "power plant" Strength for purposes of pulling or powering a vehicle. The actual Strength for purposes of lifting, encumbrance or *kicking* damage is going to be adjusted by the creature's size and intelligence. And so, the horse:

Creature	Strength/modifiers
Animal power	+6 Strength
Adventurer sheet modifier	+11 bonus
1 hexagon creature	+0 bonus
1g gravity well	+0 bonus
Herbivore	+0 bonus
Endoskeleton	+2 bonus
High animal intelligence	-1 penalty
Running multiple(total of x3)	-4 penalty
Lifespan ($x^1/2$)	+3 bonus
Total	+17 Strength(2d+0)

So, the horse would be listed as having a Strength of 6 (power plant) + 11 (adventurer sheet modifier) = 17 (a roll of 5d+2). We know from previous text that we get two "freebies" for the horse. This is one each at +3 and +6 *power plant* (not adventurer sheet) Strength. We opt for a 0d+1 hide and leave the other freebie for later.

LET'S SEE IF IT WORKS - That's all you need to design a large number of conventional creatures. We will do two basic creature designs, one from the present, and one from bad 1950's horror movies.

Homo sapiens - Humans. We have the rules needed for a basic human in the basic design rules.

Creature	Strength/modifiers
Animal power	+6 Strength
Adventurer sheet modifier	+8 bonus
.15 hexagon creature	-8 penalty
1g gravity well	+2 bonus
Omnivore	+2 bonus
Endoskeleton	+2 bonus
Sentient intelligence	-4 penalty
Tool-user	-1 penalty
Lifespan (x1 1/4)	-1 penalty
Total	+6 Strength(2d+0)

This is the "adventurer sheet" Strength, which gives a 75 kilogram human a Strength of +6 (roll of 2d+0). But, for powering something like a bicycle, you remove that modifier and count them as a powerplant with a Strength of -2 (roll of -0d+2). You might quibble over giving an average person a lifespan of only 62 years, but remember that this is "wild" lifespan, excluding being eaten by other creatures, nor including any medical care more sophisticated than wild herbs. We get one freebie (the minimum), which we save for later. A semi-sentient primate of the same size and lifespan would have a power plant Strength of -1, and an adventurer sheet Strength of +8, which is about sixty percent more than a human of equal mass, and if they had the default lifespan, they would have a Strength of +9, twice as strong as a human for the same size package. *Don't get into wrestling matches with the lesser primates. They'll kick your ass.*

Lobster from Hell - We decide to recreate the movie "Attack of the Giant Lobster", a creature which we'll say is 32 hexagons in size (16 tons). If we quadruple the power plant size to get a better representation of *actual* creature size, we have a 128 hexagon lobster (about 10 meters long by 4 meters wide by 3 meters high).

Creature	Strength/modifiers
Animal power	+6 Strength
Adventurer sheet modifier	-2 penalty
32 hexagon creature	+30 bonus
1g gravity well	-15 penalty
Omnivore (it eats anything)	+2 bonus
Exoskeleton (four times)	-4 penalty
Instinct intelligence	+1 bonus
Lifespan (x1/4)	+6 bonus
Total	+24 Strength(8d+0)

We decided the base 1d+0 armor from the exoskeleton isn't enough, so we take it three extra times for a total -4 penalty, but a 4d+0 total armor that should keep the townsfolk busy. Our lobster gets four freebies (1 freebie at each of +3, +6, +12 and +24 Strength). We use one to give it lethal crushing claws at -2d to normal damage (details in the advanced rules).

The lobster has a "power plant" Strength of 8d+2, which compares to a vehicle design number of 7d+0, though to be fair, the vehicle rules were not meant to be used with a single creature this big. A team of sixteen 1 hexagon horses would have a power plant Strength of 6d+0. Of course, our lobster is also an energetic, short-lived omnivore that is dumb as a box of rocks.

The lobster has a "adventurer sheet" Strength modifier based on its size and intelligence. This is its intelligence modifier, plus 12, minus half its Strength bonus from size. The total modifier is -2, giving the lobster an adventurer sheet Strength of +24 (8d+0).

Its lethal damage would be 2d less than this, for a 6d+0 attack. Yeah, that's a lot, but the lobster *is* about the size of a locomotive, so if its claws can snap a person in half with one "clack!", who are we to argue with it?

OTHER BASIC CONCEPTS - These are addressed in varying detail in the advanced rules, but remember:

Hit brackets - Small creatures will have smaller hit brackets, large ones will have larger ones. See **EABA**, page 2.19. The number of spots in a bracket is the creature's (Strength plus Health), divided by four, rounding nearest. The minimum Strength for determining hit brackets is zero.

EXAMPLE: Our giant lobster has a Strength of 8d+0, which is a level of 24. If its Health were 2d+0 (a level of 6), this would give it a hit bracket of 8. This means that while a person takes a -1d injury penalty per 4 hits, the lobster only takes a -1d injury penalty per 8 hits. Add this to its inherent 4d+0 armor (2d+0 vs. guns), and it becomes a pretty tough monster to take down.

You can alter a creature's hit brackets by ±1 point spread between damage brackets by taking a ±1 to Strength. Note that this will sometimes end up with zero change for a particular creature, like if a 1 point drop in Strength also drops the hit bracket by 1, which you just canceled by buying +1 hit bracket...

Cognition vs. perception - The Awareness attribute in people covers both sensory acuity and how well you can interpret that info to make decisions. For animals, they may be able to spot things just fine, but they might not have the ability to recognize that guns are dangerous, or figure out the "doorknob principle" in order to escape captivity. That's why they have the arbitrarily low values for mental tasks. A task with a difficulty of 4 is barely within the capability of a smart dog to figure out with its native wits, though it is worth noting that an animal with a cognitive Awareness of 1d+0 can with time and effort be trained up to a +1d skill level, giving it a 2d+0 roll for *specific* intellectual tasks.

ADVANCED CREATURES - Again, we start with the basics and move on to advanced creature topics.

When Animals Attack! - The default for *lethal* attacks from an animal is its character sheet Strength with a -2d penalty, with a minimum of 0d+1 damage for any creature reasonably able to do a nasty gash to an unprotected person. This seems reasonable on the face of things, but what if the creature is really huge? No matter how vicious the creature, no weapon of bone or tooth or horn or claw is going to get through the front of a tank, any more than you could chew up a steel ball-bearing. Swallow it, yes. Chew it up, *not* likely.

If kick damage is based on Strength, and punches are based on Strength minus 1d, other attacks would have default values as listed below. All damage is half-lethal.

Attack	Damage
Kick	Strength+0
Punch	Strength-3
Head butt	Strength-3
Bite	Strength-6
Claw crush	Strength-3
Tail thrash	Strength-6

If a creature has the lethal damage modifier, it is an *extra* -6 on these amounts. The maximum damage that can be done by flesh and bone attacks is 5d+0 (or 3d+0 lethal). If a creature would have an attack that can do more than this, you can give it +2 "battering power" (see page 2.27) for each full die the attack exceeds the normal maximum. This represents a really big attack. A great white shark might have a limited ability to get through armor, but it has a *big* mouth, and if it gets through your protection, it will take a big chunk out of you.

EXAMPLE: A large great white shark as a creature design might have a Strength of about +31(10d+1). If a bite is -6, and lethal damage is -6 more, this gives the shark a lethal bite of 6d+1. We downgrade this to 3d+0 lethal with +6 battering power (+2 per extra die). Against armor of 3d+0 or more, the attack does no damage, but on any attack that gets *anything* through armor, you add +6 to the damage done. *Chomp!*

Enhanced Attributes - So far, we have dealt only with Strength, and assumed all other Attributes were at 2d+0. The way you alter these Attributes (in either direction) is by using Strength. *Got extra Strength*? Put it towards the creature's Health. Not enough Strength? Take a point or two from Agility or Awareness. The near-sighted rhinocerous or the glacially slow sloth would be examples of decreased non-Strength Attributes. In general, Attributes can be raised or lowered by 1 for a -1 penalty or +1 bonus to Strength.

In addition, the level of an Attribute in different limbs can be altered on a 1-to-1 basis. For instance, rear leg Strength can be increased by 1 if front leg Strength is decreased by 1 (think of the difference in strength between the front and rear legs of a tyrannosaurus). If limbs normally have more of a non-Strength Attribute than others, or you want to switch between Attributes, this is on a 2-to-1 basis per type. If you rearrange the *same* Attribute, but move the ability from full use to a Forte, you can trade on a 1-to-2 basis.

EXAMPLE: Altering limb Strength is done on a 1-to-1 basis. However, dropping leg *Health* (which affects movement rate) to increase arm *Agility* would be done on a 2-to-1 basis. Each 2 points of Health lost from the legs for movement purposes would increase base arm Agility by 1.

EXAMPLE: If you have a creature that has poor Agility for things like combat, but has very fine motor control for things like craft skills, you are rearranging Agility. Each 1 point lost off normal Agility is a +2 bonus to Agility as a Forte on "craft skills".

Magic - In a non-magical gameworld, most creatures usually have a Fate of 0d+1. If a gameworld is such that there are creatures with inherent magical ability, they start off with a Fate that is half their default "adventurer sheet" Strength (the Strength *before* you rearrange any Attributes). Increasing or decreasing this default would be done as for any other Attribute. Any spell or paranormal effect a creature has use of is at a -3 penalty off their designed level of Fate. Note that such an ability would likely be a paranormal phenonomenon and those rules would apply instead of the attack type rules.

EXAMPLE: A creature with a Fate of 7 has a Fate roll of 2d+1. However, for purposes of using any natural magical abilities, it uses a Fate of 1d+1 to determine the level of effect.

MacGuffin bonus - Sometimes a creature has abilities that are just so far "out there" that basic design rules do not apply. This is especially the case if recreating a creature that is the centerpiece of a particular fictional universe. An example might be a flying dragon-like creature with flaming breath, human intelligence *and* the ability to teleport across vast intervals of space and time. It's just not going to happen in the normal **Stuff!** design rules. To do it, you need to add a "MacGuffin" Strength bonus to that creature type, typically is just enough to offset the high cost of the creature's abilities. This allows normal variation in mundane abilities, but also covers unique abilities of that particular creature.

Mobility - The basic rules really only cover land creatures. You can do things like snakes by saying they have no limbs and altered movement rates, but there are no basic provisions for fish, birds or other modes of movement other than walking or slithering on a solid surface.

Swimming movement is based on Health, just as running would be. However, a creature that moves mainly by swimming would likely be at a disadvantage trying to walk on land. A swimmer is not prohibited from land movement (witness an alligator), but it will usually take penalties.

Creature can:	Strength
Swim and walk equally well	-4 penalty
Swim normally, walk at x1/2	-2 penalty
Swim normally, walk at x1/4	-1 penalty
Swim normally, no walk at all	+0 bonus
Walk normally, no swim at all	+0 bonus
Walk normally, swim at x1/4	-1 penalty
Walk normally, swim at x1/2	-2 penalty
Walk and swim equally well	-4 penalty

An exception to the above table is a creature which can move on land but has absolutely no chance of surviving in the water. This is *worse* than "no swimming ability", and would get a +1 bonus to Strength. An example might be a heavy dinosaur that simply sinks like a rock and drowns. Movement modifiers can be taken in combination with altered numbers of limbs. A snake might have no limbs and be equally mobile on land and in the water, while a fish might have no limbs and be helpless on land. "Running multiples" may be taken on swimming or running speed, but multiples only affect one mode of movement. Increased speed multiples may not be applied to a *decreased* movement rate. Swimming multiples are a -4 to Strength each, instead of the -2 for flying or running movement.

EXAMPLE: A creature with equal walking and swimming base movement can get a running multiple on swimming and a separate one on running. A creature that has walking at x1/2 its swimming rate can buy a multiple on swimming speed, but not on running speed. Running speed is half the base swimming speed, not the swimming speed after the multiple is applied.

Note - A creature which has "walk normally, no swim" can usually gain the benefit of "swim at x1/4" by having a "Swimming" skill. Consider a person who can't swim vs. a person who has learned to swim. If a mode of movement is possible to your biology, but not known by instinct, you can usually spend skill points to compensate.

Flying movement is a bit trickier. In general, the creature needs to have a superior amount of muscle and a low weight in order to get itself off the ground. There are two ways to do this. The first is that the creature can take off from a standing start, but has negligible ground movement (a very slow waddle). This is a +0 to Strength. If the creature needs a running start to get airborne (equal to its running speed), it gets a +1 bonus. This bonus is *in addition* to another modifier, not a stand-alone case, and means the creature must have at least "walk at x1/4" Note that for a running start, the creature also needs some room downrange to gain altitude or get over any nearby obstacles. Running speed also takes two turns of ground movement to achieve (walk first turn, run on second turn). In general, a flying creature cannot get off the ground or stay airborne if is burdened to more than a -1d penalty on Strength. As with swimming creatures, a flyer may have decreased land movement.

Creature can:	Strength
Fly and walk equally well	-12 penalty
Fly normally, walk at x1/2	-9 penalty
Fly normally, walk at x1/4	-6 penalty
Fly normally, no walk at all	+0 bonus
Walk normally, no fly at all	+0 bonus
Walk normally, fly at x1/4	-6 penalty
Walk normally, fly at x1/2	-9 penalty
Walk and fly equally well	-12 penalty
Requires running start	+1 bonus

Flight speed is based on Health,as for running. Most flying creatures will have "running multiples" to increase their flight speed, at the same cost. As for swimming, flight multiples are separate from and do not affect running speed.

EXAMPLE: A creature with a Health of 2d+0 and equal running and flying speed will have a base movement of 2 meters per turn. If it takes a x4 multiple on flight speed, its base flight movement is 8 meters per turn, but its base walking speed remains 2 meters per turn.

If a creature for some reason can walk, fly *and* swim well enough to matter (like a duck or goose), then you decide which is the primary means of movement, and apply modifiers in order.

EXAMPLE: A goose would be a flyer that can walk and swim. It flies first, so we say it can fly normally and walk at x$^1/_4$, for a -6 penalty. If we then say it can swim and walk equally well, this is another -4 penalty, for a total of -10.

ADVANCED TOPIC: FLIGHT MUSCLES

A creature with flapping wings generally has a huge amount of muscle and bone mass devoted to this aspect of its biology. It is the strongest part of the creature. In general, such creatures usually consider their wings to be the stronger limbs, and these will do kick damage instead of punch damage. This can be further enhanced by moving Strength from the other limbs to a Forte on "wing Strength". This *does not* affect flight lifting capacity, but will affect any damage done with a wing strike. You would normally get this as a freebie for the creature.

EXAMPLE: A goose might have a final Strength Attribute of +0 (0d+0). If we divert 3 points of Strength from its walking limbs and give it a Forte of "wing strength" for a +6 bonus, it means that a goose with a normal Strength of 0d+0 can slap you with its wings for a 2d+0 half-lethal attack (base of 0d+0, +6 for diverting leg Strength to the wing Forte). Since we have diverted Strength from the legs, this means that the amount of weight the goose can support on land is based on a Strength of -1d+0 instead of 0d+0.

Reaction movement - It is possible for a creature to be a living rocket, almost a necessity for any form of self-mobile space creature. This is a severe biologic strain on the system. Imagine if you had to leave part of yourself behind with every step you took. *You would not do any casual walking...*

Reaction movement would be counted like other movement, based on Health. However, each time movement is used, the creature takes a non-lethal hit. This represents biological fuel or energy reserves being used up. These reserves are recovered normally if the creature has a food source, otherwise they are not. Using running speed is two hits, and sprinting is three hits. On the plus side, once movement is started, the creature can coast through the vacuum of space at this speed with no further fuel expenditure. On the minus side, it needs to expend fuel again in order to slow down. Running multiples do not change fuel expenditure, but they do increase the speed you get for a given expenditure. Reaction movement creatures with a walk movement of 10 meters or more are assumed to be able to make small course or velocity changes without taking hits, like a solar sail slowly accelerating, or a magnetic web slowly altering course along interplanetary magnetic field lines.

EXAMPLE: We decide to work on a space slug that chews on cometary debris and uses gas jets to move about. With a basic Health of 2d+0, it has the ability to accelerate 2 meters per turn, at the cost of 1 non-lethal Hit per use. In order to get a walk movement of 10 meters per turn, we need 4 running multiples (x1 is the base, +4 makes x5 on the base of 2 meters). This would be a -8 penalty to Strength. On the other hand, it operates in a zero-g environment, which is good for a +15 to Strength.

As long as the creature has a food supply and can recover the non-lethal hits, it can jet about all it wants. However, space is very, very big, so if your creature is going to be doing any interplanetary foraging, you better give it a really long lifespan...

Other movement - Creatures can also burrow, climb and possbily have other forms of movement in specialized environments. These need to be handled with a certain degree of common sense. A digging creature has to have claws or something tough enough to get *through* what it burrows into. *Claws that are glorified fingernails may be okay for sand or dirt, but don't expect to dig tunnels through granite with them!* The rate of most specialized movements is likely negligible in combat terms. A badger may outdig a man with a shovel, but he still can't dig faster than a man can walk. For most types of specialized environment, you can usually set a constant to multiply normal walk distance by. For instance, digging through dirt would be about $^1/_{16}$th normal movement. Every time the creature could walk 16 meters on the surface, it could dig 1 meter through dirt. If you want to give specialized movement multiples for some mythical creature, you can. So, you can have giant, fast-swimming sandsharks terrorizing desert dwellers on an alien world.

Hit brackets - A creature that has a lighter body structure has more mass available for muscle, but is not as structurally strong. Remember that you can *decrease* a creature's hit brackets instead of increasing them. A creature can get a +1 to Strength for each point of hit brackets it loses, down to a hit bracket of half normal for its Strength and Health(round down) before this modifier is applied.

EXAMPLE: A flying creature with a hit bracket of 4 could get up to +2 Strength by dropping its hit brackets to 2.

Each 2 points you drop hit brackets by doubles the physical size of the creature for its listed mass, each 1 point being about a 50% change.

EXAMPLE: A living balloon with a normal hit bracket of 7 could drop its hit bracket to 3 for +4 Strength. This creature would be four times as large for its mass as normal.

Environment - The default creature will be an atmosphere-breather. If the creature pulls its oxygen (or other necessary external life support) from a less efficient storage medium, it takes a -2 penalty on Strength. The obvious example is a fish obtaining its oxygen from the air is dissolved in water. If the oxygen is especially rich or poor, this modifier can be altered anywhere in the -1 to -3 range.

Creature can:	Strength
Only survive in atmosphere	+0 bonus
Water-breather	-2 penalty
Can survive in vacuum	-7 penalty
Has 25°C comfort range	+0 bonus
Has 50°C comfort range	-1 penalty
Has 100°C comfort range	-2 penalty
Has 200°C comfort range	-3 penalty
Tolerate x$^1/_4$ atmosphere var.	+0 bonus
Tolerate x$^1/_2$ atmosphere var.	-2 penalty
Tolerate x1 atmosphere var.	-4 penalty

If a creature can survive unaided in a vacuum environment, it takes a -4 penalty (a 100% reduction in pressure). If it can withstand the temperature extremes from burning sun to shaded chill in outer space, it takes an additional -3 penalty (total of -7 for a space-adapted creature). The more detailed way to do this is to give a creature a normal air pressure and temperature range it is comfortable in. The temperature comfort range is generally about 25°C wide. Each time you double the size of the range is a -1 penalty. The comfort range for pressure starts at about a quarter of one standard Earth atmosphere.

The pressure range is what the creature can sustainably live and work in without serious penalty. A $^1/_4$ variation means you can survive in a range of x$^3/_4$ normal pressure to x1 $^1/_4$ normal air pressure. You can usually survive (at some mental and physical penalty) for long periods at pressures of $^1/_2$ your optimum air pressure, and operate at marginal effectiveness for short periods at pressures of $^1/_4$ your optimum air pressure. This is not perfectly accurate, but good enough for game purposes.

EXAMPLE: This gives humans (who have a x$^1/_4$ atmosphere pressure range) a "comfort range" up to an altitude of 2,400 meters, a "survival range" up to about 5,100 meters, and an "I can barely breathe!" range up to about 10,000 meters. Close enough to real-world figures for game use.

The extremes of the survivable range would cause exertion penalties as listed in the **EABA** rules. If the creature can only survive pressure changes in one direction, the penalty is halved. Note that water-breathers generally can operate over a large range of water depths at *no* Strength penalty.

EXAMPLE: A space creature that can survive in vacuum but which is imploded by any significant air pressure would take no Strength penalty (it survives from zero to 1/4 atmosphere of pressure). If it can tolerate a temperature range of 200°C, this is three doublings of the standard range, for a total Strength penalty of -3. If it could survive at pressures of up to 1/2 atmosphere of pressure, this would be a change in one direction (no pressure to some pressure), and would be a -1 penalty on Strength instead of -2.

Special diet - Alien creatures might take their nourishment from things we wouldn't normally consider. For instance, a space-faring creature might subsist on sunlight and interplanetary dust. Specialized diets are also "-vores", like carnivores eat meat, herbivores eat plants, and so on. Unusual vores might be:

Photovore - Lives on sunlight
Lithovore - Lives on stone
Metallovore - Lives on metal
Magivore - Lives on magical energy

Most of the specialized vores will be a -4 penalty. Any two of them would be a -3 penalty, and four specialized vores would be a -2 penalty.

Creature diet:	Strength
Specialized -vore	-4 penalty
Two specialized -vores	-3 penalty
Four specialized -vores	-2 penalty

Note that a vore which does not consume any matter either is not made of matter, or cannot reproduce itself.

EXAMPLE: A living solar sail might be photovore *and* metallovore. Perhaps it can live for extended periods solely as a photovore, but in order to reproduce, it needs to acquire extra mass to create its offspring. It would have two specialized -vores and take a -3 Strength penalty.

EXAMPLE: A spirit might be a magivore (it consumes magical energy). It has no physical form, but neither does it need to ingest matter in order to continue its existence.

Reproduction - The default creature has two sexual forms, male and female. If a creature has only one gender, it can typically procreate by self-cloning. This is a -1 penalty to Strength. On the other hand, if the creature is tri-sexual and requires more than two individuals in order to reproduce, each of the creatures is spending less of their biologic capital on the necessary hardware, and such creatures get a +1 bonus to Strength.

Creature reproduction:	Strength
Unisexual	-1 penalty
Bisexual	+0 bonus
Trisexual	+1 bonus

Typically, different genders have discernable physical differences. By this, we mean one is often larger and stronger than the other. The easiest way to design this is to make one gender slightly smaller than the other, which is enough for an average 1 point of Strength difference.

Specialized senses - Sometimes a creature will have a sense or senses outside the range of what we consider the normal biologic possibilities. A creature with built-in long range radar, or the ability to read auras or see magic would be an example. A specialized sense is a -1 penalty to Strength. If the sense is such that it has or needs Accuracy for long range use (a space creature's long range radar, for instance), the first point of Accuracy is a -1 penalty, and each time Accuracy is doubled is another -1 penalty.

The default creature has the senses of sight, hearing, touch, taste and smell, all at the same level of acuity (their Awareness roll). While alien environments might preclude a particular sense as humans have it, they can still have something that serves the same purpose, so a creature in the vacuum of space can still have a sense that does what "smell" does for humans. A creature can have a Weakness in one sense to get a Forte in another.

Senses can be "sold off" to get freebies for enhancing the creature. A -1d penalty on use of a sense is worth one freebie. A -2d penalty is worth two freebies, but means the sense is more or less absent (since an average creatre has a 2d+0 Awareness roll).

EXAMPLE: If your creature is deaf, they get 2 freebies later in creature design, but any task which requires hearing is more or less impossible to succeed at.

Creature senses:	Strength
Specialized sense	-1 penalty
Accuracy of 1	-1 penalty
Each doubling of Accuracy	-1 penalty

EXAMPLE: You design a giant space slug that sees by radar. Since it needs to be able to spot food at ludicrous distances, you give this sense an Accuracy of 64, sufficient to counter up to 1.6 million kilometers of range penalties. This specialized sense has a biologic penalty of -1 for the sense, and -7 more for the Accuracy, for a total modifier of -8.

Remember that a sense with Accuracy only uses this Accuracy if the creature spends an action on "aiming" the sense, just like it were a weapon.

Weaponry - In the basic rules we allowed for the mundane things like horns, hooves, teeth and so on. Some creatures may have specialized attacks. Attacks that aren't based on normal physical force start at +3 effect, and cause the creature to take 1 non-lethal hit from loss of biological reserves. To get a greater than 1d+0 effect, you can either take 1 extra non-lethal hit per +3, *or* the creature suffers an overall -2 for the first +3, and another -2 for each extra +3 in the effect. Use the following table to get the final attack.

Creature has:	Strength of creature
Special attack at +3 damage	+0 bonus
+1 effect	-1 penalty
+2 effect	-2 penalty
+3 effect	-2 penalty
+4 effect	-3 penalty
+5 effect	-4 penalty
+6 effect	-4 penalty
+7 effect	-5 penalty
+8 effect	-6 penalty
+9 effect	-6 penalty

Attack has:	Strength of attack
Ranged attack	-1 penalty
Cone effect	-3 penalty
Line effect	-3 penalty
Explosion effect	-3 penalty
Non-lethal damage	-1 penalty
Half-lethal damage	-2 penalty
Lethal damage	-3 penalty
Duration effect	-2 penalty
Declining duration effect	-1 penalty
Resisted effect	+1 bonus
Reactive effect	+3 bonus

Ranged attack - The creature's attack can be used at range. It takes a -1 penalty on Strength per 2 range bands. So, the base -1 penalty gives an attack good out to a maximum of 4 meters, enough for something like a spitting cobra. If the attack does declining damage (subtract 0d+1 per range band), the penalty is -1 per 3 range bands.

Area effect - An attack which fills an area or acts like an explosion uses standard **EABA** rules for these types of effects. If the creature is in its own area of effect, it also suffers the effects of the attack. It is an extra -1 penalty to be immune to your own type of damage.

EXAMPLE: A creature which fills an area around itself with a poison gas might take an extra -1 penalty in order to be immune to this poison.

Damage type - The creature takes the penalty for the type of damage done by the attack.

EXAMPLE: A creature with a specialized 2d+0 half-lethal attack would take a -2 modifier.

An attack which has two separate components will take the average of the two damage types, rounding up.

EXAMPLE: If the attack did 1d+0 lethal damage from spines and 2d+0 non-lethal from a noxious gas, then it averages to a -2 penalty to the effect.

Duration effect - This is simple way of simulating poisons or continuing effects. Each time this modifier is taken, the damage effect happens at an interval of 4 Time levels after the last effect.

EXAMPLE: If the modifier were taken twice on a 1d+0 effect, the target of the attack would take 1d+0 immediately, 1d+0 after four seconds (a Time level of 4) and another 1d+0 after sixteen seconds (a Time level of 8).

If the effect decreases by 0d+1 per 2 Time levels, the modifier is only -1.

EXAMPLE: If the previous attack were 2d+0 and declining duration, the target of the attack would take 2d+0 immediately, 1d+1 after four seconds (lose 0d+2 for 4 Time levels), and 0d+2 after sixteen seconds (lose 1d+1 for 8 Time levels).

Resisted effect - If a specialized attack is resisted by the target, like perhaps a toxin, then the target has to make an Average(7) Health roll when attacked. Any amount they make this roll by reduces the effect of the base attack (and thus any duration effects). This modifier may be taken multiple times, and each time it is take increases the difficulty of the task by 2.

The base resisted effect can also be used to represent a physical threshold. The creature must penetrate physical defenses with its attack in order for it to have effect. For instance, a snake has to get through your boots in order to poison you.

EXAMPLE: You decide to work on a poisonous snake. This starts off as a 1d+0 special attack that causes the snake 1 non-lethal hit each time the poison is used (the snake expends energy to refill its poison sacs). This has a Strength modifier for the creature of +0.

You say that the poison is both resisted on Health *and* because it is a bite that has to penetrate normal defenses. This is a +2 modifier. You decide the base poison damage is lethal damage, a -3 modifier. Then, you say it is a duration effect four times, a -8 modifier. The total modifier is -6, for *negative* damage. So, we have to either adjust the amount of non-lethal Hits the creature takes, or adjust the overall Strength of the creature. We go the latter route. We want an initial poison damage of 0d+2, which is +8 effect, which gives the creature a -6 Strength penalty.

Creature has:	Strength of attack
Special attack(-6 to Strength)	+11 damage
Resisted	+2 bonus
Lethal damage	-3 penalty
Duration effect x 4	-8 penalty
Final damage	0d+2 lethal

If the target fails an Average(7) Health roll after being bitten, they take 0d+2 hits, then take the same damage again after 4 seconds, 16 seconds, 1 minute and 4 minutes, for a maximum possible damage of 10 lethal hits.

Reactive effect - This is a type of damage or effect that happens *automatically*, either as a result of stress or being attacked. For instance, a poisonous frog doesn't actually attack anyone with poison, it just poisons anything that tries to eat it.

FREEBIES - These were mentioned earlier. They are traits a creature can have for free. A creature gets one freebie for a final "power plant" Strength of +3 or less, and one each time Strength is doubled (at +6, +12, +24, etc.). Humans get one freebie. These is normally "full color vision". A creature can have more than the "free" amount, but exceeding the base amount and each multiple of the base amount is a -1 penalty to final Strength. A creature can offset this by any freebies accumulated in other parts of creature design, or by use of negative freebies (which we'll get to soon enough).

EXAMPLE: A creature which gets two freebies will take a -1 penalty to Strength for the third freebie, fifth freebie, seventh freebie and so on, unless it had gained freebies elsewhere in creature design.

Typical freebies are listed below:

Camoflauge
Tastes bad
Full color vision
Directional sense
0d+1 fur or hide
Lethal attack at -2d normal Strength
Forte on a sense
"Larger than life" Trait
Forte on an Attribute
Low metabolic rate
Locator sense

Camoflauge: The creature has a skin or coat that tends to blend into its normal environment. This makes it a +2 difficulty to be spotted by the normal sensory organs used by potential predators. Camoflauge is something that evolves in concert with potential predators and works best in a particular environment. This freebie may be taken up to twice, for a maximum of +4 difficulty to spot.

Tastes bad: The creature is edible, but tastes extremely unpleasant. Predators will choose different prey if there is any choice in the matter. If this freebie is taken more than once, the creature is actually slightly toxic and causes 1 non-lethal hit from indigestion. Taking it twice also gives the creature a +2 bonus to any skill or ability it has to intimidate a potential predator.

Full color vision: A creature can normally see in shades of grey and *limited* amounts of color. A creature with *full* color vision can see the full visual spectrum. As an example, humans have full color vision and dogs and cats have limited color vision. If the normal primary sense for an ecosystem is not sight, then a creature with "full color vision" simply has a broader or more acute sensory range than normal.

Directional sense: Normally, a creature's primary sense will be in a limited arc (like sight), its secondary sense will be omnidirectional (like hearing) and other senses will be generalized (like touch). A directional sense means that the sense can localize input from any direction. The swiveling ears of a horse, or the turreted eyes of a chameleon would be an example. This gives the creature a -2 to the difficulty of spotting something outside its normal "vision arc" and makes it harder to sneak up on the creature (it has fewer blind spots).

Fur/hide: As mentioned in the basic design section. This freebie can be taken more than once, for 0d+1 armor per time. This armor has the same limits as body armor with the "organic" modifier. That is, it is inappropriate armor against high-velocity projectiles like bullets. However, if the creature is a lithovore (a rock eater), then it might have stone armor, or a metallovore might have a metal hide, so keep this in mind.

Lethal attack: As mentioned in the basic design section. A form of natural weaponry that can do *lethal* damage with a -2d penalty on "character sheet" Strength (with a usual minimum damage of 0d+1). This allows even small creatures like cats or rats or small dogs to do 1 point of lethal damage.

Forte on an Attribute: Like any other Forte, Perhaps the creature has a powerful bite, can leap especially well, etc. This freebie can be taken up to twice.

Forte on sense: The creature can get a +1d Forte on a particular sense, like a hawk's vision or a bloodhound's sense of smell. This freebie can be taken multiple times, which is required to get the extraordinary sensory acuity some creatures have. This is just a special case of a Forte on an Attribute.

Larger than life: The creature has the "larger than life" Trait, normally on a sense. It can keep 4d+0 or more when rolling, depending on how many times the freebie is taken (assuming that the creature has a 4d+0 roll or more to begin with).

Low metabolic rate: The creature consumes less food than would be expected for its size. It might be very efficient, or it might just lay around a lot and only expends energy when it needs to. This freebie may be taken up to three times, and each time reduces normal food needs by 25%. A creature that needs to eat less has to spend proportionatly less time hunting, grazing or whatever.

Locator sense: The creature has some sort of built-in direction finder, which may operate off of sun position, magnetic fields, genetic memory, or whatever. The creature can successfully migrate and find isolated breeding grounds over vast distances. Knowledge of how to find these areas may be genetically encoded, so that individuals who have never been to a spot can still find their way there.

Negative freebies - A creature can take "negative freebies" in order to offset positive ones that would otherwise subtract from the creature's Strength. Or, if a creature has more negative freebies (or unused positive ones) than its *dice* of "power plant" Strength, it can increase its Strength by +1.

EXAMPLE: A creature with a "power plant" Strength of +3 (1d+0) gets 1 freebie. If it has two unused freebies (more than its one die of Strength), it can increase its final Strength by +1. The creature can do this by taking a negative freebie and not using its positive freebie. Or, it could have normal Strength, and use the negative freebie to offset a second positive one.

The negative freebies are:

Weakness on a sense
Bright coloration
Extended gestation
Specialized diet
Specialized mating
High metabolic rate

Weakness on a sense: The creature has an especially weak sense of some type, and takes -1d to rolls involving that sense. This weakness can be taken up to twice on a given sense. For instance, a cave-dwelling fish might have no sense of sight at all.

Bright coloration: The creature is exceptionally easy to spot in its native environment, and is -2 to the normal spotting difficulty by the sensory organs of typical predators. Such coloration is usually used to advertise something else the creature has that makes it not good to attack, like an evil taste, poisonous quills, etc. This can be taken up to twice, making the creature -4 difficulty to be spotted.

Extended gestation: The normal time for a mother to carry the young before delivery or egg laying is normally 1/32nd the maturity age of the creature. If you double this to 1/16th, you get a freebie. This can be taken no more than twice, to 1/8th normal maturity age.

Specialized diet: If a creature has a specialized diet within its normal food type, it gets a freebie.

EXAMPLE: Koala bears are herbivores, but they only eat eucalyptus leaves, which would be a specialized diet.

Specialized mating: If a creature has some sort of restriction on its mating behavior, it gets a freebie. Monogamy or mating for life would be an example. Mating only in a particular season or particular place would also work. This freebie can be taken up to twice.

High metabolic rate: The creature consumes more food than might be expected for its size. it might be inefficient, or its lifestyle may be one of constant motion and activity. This may be taken up to twice, and each time increases normal food consumption by 50%. A creature with higher energy needs must spend proportionately more time hunting, grazing or whatever.

That about covers the physical aspects of the creature. Before we do any design examples, we'll deal some of the intangibles.

GESTATION/MATURITY - These are not so much part of the design process, but side effects of biology. In general, the type of intelligence a creature has is the most important factor in determining how quickly it matures or how long it needs to be cared for by its parents. Self-sufficiency is defined as having learned what it needs to know to survive without the presence of its parents, and maturity is the age by which it should start being able to reproduce.

Intelligence	Self-sufficient	Maturity
Instinctive	at birth	1/8 lifespan
Animal	1/32 lifespan	1/8 lifespan
High animal	1/16 lifespan	1/4 lifespan
Semi-sentient	1/8 lifespan	1/4 lifespan
Sentient	1/4 lifespan	1/4 lifespan
Super-sentient	1/2 lifespan	1/2 lifespan

EXAMPLE: A turtle (instinctive intelligence) lays its eggs and then abandons them. The young must fend for themselves from birth. A cat (say a lifespan of 12 years) is high animal intelligence. It's young need to be cared for 1/16th of this, or about three-quarters of a year, during which the mother nurtures them, teaches them to hunt and protects them from danger.

A special case of maturity is if the parents have an unusual means of passing on their knowledge. For instance, a creature that reproduces by splitting itself into two pieces would be born with the full knowledge of its parent. A creature's designer can shift the maturing time up one or more rows as desired, but each row shift makes it twice as expensive to learn or improve skills.

EXAMPLE: A creature which stores its learned knowledge genetically rather than by re-wiring its neural connections will mature faster, since it has much (or all) of the knowledge of its parent. On the other hand, it would take a lot of effort to actually encode knowledge into genes, so this creature will take longer to learn its skills.

The gestation period is defined as the interval during which the mother is likely to be physically inconvenienced by the development of the unborn young up to the time that the young are actually born, eggs laid, etc. This period is usually 1/32nd the maturity age of the creature, but the largest physical penalties on the mother are usually only for half this time. Actual pregnancy, egg-carrying, etc. may be up to twice this long, and can be adjusted by the creature designer to suit available data.

There is no easy way to determine the physical penalties a mother will take from the burden of carrying unborn offspring. They might be born very small, like with marsupials, or very large, as for humans. As a general figure, assume the mother takes a -1 penalty to all physical actions after 1/4 of the gestation period, a -3 penalty after 1/2 of the period, and a -6 penalty after 3/4 of the period.

EXAMPLE: Humans (base lifespan of 62.5 years) have a maturing time of about 16 years, and would have a "gestation" time of 1/32th the lifespan, or a about half a year. *Close enough*.

SKILLS - There is no direct correlation between the size of a creature and how many skill points are needed to adequately represent its abilities. But, it's really all we have to work with. In general, skills represent training, training requires brain power, and bigger creatures can (but do not always have) bigger brains. So, work from the following:

Creature size	Skill Points
.001 hexagon(.5kg)	-20S
.002 hexagon(1kg)	-10S
.004 hexagon(2kg)	0S
.008 hexagon(4kg)	10S
.015 hexagon(8kg)	20S
.03 hexagon(15kg)	30S
.06 hexagon(30kg)	40S
.12 hexagon(60kg)	50S
.25 hexagon(125kg)	60S
.5 hexagon(250kg)	70S
1 hexagon(500kg)	80S
2 hexagons(1000kg)	90S
4 hexagons(2000kg)	100S
8 hexagons(4000kg)	110S
16 hexagons(8000kg)	120S
32 hexagons(16 ton)	130S
64 hexagons(32 ton)	140S
125 hexagons(64 ton)	150S
250 hexagons(125 ton)	160S
Each doubling	+10S
Each halving	-10S
Each 25% extra size (max +50%)	+3S
Each 25% less size (max -25%)	-3S

Modifiers	Row shift
Herbivore	-2
Omnivore	+0
Carnivore	+1
No skeleton	-1
Endoskeleton	+0
Exoskeleton	+0
Instinct intelligence	-8
Animal intelligence	-6
High animal intelligence	-4
Semi-sentient	-2
Sentient	+0
Super-sentient	+2
Tool-using manipulators	+1
Each 25% extra limbs	+1
Each 25% less limbs	-1
50 year lifespan	+0
Each x2 lifespan	+3
Each x1/2 lifespan	-3

EXAMPLE: As a .15 hexagon creature, humans would start with 50SP, and get +1 row for tool-using manipulators, +1 row for slightly extended lifespan, and +3S for 25% increased size, for a total of 73S.

EXAMPLE: A great white shark is about a 5 hexagon creature, which would give it 100S. Modifiers on this would be +1 row for being a carnivore, -8 rows for instinct intelligence, and +3S for 25% increased size, for a total of 23S.

If a creature ends up with zero or negative skill points, it means that it has +0d skill in whatever it uses to survive, and has no other abilities (use the relevant Attribute-1d for any other skill rolls). If it has a positive number of skill points, these may be spent on a better level of "survival" skill, or giving it an improved chance at some secondary ability, its ability to learn from its mistakes.

For a non-sentient creature, its ability to learn Awareness-based skills is limited by its cognitive Awareness. For creature purposes, this can be in fractional dice. So, a creature with a cognitive Awareness of 0d+2 could have a 0d+2 skill, for a total skill roll of 1d+1. This maximum limit also applies to any skills taught by a trainer, and the time required would be as for normal skill learning, with the caveat that the trainer has to match or beat a difficulty of the creature's Will plus any tractability modifier.

EXAMPLE: If a creature has a Will of 7 and +2 tractability, the trainer needs has a difficulty of 9 on whatever skill they are using to train the creature.

TRACTABILITY - This is not so much a design issue as a game play issue. Some creatures will be easier to handle or train than others. A tractability modifier is an increase in the difficulty of managing or training the creature. In general, you can add this to the Will of the creature to get the difficulty to train or manage the creature into doing something it really doesn't feel like doing. *Getting a tiger to eat meat isn't a problem. Getting it to jump through flaming hoops on command is another matter entirely...* In addition, the intelligence of the creature also limits the maximum level of skill the creature can ever acquire.

Creature type	Tractability
Herbivore	+0 difficulty
Omnivore	+1 difficulty
Carnivore	+2 difficulty

Intelligence	Tractability
Instinctive	+1 difficulty
Animal	+0 difficulty
High animal	+1 difficulty
Semi-sentient	+2 difficulty
Sentient	+3 difficulty
Super-sentient	+4 difficulty

EXAMPLE: Training tigers (carnivore, high animal intelligence) to leap through flaming hoops is going to be at +3 difficulty. Breaking an ox (herbivore, animal intelligence) to harness and pull a plow is +0 difficulty. Teaching a child (omnivore, sentient) to play piano when they really don't want to is +4 difficulty...

Training any sort of creature will require a skill, which can either be Will-based or Awareness-based, depending on the technique and what is being trained. You can use your default roll (the Attribute minus 1d) if desired. If the creature being trained has no more than high animal intelligence, the training skill also covers what is being trained as well as the actual techniques used. If the creature is semi-sentient or better, the teaching skill is only the techniques, which are used to teach a separate skill that is also possessed by the teacher. A skill for teaching non-sentient animals will only apply to that class of animal.

EXAMPLE: If you are a "lion tamer", you can probably teach most large cats, and this skill includes what you are teaching them to do. If you want to give piano lessons, you need to be a teacher and know how to play the piano.

LET'S SEE IF IT WORKS - We'll use the advanced rules to design a few more creatures so you have something to refer back to.

Goose - An omnivorous flyer with walking and swimming ability, of average animal intelligence.

Creature	Strength/modifiers
Animal power	+6 Strength
.015 hexagon creature	-18 penalty
Adventurer sheet modifier	+12 bonus
1g gravity well	+4 bonus
Omnivore	+2 bonus
Endoskeleton	+2 bonus
Animal intelligence	+0 bonus
Lifespan (x1/4)	+6 bonus
Fly normally, walk at x1/4	-6 penalty
Requires running start	+1 bonus
Swim and walk equally well	-4 penalty
Flying multiple(total of x4)	-6 penalty
Smaller hit bracket(-1)	+1 bonus
Total	+0(-0d+0)

This gives us a creature that weighs about 8 kilograms. With default Health of 6 (2d+0 roll) and x4 movement, it has a walk/run/sprint *flying* speed of 8, 16 and 24 meters per turn. A Strength of 0 gives it a maximum encumbrance of 12 kilograms, though it could not take off if burdened to more than a quarter of this (enough to give a -1d encumbrance penalty). It can walk and swim at a walk/run/sprint rate of 1/2, 1 and 2 meters per turn (1/4 its default walk of 2 meters). As mentioned under the topic of flight muscles, we do a 1-to-2 trade of leg Strength (and carrying encumbrance) to a wing Strength Forte, so it can actually do a wing strike for 2d+0 half lethal damage, while simultaneously dropping its land-based carrying capacity.

For hit brackets, it has a Strength of 0 and a Health of 6, for a hit bracket of 2 (6 divided by 4, round nearest). We reduced this to a hit bracket of 1. *Any* hits at all are a -1d penalty, though the *first* hit is still a -0d threshold.

With animal intelligence and average lifespan of 12.5 years we infer that the self-sufficiency period for goslings is about four and a half months, with biological maturity at a year and a half, and an egg carrying period of about three weeks. These numbers aren't perfect, but they're pretty good for a generic system.

In addition, we can add minor tweaks with freebies. Geese have a limited breeding season (once a year), and within a given breeding season are monogamous. This gives us two extra freebies, which we use on "directional sense" and "lethal attack". The former lets the goose figure out north and south for migration purposes, and the latter represents its beak, which can deliver a vicious 0d+1 lethal pecking.

Great White Shark - An ocean-bound carnivore at the top of the food chain. No single creature preys on the great white, though packs of orca have been seen attacking them.

Creature	Strength/modifiers
Animal power	+6 Strength
4 hexagon creature	+12 bonus
25% increased size	+1 bonus
Adventurer sheet modifier	+7 bonus
.5g gravity well	-4 penalty
Carnivore	+2 bonus
Endoskeleton	+2 bonus
Water-breather	-2 penalty
Instinct intelligence	+1 bonus
No limbs	+4 bonus
Lifespan (x1)	+0 bonus
Swim normally, no walk	+0 bonus
Swimming multiple(total of x2)	-4 penalty
Total	+25(8d+1)

For purposes of towing things through the water, you subtract the +7 "adventurer sheet" bonus and count it as a 6d+0 power plant.

Bite damage is normally a -6 on Strength, and we take lethal damage as a freebie, which would be another -6, for a lethal bite damage of 4d+1. This is +1d more than the maximum for a flesh & blood creature, so it gets a 3d+0 attack, with +2 battering damage on the bite (any damage that penetrates armor gets +2 added to it).

With a power plant Strength of +18, the great white gets three freebies to apply (at +3, +6 and +12). The first is the aforementioned lethal damage. In addition to this, we give it a Forte on Awareness, which in this case applies to a specialized sense akin to smell that lets the shark detect minute differences in electrical potential in the water. The other freebie we use to give the shark a 0d+1 hide. We could give the shark a few negative freebies to make this hide thicker, but we'll leave that (and any rearranging of other Attributes) up to you.

Fantasy Dragon - A large, flying, fire-breathing reptile with a penchant for hoarding loot.

Creature	Strength/modifiers
Animal power	+6 Strength
32 hexagon creature	+30 bonus
Adventurer sheet modifier	+0 bonus
1g gravity well	-15 penalty
Carnivore	+4 bonus
Endoskeleton	+2 bonus
Sentient intelligence	-4 penalty
Lifespan (x4)	-6 penalty
Fly normally, walk at x1/4	-6 penalty
Requires running start	+1 bonus
Walk normally, no swim	+0 bonus
Flying multiple(total of x4)	-6 penalty
Total	+6(2d+0)

Our mighty dragon has a Strength of +6. Right here it is clear that dragons are a creature that need a serious MacGuffin bonus. *Making a 16 ton flying creature is a big part of the problem...*

For now, we'll leave it as it is, and design the flame breath. This starts off as +3 damage (or 1d+0). It has the following characteristics:

Creature has:	Strength of creature
Special attack at +3 damage	+0 bonus
+12 damage effect	-8 penalty

Attack has:	Strength of attack
Takes 1 extra non-lethal hit	+3 bonus
Ranged attack	-1 penalty
Explosion effect	-3 penalty
Lethal damage	-3 penalty
Declining duration effect	-1 penalty
Total	+10(3d+1)

So, for a cost of -8 to the dragon's Strength and two non-lethal hits per use, the dragon can let loose with a 3d+1 explosion that clings and burns for a little while to anything it touches.

We want the dragon's front claws to be a 3d+0 lethal attack, which means with a -3 punch penalty and -6 for lethal damage we need a base Strength of 6d+0. Armed with this number (Strength of +18) *and* the -8 penalty for the special attack, we need dragons to have a MacGuffin bonus of at least +20 Strength! And that's not counting if we want to boost its Intelligence or other Attributes. We may also need to factor in a few freebies, depending on how tough we want the armored hide to be.

From here, we can tinker with gestation times, metabolic rate, senses, and what kind of things it can do with its default of around 200 skill points.

CONSISTENCY? - *So, you've gone and made up a creature*. Does it work? If it's an herbivore, probably. If it's an omnivore or carnivore, you've got to remember that meat doesn't grow on trees (though it might live there). If you designed up a sluggish carnivore that can't chew its way out of a wet paper bag, then how does it catch and kill things? The clever answer would be to say it is an anteater, but that's beside the point. You probably have a particular creature or range of creatures on your mind, and they most likely are *not* anteaters.

Remember that **Stuff!** is a generalized design system and expecting this chapter to perfectly recreate a nearly infinite universe of creatures in 25 pages isn't going to happen.

In the end, can the creature do what you intend it to do? Can your giant sandshark find enough food in the desert to keep itself alive? This leads us to the question of...

ECOSYSTEMS - Remember, it's a gameworld, not the real world. As long as it looks good, it will probably work. We only have one real ecosystem to work from, and that is Earth, so take any of these generalizations with a grain of salt.

An ecosystem is biological pyramid scheme, with numerous tiny creatures at the bottom, and a small number of larger ones at the top. The pyramid may have more than one peak or top predator, or more likely, you have two overlapping pyramids, and one species at the top of each.

EXAMPLE: Humans are arguably the top creature in Earth's food chain, and directly or indirectly draw from virtually *every* food-producing environment. However, people *still* get eaten by sharks, who might occupy a top slot in the *ocean* food chain.

At the bottom of the pyramid are microflora and fauna, bacteria, plankton, dust mites and other things too small to see. Above that are the tiny but visble creatures, such as insects, tiny crustaceans, and so on. You move up to things that eat those, and the larger things that eat them, moving up until you get something that nothing eats until it dies, when the microflora and fauna get their revenge and break the creature down into its component bits, which are then spread around the ecosystem to start the process all over again. We can't break this down into specific game terms, because it is a continuum of creature size, smoothly going from viruses to blue whales.

For your ecosystem, there needs to be a pervasive source of food that most types of non-carnivore can eat, and there also needs to be a source of energy to power the system. It is far from 100% efficient, so without new energy coming in, eventually *everything* will die.

For most things on Earth, the ultimate source of energy is the sun. This provides light for plants, which are then consumed by a myriad of herbivores, which then provide food for the omnivores and carnivores. But the sun does not have to be the source you use. There are creatures that live around deep geothermal vents in Earth's oceans, with an ecosystem that runs on hot water and sulfur, with creatures that never see the sun. We can imagine a space creature with gossamer wings, collecting interplanetary dust and solar energy to synthsize semiconductors, or things that live very slowly in the dark and cold of the atmospheres of gas giants or grazing on the dusty surface of a comet.

Remember that while advanced technology may give us the ability to custom design a lifeform, nature has had a several billion year head start. That or we're the result of some drunken alien with a "create an ecosystem" kit, and like alligators flushed down into the sewers, we managed to survive in spite of being a horribly botched "intelligent design" job.

What we're getting at is that if there are large and complex creatures in an environment, there are probably smaller, simpler ones as well. If there are giant sandsharks, there might be sand remoras clinging to its flanks, and sand fleas living under their scales. And all of them probably share bits of biology, incremental increases in complexity gained over time, co-existing for at least millennia, likely longer. Predators that consume all their prey have nothing to eat. Prey without predators breed beyond the capability the ecosystem to carry them, etc. So, if you make up a "superpredator" to terrorize adventurers with, there is probably also a "superprey" that can *only* be caught and killed by something as powerful as the predator. And the prey could be equally as dangerous to the adventurers if it gets cornered...

EXAMPLE: A Tyrannosaurus rex would not be under evolutionary pressure to evolve its mouthful of huge teeth unless there were things out there that *needed* a mouth like that in order to take a bite out of them...

DESIGNING CHARACTER RACES - This chapter *can* be used to design different sentient species that may inhabit a game world. You can easily design an "average human" that is pretty much on the mark. But, you need to consider the balancing factors associated with different abilities. For making different species, all of which are supposed to be theoretically equal in appeal to players, you may have to toss a few MacGuffins in for the physically smaller ones, and subtract a few points for larger ones. This is because the "currency" used in this chapter to buy creatures with is based mostly on size.

But, life isn't fair, and neither is nature. It might be that some species are simply not as likely to succeed in the long run as others.

On the other hand, if all the adventurer species are about the same size, then the system should compensate automatically. Your long-lived elves pay for that longevity with a thinner build. Your stocky dwarves pay for their extra Strength by taking reduced running speed. *And so on*. It's your giants and faeries that are going to be the problem in terms of balance and playability.

To start off with any inter-species comparison, look at the average Attribute levels between the different races/species. Humans should be the baseline for this comparison, with 2d+0 average Attributes. If a creature's average is more or less than this, then you need more or less points with which to buy them. See how many points it takes to buy the Attributes of an average human, add the skill points they have, and then see how many points the default values are in the other races.

EXAMPLE: If a character race or species starts off with an average of 2d+2 in every Attribute, then that race will need to start off with more points, equal to the difference in cost between an Attribute of 2d+2 and 2d+0, times six Attributes.

Now, if you want a gameworld to be balanced, the difference has to be made up *somewhere*. If you don't do it in straight points, then you need to do it in intangibles. This could be racial bonuses for specific tasks (or limits on the more advantaged species), available wealth, a deeper and more useful social structure, technological aptitude, or having the advantaged species be a minority that is not looked on favorably in many areas, balancing their superior attribute and skill levels with a social bias against them.

However, the universe is not balanced and does not start everyone on an equal footing, so this is purely gamemaster option. Authors will often have a race be *measurably* superior to others, then just wave their hands and say something like *"the elves, being slow to breed, were gradually being pushed towards extinction by the expansion of human kingdoms into their lands"*. If such were *actually* the case, humanity itself would be fading away before the onslaught of the Chimp Empire (who breeds faster than us). *The superior species tends to stay on top, either from having a superior adaptation to the environment, or by kicking upstart species in the head whenever they try to take the top slot*. If a "superior" species can't or doesn't stay on top, then it *isn't* superior, and it should not be treated as such. It might have been superior at one time, but if conditions have now changed to favor another species, then that's part of the history of the gameworld.

EXAMPLE: Elvenkind might have once been unchallenged due to their mastery of magic, but when magic slowly started fading from the world (and elves lost their species advantage), the other species were able to make inroads. It may be that arcane artifacts from the past might slow their decline, but the time of elvish dominance has come to an end.

For non-adventurer races or species, you simply do what works for the gameworld. These species are often going to be foes, and balance is not an issue, since adventurers aren't going to be dealing with them on a one-on-one basis. For instance, a dragon does not need to be balanced, it needs to be an intimidating force to a group of adventurers. Similarly, a tribe of evil garden gnomes also doesn't have to match up one-on-one, since they would operate in groups and try to overwhelm their larger foes with sheer numbers.

Last, bear in mind that adventurers are unlikely to be "average". In terms of the chart on page 5.3, most adventurers will *start* their careers in the top 5% of the population, with some or even all of their Attributes above those of the average person. This is not a function of the physical size their species was built on, but rather the statistical distribution of individuals within that species. And that's the last form of play balance to consider. A disadvantaged species can still have quality adventurers, it will just have far fewer of them, maybe in the 1% range of distribution instead of the 5%. That's an easy way to fudge the numbers for a disadvantaged species.

DESIGN PAGE 5 - If you are viewing this page as a pdf, it has forms that allow you to do most of the aspects of creature design right here on the page, and then print off your finished specs. It may not cover *all* the advanced topics, but will give you the basics to work from.

Insert critter name here				
Critter of .12 hex(60kg)		-1	d+	0
+25% size (if < 1 hex)		0	d+	1
1g gravity well		0	d+	2
Omnivore		0	d+	2
Endoskeleton		0	d+	2
Sentient		-1	d+	1
Tool-using manipulators		0	d+	-1
Normal limb count (4)		0	d+	0
Move multiple of x1	Run	0	d+	0
Normal hit bracket		0	d+	0
x1 1/4 lifespan (62yr)		0	d+	-1
No blessing/curse		0	d+	0
No blessing/curse		0	d+	0
McGuffin of +0		0	d+	0
Non-magical		0	d+	0
Walk x1, swim x0		0	d+	0
Walk x1, fly x0		0	d+	0
Normal movement		0	d+	0
25°C comfort range		0	d+	0
x1/4 atmosphere var.		0	d+	0
Requires an atmosphere		0	d+	0
No special -vore		0	d+	0
Bisexual		0	d+	0
Normal senses		0	d+	0
No unusual attack		0	d+	0
No attack effects		0	d+	0
No attack effects		0	d+	0
No attack effects		0	d+	0
Full color vision		0	d+	0
No freebies		0	d+	0
No freebies		0	d+	0
No freebies		0	d+	0
No freebies		0	d+	0
No freebies		0	d+	0

Stuff! v1.0

Autocalc on

Insert critter name here

homo sapiens	horse
dragon	wolf
	Reset form

Strength	2d+0	- +
Agility	2d+0	- +
Awareness	2d+0	- +
Will	2d+0	- +
Health	2d+0	- +
Fate	0d+1	- +

	Walk	Run	Sprint
Walk	2	4	6
Swim	0	0	0
Fly	0	0	0

Punch or equivalent:	1d+0
Kick or equivalent:	2d+0
Other attack	0d+0

Gestation:	0.5yr	**Tractability:**	4
Self-sufficiency:	15.8yr	**Mass:**	75kg
Maturity:	15.8yr	**Size mod:**	0

Attribute cost: 46A

Skill points: 73S	**Level(cost)**	
none	+0d(n/a)	- +
none	+0d(n/a)	- +
none	+0d(n/a)	- +
none	+0d(n/a)	- +

Freebies available: 0

1	-0d
2	
3	
4	-1d
5	
6	
7	-2d
8	
9	
10	-3d
11	
12	
13	-4d
14	
15	
16	-5d
17	
18	
19	-6d
20	
21	
22	-7d
23	
24	
25	-8d
26	
27	
28	-9d
29	
30	
31	-10d
32	
33	
34	-11d
35	

CIVILIZATIONS

"The influence of the clergy, in an age of superstition, might be usefully employed to assert the rights of mankind; but so intimate is the connection between the throne and the altar, that the banner of the church has very seldom been seen on the side of the people. A martial nobility and stubborn commons, possessed of arms, tenacious of property, and collected into constitutional assemblies, form the only balance capable of preserving a free constitution against enterprises of an aspiring prince."

- Edward Gibbon, *Decline and Fall of the Roman Empire*

INTRODUCTION - *Civilization is really just about accounting*. Who has the most stuff, the biggest army, highest food production, best factories, best resource utilization, and so on. In the end, most of what makes *human* civilization is cities, and what makes cities possible is agriculture. Agriculture concentrates the effort of food production into a smaller number of hard-working hands, and the increased efficiency of production per person gives *other* people the ability to have careers not tied to the act of collecting enough food to stay alive. It also gives them the ability to live in concentrations that would be impossible for hunter-gatherers, which facilitates the sharing of ideas, construction of infrastructure and a whole host of other goodies.

This chapter works off a table-based system that should be familiar to you by now. The minimum increment of productivity for this system is about plus forty percent or minus thirty percent. So, tiny incremental improvements will not show up until you get enough of them or enough time has passed for them to make a cumulative difference. We're going to be designing "civilizations" here. This could be anything from a farming village to a continent-wide system of government. Remember that the level of detail is appropriate to the scale. For a village, you may be able to get detail down to a family level. On a continent level the minimum level of scale may be entire sectors of commerce. This chapter gives gamemasters a tool for civilization-based stuff they would otherwise just have to make up.

Supporting a population is about farmers (or other food producers) and real estate, not Strength. So, the table that follows is based on the farming population, using Size levels, not Strength levels. Your end result is a Size level, which you then check to see how many people one farmer can support with the modifiers you have chosen. *We will generally be using the word "farmer" to denote anyone who is engaged in a job that produces a surplus of food.*

EXAMPLE: If you take a quick look at the table on the next page, you would see a Basic Era society (+0 Size) using basic agriculture (+0 modifier) in an average ecosystem (+0 modifier) has a total Size of +0. Checking the **EABA Universal Chart** (or the table below), this is a result of "2 meters", so one farmer in these circumstances will support 2 people per year. As a quick reference, a useful range of numbers is:

Size	Result	Size	Result
-2	1	+9	45
-1	1.4	+10	64
+0	2	+11	90
+1	3	+12	125
+2	4	+13	175
+3	6	+14	250
+4	8	+15	350
+5	11	+16	500
+6	16	+17	700
+7	23	+18	1000
+8	32	+19	1400

So, a result of +8 might be 64 people, *or* an area of 64 hectares.

The basic unit of land area will be the hectare. One hectare is 10,000 square meters (a square 100 meters on a side). A hectare is 2.47 acres. One square kilometer is 100 hectares. If you want to use the **EABA Universal Chart**, the closest hectare-acre conversion will be +3 Size (i.e. hectares of Size 2 (4 hectares) would be about acres of Size 5 (11 acres)). The reflecting pool in front of the Lincoln Memorial in Washington DC has an area of about 3.5 hectares. In terms of *actual* area, one hectare is a Size of +12, and a square kilometer is a Size of about +18. We're simply using the table as a means to simplify the math, and for that purpose, 1 hectare is the same as "1 meter" on the Size column, or a Size of -2. You take *half* the Size level and add +13 to get the *approximate* diameter of a circular area that size.

EXAMPLE: A Size of -2 (1 hectare) can be a circular area that is approximately Size 12 across (125 meters).

What you get from this first section is how many people a given amount of farmers can support with a default crop like the European grain basket (wheat, barley and the like). If you use this system for non-human fantasy/science fiction races, you'll need to adjust up or down based on the difference in mass compared to the mass of a normal human. Each doubling or halving of weight will be a ±2 on area required (bigger creatures eat more or need more farmland). Carnivores are +3 (more space), omnivores are +0, herbivores are -3 (less space).

EXAMPLE: Humans are about 80 kilograms, (or what a Strength of 8 can lift). A fantasy race of 160 kilogram carnivores would find a given amount of land supports 5 levels less people (2 levels for their doubled size, 3 levels because they are carnvores).

Before we get into it, a few things to keep in mind. First, consider your technology, likely travel distances and the terrain of any budding civilization. *If you can't efficiently get your agricultural or animal products to a central location, you can't support a centralized population.* For land transport, you can't go more than a few hundred kilometers (at best) before draft animals have eaten more than the contents of the wagons they are towing.

Second, remember that a country is more than farms and cities. *The amount of cultivatible land is going to be less than the total land available*. There will be land unsuited for agriculture (rocky hillsides), land not yet converted to agriculture (cutting down forests), or land used as a place to live (cities). If you define your civilization as having a certain amount of area to begin with, you should also decide how much is suitable for some sort of food production. This will range from a maximum of perhaps seventy percent down to only a few percent, and this will be split into land of varying amounts of fertility. The lower the total percentage of arable land, the more likely it will be that animal herds are a significant use of the land (animals can forage where conventional agriculture is impossible).

Last, no land is an island. *Unless it is one, we suppose.* What we mean is that civilizations have neighbors, people have needs, and leaders have ambitions. If you live in the land of milk and honey, don't be too surprised if someone else's god tells his chosen people to invade your land, kill every last one of you and take it for themselves (just ask the people of Jericho...). Those who "have" often have the power and resources to take more from those who "have not", and those who "have not" will be quite often be jealous of those who "have".

Technological Era	Size
Primitive	-3
Basic	+0
Industrial	+3
Atomic	+6
Post-Atomic	+9
Advanced	+12

Modifiers	Amount
Early part of an Era	-1
Late part of an Era	+1
Default crops	+0
Rich crops	+3
Very rich crops	+6
Hunter-gatherer(x.5 effort)	+3
Semi-nomadic(x.75 effort)	+4
Basic agriculture(x1 effort)	+0
Intensive agriculture(x1.5 effort)	+2
Overintensive utilization	+1
Not saving seed crop	+1
Hostile ecosystem	-6
No ecosystem(desert)	-4
Marginal ecosystem(dry)	-2
Average ecosystem(temperate)	+0
Rich ecosystem(tropical)	+2
Very rich ecosystem(equatorial)	+4
Early use of ecosystem	-1
Late use of ecosystem	+1

As we said, this result gives us how many people a "farmer"(or hunter or herder) can support. To figure out how much *land* this takes, use the table below. You take the basic area for a given type of production, and add any tech era modifiers and the *opposite* of the ecosystem modifier (negative ones add, positive ones subtract). For instance, an Atomic Era farmer with a tractor and a combine can utilize far more land than a person with a scratch plow and a hand sickle.

Production	Basic *area*
Hunter-gatherer(1400 hectares)	+19
Semi-nomadic(250 hectares)	+14
Agriculture(1 hectare)	-2

Note - The notion of 'hunter-gatherer", "semi-nomadic" and "agriculture" are arbitrary definitions, and it is really a continuous gradation between hunter-gatherer and farmer, with semi-nomadics really being neither and off to one side. The transition between the different types in any given area will probably take several centuries. So, if you really need to tweak the numbers a little bit, feel free to.

EXAMPLE: An Atomic Era farmer might have a total production of +10:

Modifiers	Size
Atomic Era	+6
Intensive agriculture	+2
Rich ecosystem	+2
Total(64 people)	+10

A size of +10 is 64 people per farmer. The Atomic Era farmer is able to feed 64 people. Later, we'll see that this works in the design process by a combination of being several times more efficient per hectare, and using technology to plant several times as many hectares as a Basic Era farmer can manage.

Note - *What is a "farmer"?* Certainly the man or woman behind the plow or the wheel of the tractor. For our purposes, a farmer also includes *everyone* in the chain of technology that is required for the "farmer" to do their job. For a Primitive or Basic Era farmer, they might be able to do it all themselves, with partial contribution by the person who made the yoke for their oxen, or fashioned their plow, and of course the farmer's wife. In times and places with poor agricultural efficiency, she is going to be as much of a farmer as any male head of household and will be working as hard if not harder than he is. Moving forward, an Atomic Era "farmer" will have fractional contributions from *many* people. The person who drilled the oil well their fuel came from, the chemical plant that made their pesticides, the factory that made the tractor, the *other* farm that grew their gene-engineered seed crop, and so on. **Stuff!** will count the total contribution as "farmers". The actual number of people *out in the fields* will probably be the number of "farmers", adjusted down by any *positive* tech era modifier.

EXAMPLE: A Size of 18 is about 1,000 "farmers". At Basic Era (+0 tech modifier), this probably *is* 1,000 people working in the fields. At Atomic Era (+6 tech modifier), you *subtract* the tech era modifier of +6 to get a Size of 12, which is about 125. So, out of the 1,000 farmers you have 875 people's worth of labor in the *other* sectors of society that the farmer relies upon to do their job. For **Stuff!** purposes, they are all "farmers", in the sense that agricultural production would be hampered without their contribution. If we look at the previous example and adjust it to only represent the *actual* number of people doing *direct* farm work, then only 1 out of 8 "farmers" is actually in the field, so the true farmer is actually tilling eight times as many hectares, while the other seven people's worth of effort are split between what could be *hundreds* of support roles that the *one* person in the fields relies upon.

A side effect of this is that disruptions to society will hit high tech food production far harder than low tech food production. If a Basic Era society is hit by a disaster, all they need to replace the system is strong backs, a harness maker and a blacksmith. If an Atomic Era society is hit by a disaster, unless you have fuel, spare parts, pesticides, fertilizer *and* a whole bunch of other things, you cannot maintain an Atomic Era level of food production. *And if you needed Atomic Era levels of production to keep people fed, this can be a real problem*... Breaking *any* vital link in this food production chain can cause a complete collapse of civilization. Imagine if a gene-engineered bacteria were to ruin a nation's oil supply. Food production and delivery would grind to a halt, and widespread chaos would result from the inability to get food into urban areas.

MODIFIERS - The modifiers to food production for a civilization are detailed below. This is by and large a boring section, but the ability of a small number of people to efficiently produce large quantities of food is the fundamental thing that allows civilization as we know it to exist. So, to get to all the fun bits, you have to get through this part first.

Tech Era - This covers all the aspects of tech and civilization that can be turned towards food production. From tangible things like tractors to ideas like irrigation and crop rotation, advances in technology combine to increase the ability of a farmer to produce food. In this respect, technology feeds itself. The denser populations that can be supported by organized agriculture allow for easier interchange of ideas, which helps to advance technology, which helps support even more people through new agricultural tools and methods.

Crops - The default crop (+0) is something like wheat or barley, but other areas of the world started with other wild grains, some of which had far better yields. Rice is considered a rich crop (+3), and wetland rice (a Basic Era crop) will have at least double the yield of European grains. Maize (corn) has even better yields, and is considered a very rich crop (+6), which is somewhat offset by the marginal ecosystems it was sometimes grown in.

You can see that the nature of the crop can by itself equal thousands of years of technological improvement. Crops like maize can give a yield per seed planted of thirty times or more that which you can get from wheat. Without yields like this you simply cannot have civilizations like the Aztecs.

Time and effort - The amount of people a given amount of land can support is only part of the equation. You also have to factor in how much effort it takes to plant, maintain and harvest the crops. The basic effort is that one person, unaided by machines or livestock, can manage agriculture on about 1 hectare of land on an amount of labor that adds up to approximately 6 hours of work per day (about 2,000 hours a year). This could be long, before-dawn-to-after-dusk days during the planting and harvesting season, average days during the summer, and lighter days during the winter, repairing tools and such. A hunter-gatherer can exploit the resources of hundreds of hectares per day, and a semi-nomadic can exploit about a quarter what the hunter-gatherer does. These numbers do *not* mean that the hunter-gatherer is combing every square centimeter of several hundred hectares each day. It *does* mean that over the course of a year, the territory they have to hunt and collect seasonal wild crops from is probably several hundred hectares. *Adjusted of course for the productivity of the land.*

Every bit of time gained by efficiency or tech means that the farmer can till more land, for higher overall yield per year for their effort. Part of this is factored into the tech era. *It is assumed an Atomic Era farmer is using a tractor!* Part of it is also how much work is going into it. A hunter-gatherer can harvest far, far less from the land than a farmer, but they spend a lot less time doing it. However, they also have to do it year-round, since they never have a "harvest" that tides them through the rest of the year. Intensive farming means long hours, leaving less time for other pursuits, but this hard work may be necessary in marginal environments. It also includes the extra effort required for setting up irrigation systems and such.

Hunter-gatherer: Living off the land, eating nuts, berries, fruits and other wild produce, plus hunting and fishing the local animals. Once you know what you're doing, it takes far less time to support yourself than traditional farming, and is fairly time-efficient, but supporting large numbers of people is almost out of the question because of the *vast* areas needed. However, it is worth noting that the earliest villages (populations *at least* in the hundreds) were apparently supported mostly by a hunter-gatherer lifestyle, and in *optimum* conditions hunter-gatherers could perhaps support a central population of a few thousand. In the case of hunter-gatherers, most will support far less than 1 person per hectare per year. Since most hunter-gatherers are not tied to a particular piece of land, it simply means that such a band has to have a larger home region to support it. This limits population density, which is important if you are trying to get a lot of people in one spot for some reason (like building an army). The hunter-gatherer or semi-nomadic numbers can also give you an idea of the area an army has to scavenge from to feed itself while on the move (use hunter-gatherer for foraging, semi-nomadic for pillaging).

EXAMPLE: A basic hunter-gatherer society will have something like this:

Modifiers	Size
Primitive Era	-3
Hunter-gatherer(50% effort)	+3
Average ecosystem	+0
Total(2 people)	+0

A Size result of +0 means that 1 hunter-gatherer can find sufficient food for 2 people in an average of 3 hours per day (50% of a normal farmer's 6 hour average effort). However, the basic area for this foraging is a Size of +19, -3 for the tech era, for a result of +16, or 500 hectares. This is 250 hectares or 2.5 square kilometers per person fed. So a band of twenty hunter-gatherers will need about 50 square kilometers of land to support themselves in these conditions. From where you sit, imagine the land 4 kilometers in every direction (a circle of 4km radius). That's 50 square kilometers.

Note - If you assume the United States averages to an "average" ecosystem, it would mean the entire country (including Alaska and Hawaii) would support a maximum population of about 3.8 million people at a hunter-gatherer level. Using the "rich crop", "rich ecosystem", "intensive agriculture" numbers, it would require an area of 900 square kilometers to support a Primitive Era city of 2,000 using only hard-working hunter-gatherers. This is a circular area about 17 kilometers in radius. Of those 2,000 people, about 90 would be required to collect the food each day.

The hunter-gatherer lifestyle is probably the easiest (3 hours per day), but is certainly the least productive per area "farmed". You don't have to spend all day tilling, or weeding, or tending to animals or repairing fences, leaving you with free time for other pursuits. However, this comes at the price of requiring an inoridinately large amount of land to support a person, making large, permanent populations next to (but not quite) impossible. Plus, you have far less of a stored surplus under most conditions, making you vulnerable to any disruption in the food supply. Hunter-gatherers do have *some* surplus. Nuts, dried meats, surplus grains, just not nearly as much as an agricultural society can accumulate. Seasonal bounties can also mean *much* more work per day in the most productive parts of a season, to collect this surplus for the lean times. On the other hand, positive changes can *destroy* a primitive hunter-gatherer society. *If you were to introduce health changes that result in a doubling of the population in a few generations, then you better have double the land available to feed them!* Long-term climate changes or cultural or technological improvements can force a band of hunter-gatherers to become semi-nomadic or agricultural types simply to avoid starvation.

You *can* design high tech hunter-gatherers. They can feed a decent number of people, but use *lots* of territory.

EXAMPLE: Let's say you have some horse-borne nomads who use satellite photography to find particular types of vegetation, and modern hunting rifles to take down game.

Modifiers	Size
Atomic Era	+6
Hunter-gatherer(x.5 effort)	+3
Average ecosystem	+0
Total(45 people)	+9

Each of our eco-friendly horse nomads can feed 45 people by riding to areas with decent-sized game, taking it down quickly and getting it back home on a reliable basis. *But, what kind of territory do they need to hunt to do this?* You start with a base area of +19, and add in +6 for the tech era to get +25, which is 11,000 hectares (or 110 square kilometers) per "farmer", or 244 hectares per person, virtually the same area as the Primitive Era hunter-gatherers in the previous example. Note that the amount of people being fed per unit area is *not* improved (you're still relying on natural, unimproved density of food resources). Technology simply gives the high-tech hunter-gatherers the ability to quickly exploit an area and move on to another one.

Semi-nomadic: This lifestyle involves organised animal husbandry, but little traditional agriculture. Call them "herder-gatherers". The normal hunter-gatherer lifestyle is supplanted by domesticated animals, which *are* used for meat, but more for dairy products and animal byproducts (like wool). Herds are moved from grazing area to grazing area, either seasonally, or as one area is exhausted.

Food animals are a way to take advantage of land that is not otherwise suitable for agriculture. It is also a way for a nomadic people to "store" food (on the hoof). In general, you can support about 50kg of herbivore (Strength of 6) per hectare of "average" land. Each ±1 in the ecosystem modifier doubles or halves the weight of animals the land can sustainably support. Each +3 for "rich crops" that could apply to forage would count as a +1 ecosystem modifier for this purpose.

EXAMPLE: If you give a generic hoofstock (a beeve) a weight of 500 kilograms, then you would need about 10 hectares of "average" land to support each one. Keeping a herd of 100 beeves fed means roving them over 1000 hectares of average land. If it were a marginal ecosystem (-2 modifier), you could only support 12.5 kilograms of herbivore per hectare, or 40 hectares per beeve. However, if it were a rich ecosystem that had an especially nutritious grass (a "rich crop"), then you could support 400kg of herbivore per hectare, or 1.25 hectares per beeve.

Note - This is one of the reasons cattle grazing areas in the southwest United States are so huge. Much of the public grazing lands are a "marginal ecosystem", so it takes a *lot* of grazing land to keep the cattle fed (calculates out to about 40 hectares per head, a figure which is a close enough match to the 30 to 100 hectares per head listed by the US Bureau of Land Management for Western US grazing lands).

To figure out how many people it takes to manage a herd, take the tech era of the *herders* , subtract the Strength of the animals (that is, the Strength to lift them), and add +23. The level that results is how many animals one herder can manage. Most domesticated herbivores get an additional +2 to the total.

EXAMPLE: In the previous case, we'll say we have Primitive Era herders (-3), then subtract the size of the beeves (Strength of 16 to lift one), and add +25 (herbivores for +23, with a +2 domestication bonus) to get a Size level of +6. Each herder can manage 16 animals under normal conditions, so managing a herd of 100 beeves would require the full-time effort of six people.

This doesn't work perfectly (the numbers do not work for squirrel herders), but it's a reasonable guide. You can say that certain forms of assistance can count as extra herders, like sheepdogs or a cowboy's horse, and of course things like fencing are going to be extremely useful as well. The total number of people supported by the semi-nomadic lifestyle is calculated based on *people*, not their animals. The animal examples are just to provide flavor. There is more than just herders. There will be people involved in various activities related to the animals (cheesemaking, drying of meat, etc.), and the effort involved in having a fully mobile society.

EXAMPLE: To do the example based on people, you would have:

Modifiers	Size
Primitive Era	-3
Semi-nomadic(x.75 effort)	+4
Total(3 people)	+1

A Size of +1 means that each herder can support 3 people (themselves and 2 others). The base area for a semi-nomadic system is +14, -3 for the tech era, is a result of +11, or 90 hectares per herder, or 30 hectares per person supported.

If we took the example as a whole, and had a herd of 100 beeves roving over 1000 hectares (10 square kilometers), then this area would sustainably support 33 people.

We just used an average ecosystem for our example. However, in most cases, semi-nomadic systems develop because it is the only way to effectively colonize marginal areas (because while poor, it is better than hunter-gatherer efficiency). If we used the numbers for a marginal ecosystem:

Modifiers	Size
Primitive Era	-3
Semi-nomadic(x.75 effort)	+4
Marginal ecosystem	-2
Total(1.4 people)	-1

This is 1.4 people her herder. The basic area is +14, with -3 for tech era, and +2 for marginal land (remember that you *invert* the ecosystem modifier), for a total of +13, or 175 hectares per herder, or 125 hectares per person supported. If we have a 40 person tribe, 29 of them are involved in food production, and they range their flocks over a total territory of 5,000 hectares (50 square kilometers). Each of the 29 food-producers in the tribe has to work the normal amount (4.5 hours) per day, or some of the people have to work longer hours (like the herders), to gain free time for other people.

Note - There is a *huge* difference in productivity between the three systems (hunter-gatherer, semi-nomadic, agriculture). There are *certainly* cultures and systems that fall in the middle somewhere, and you are free to define them for yourself as needed, either by using intermediate values, or adjustments to their effective tech era, ecosystem and crop type. Just looking at what we have so far, you can see that geography determines your viable lifestyle, lifestyle defines a type of civilization, and civilization determines what types of technologies you can develop.

EXAMPLE: Let's say you're using the pillaging note on page 6.5 and you have an invading army of 1,000 soldiers that is raiding farms (livestock & crops) in order to support itself as it marches:

Modifiers	Size
Basic Era	+0
Semi-nomadic(x.75 effort)	+4
Rich ecosystem	+3
Overintensive utilization	+1
Total(32 people)	+8

Since each member of a raiding party can feed 32, we need 31 or so people on raiding duty. The base area for semi-nomadic production is +14, less the +3 richness of the area, leaves a Size of +11, or 90 hectares per raider, for a total area of 2,800 hectares raided per day, or 28 square kilometers, or all the farms within a 3 kilometer radius raided each day just to keep the army fed.

Basic agriculture: This is typical dry land farming, using some sort of plow and cleared fields to raise seasonal crops, which are harvested, stored and with some surplus kept for the next year's planting. Agriculture also includes orchards, viniculture and agricultural specialties that require a stationary population. In addition, domestic animals and fowl are raised, and where conditions permit, fishing is done as well. If we do the Primitive Era calculation and assume good farmland (the first place it would likely be done):

Modifiers	**Size**
Primitive Era	-3
Basic agriculture	+0
Rich ecosystem	+2
Total(1.4 people)	-1

You get a result of 1.4 people supported per farmer. The basic size for agriculture is -2, with a -3 for tech era and +2 for rich land, for a final Size of -3, or .7 hectares worked per farmer. These people are barely getting by, no better than the marginal land nomads in a previous example. But, a mere 20 hectares of rich farmland will support the same number of farmers as 5,000 hectares will for the marginal nomad herders.

So, even with the lousy yields of this primitive farming, a circle a mere 1 kilometer in radius (314 hectares) can support a village of 440 people. Most of them will be farmers, but they can all live in a single protected area (the village) and walk to their fields as needed. To support the same population, the marginal nomads would have to range up to 13 kilometers from a central location each day! So, you begin to see the advantages of organized agriculture. These primitive farmers have to toil harder than the herders, but they can live closer to their support, live there year-round, and can begin to build support structures to increase their safety (town walls) and efficiency (grain mills, irrigation systems, etc.).

Now let's do the same example, but with a modern farm:

Modifiers	**Size**
Atomic Era	+6
Basic agriculture	+0
Rich ecosystem	+2
Intensive farming methods	+2
Total(64 people)	+10

This level of production supports 64 people per farmer. This farmer tills:

Modifiers	**Area**
Basic agriculture	-2
Atomic Era	+6
Rich ecosystem	-2
Total(4 hectares)	+2

Remember that you invert the ecosystem modifier for this calculation (so +2 becomes -2). If the farmer has rich farmland and uses intensive farming methods, he or she can support 64 people off a mere 4 hectares. Remember the note on page 6.4 about who is a "farmer". In the Atomic era, the actual person tilling the fields is probably tilling a lot more than 4 hectares.

The important thing is that the average daily work of the one farmer (9 hours) is split across 64 people to figure out how much work each one has to do on average to keep themselves fed. In the first example, everyone in the society had 4.3 hours of labor per day devoted just to not starving (6 hours of work, divided by 1.4 people supported). In the second example, everyone in the society only has to work a little less than 9 minutes per day to keep themselves fed (9 hours of work, divided by 64 people supported). And the difference is what makes modern civilization possible. *The next time you see a farmer, thank him (or her).*

Intensive agriculture: This is any farming method that relies on importing something to the land, and this requires more effort on the part of the farmer. Irrigation, fertilization, pest control, or just lots more work hoeing weeds or simply tilling more land. While the modifier says "agriculture", any form of resource production can use it. It just increases the average daily effort by the farmer by 50% (or has a monetary cost in supplies equal to the extra wages). In some extreme situations, the modifier can be taken twice, and represents working dawn to dusk and then some, every day, because that's what it takes to keep from starving to death.

The productivity from taking this modifier once is the maximum *sustainable* level for the land (or the health of the farmer). Some crops can generate higher sustained yields than others without depleting the soil. Cultural factors will also come into play here. Some primitive agricultural systems will use human waste as fertilizer, while others will only use animal manure. On the high tech end, some areas might allow genetically engineered high-yield crops, others might not.

Overintensive utilization: This can apply to agriculture, hunter-gatherer *or* semi-nomadics. What it means is that you are drawing more from the land than it can restore itself per year. Hunter-gatherers might hunt out the game in an area, semi-nomadics may consume all the useful grazing land, and agricultural societies may deplete the soil of nutrients. This modifier and the "not saving seed crop" modifier can be used by armies that feed themselves by raiding farms in the areas they pass through. Permanent depletion of an area might not happen in a single year or from a single raid, but it will eventually happen, and can *permanently* damage the productivity of the land. How long this takes varies with the intensity of the overutilization and how quickly the land can recover. A few years of slash & burn agriculture in a tropical rain forest is all you can do, but the land will recover enough to do it again in twenty years. On the other hand, Greece used to have very fertile lands. *It doesn't anymore*. The famed cedars of Lebanon are now mostly the deserts of Lebanon, and the thriving culture of Easter Island collapsed when they cut down the last of the trees. It is very unlikely that over-intensive utilization will permanently damage an area's productivity during a single human lifetime, but temporary damage that drops capacity is quite possible, like the aforementioned slash and burn agriculture, or when population pressure, politics and technological developments converge, as might happen at a fishing ground in international waters.

Overutilization is also a way for hunter-gatherers or semi-nomadics to survive in otherwise insufficient ecosystems. When they hunt an area out, they just move to a different area. This allows them to survive, but decreases the average population density, since no one else can use the hunted-out or overgrazed lands until they recover. *At a minimum, it doubles the land required by that group, and requires that the group move to a new location at least once a year.*

Not saving seed crop: This is a one-time modifier that only applies to agricultural systems. Normally some of a harvest is saved for next year's planting. However, in a time of crisis, you can eat the seed crop to stay alive. *In the following year you're just screwed.* Unless food is imported, people *are* going to starve, because they will have to rely on semi-nomadic or hunter-gatherer numbers for a full year to save up enough seed crop for the *following* year.

Ecosystems: This is a general guide to how productive the land is. An ecosystem can be "rich" without being good for agriculture. A tropical rain forest is "very rich", *if* you like to eat leaves, but is *terrible* for continual agriculture. A rain forest would only be suitable for hunter-gatherers, since the soil quality is very poor. The Nile river valley is considered "very rich" in terms of productivity, but it is actually a "rich" area that engages in continual over-utilization, since yearly floods renew the productivity of the land. *And in earlier eras, when those yearly floods didn't happen, people went hungry. Part of being a Pharoah was having the political strength to force proper land utilization and storage of surplus grain for the inevitable lean years!* For design purposes, a "very rich" ecosystem will be one that allows high-quality agriculture almost year-round, which limits it to tropical and equatorial climates without extended dry or wet spells, or where river-based irrigation can cover for an absence of rainfall. The very earliest agricultural civilizations probably started in such regions, and would be known to later generations as the places where "civilization" started.

There is room for climates between the listed ranges, like something between "rich" and "very rich". A "hostile" ecosystem is a generic term for one in which life cannot exist without technological assistance. This would be like trying to grow gene-modified crops on the unprotected surface of Mars. High-tech systems like environmentally controlled hydroponic farms simply use the size of the farm and the appropriate tech era and other modifiers.

Early/late use: This represents how long people have been living in an area. Early use means people are still getting their fields cleared, learning the best places to live or farm, and the hazards of the area have not been fully explored. Late use means that the area is being fully exploited. Fields have been cleared of rocks, pens or corrals have already been constructed in seasonal grazing grounds, and all the "best spots" are known and used. You will not normally use "late use" and "intensive methods" at the same time. The "intensive methods" modifier implies that you *already* know all the best spots. However, "intensive methods" can be used to offset the "early use" penalty, as the new colonists work their butts off to establish a foothold.

SIDE CASES - Before we get into a detailed example, there are a few side cases of food production to deal with.

Fishing - Not farming, but another way to generate food from a region. This would be factored into or averaged with the overall food production of an area. An island with poor farming might well be rich in fish, and therefore able to support far more people than its land area would indicate. This could also generate two types of civilizations, a coastal one where fishing makes up for poor land quality, and an interior one, where people have a different way of life in the harder terrain. Higher tech eras mean that fishermen go further afield, and may encounter someone else's "territory" in terms of claimed fishing grounds.

Weather - If the weather was the same every year, farmers would be a lot happier. Even if the weather was bad, at least it would *predictably* bad. While you can adjust productivity on a yearly basis for effect in a game, in the long term it averages out to the ecosystem productivity you have chosen. If the weather is so mercurial on the long scale that it impairs food production, apply an additional -1 or -2 to the productivity to take it into account. This is because extra food must be kept back in case a crop fails, and because yields on average are lowered because of floods or hail or locusts or rains of frogs.

No food - Some of the world's most famous cities have nowhere near enough land around them to support their populations, meaning that food has to be imported from elsewhere. This is just a reminder that such places were probably self-sufficient to begin with, *somehow*. At the point where they grew too large to feed themselves, they needed to have the trade mechanisms in place to handle the imports required. At higher tech eras, the ability to build infrastructure into completely inhospitable locations means that urban areas *can* be one hundred percent dependent on outside support (like Las Vegas).

WHAT DOES IT ALL GET YOU? - Once you figure out how much food you can get from a given amount of land, you can see how many person-years per year it takes to feed someone. Any time left over is free time that can be used to generate civilization and specialization of labor.

Take two cases to illustrate the point, a Dark Ages farm with a productivity of +0 (1 person supports 2 people), and a modern farm with a productivity of +10 (1 person supports 64 people).

On the Dark Ages farm, in an average year without war, famine, pestilence and so on, the average "work per day" *per person* to survive is 3 hours. That is, the farmer spends an average of 6 hours per day, and someone else can freeload for zero hours per day, averaging to 3 hours per person.

For the modern equivalent, you have a 9 hour work day (intensive farming methods) divided by 64 people supported, equals about a seventh of an hour per day per person (8.4 minutes). Or, for the average person, it takes 8.4 minutes of pay from your job to pay for the food you eat each day. For reference, United States *per capita* income in 2000CE was about 22,000Cr, or for a forty hour work week, about 11Cr per hour. So, presumably you could go to the grocery store and buy *subsistence level* food for one day for about 1.5Cr, or 10Cr per week. *How much does a loaf of bread, a big jar of peanut butter and a 4 liter jug of milk cost, anyway?*

The difference between the two societies (8.4 minutes vs. 3 hours) is a factor of about x21. So, the modern society can support 21 times as many specialists (i.e non-farmers) as the other. Artisans, soldiers, entertainers, construction workers, and so on. And it makes a *huge* difference. Which we will get into shortly...

CIVILIZATION - You *can* have civilization without agriculture, but the concentrated labor and food surplus that agriculture gives makes things a whole lot easier. On the whole, the major way we will measure this is in the number of spare people a given piece of land can support, assuming it is fully utilized. If you count the productivity result *minus 1 person* as the surplus, you end up with the people available for other jobs. You can look at your civilization as an area that is being developed or governed, or as a number of people (if there is far more land than farmers to till it).

EXAMPLE: Our Dark Ages farmer had a final productivity of +0, for a result of 2 people, which leaves 1 surplus person per farmer. Or, if you have a region with a total of 1,000 people, fully half of them are working full-time at tilling the land or engaging in activities that make the farmer's work possible.

EXAMPLE: Our modern farmer had productivity of +10, for a result of 64 people, which leaves 63 surplus people per farmer. Or, if you have a region of 1,000 people, 16 of them have to be farmers.

From here on out we get into the nuts and bolts of civilization and society. This will, despite the page count, be a superficial generalization that matches real-world data points as fortuitous coincidence. What it *does* do is provide an internally consistent structure to build gameworld civilizations with, and if it matches real-world results, consider it a bonus...

In any given group of people, you are going to have those that are Producers, Consumers, and Neutrals. These are value-neutral terms, so don't read too much into them. Right now, we're going to be looking at the non-farmers and splitting them up.

Producers: These are people that add "value" to an area. Miners, craftsmen, factory workers and so on. A Producer is someone who extracts non-food resources from the environment, or converts those resources into something with a higher value. The people who mine iron ore, smelt it into usable iron, and the factory workers who make things with it are all Producers. Cases where resource conversion is a profit-making activity that takes advantage of legal loopholes would probably be Neutrals.

EXAMPLE: A medieval miller paid a fee to the local lord for the right to make flour, and ordinary people were legally prohibited from grinding their own grain. This would tend to make a miller a Neutral rather than a Producer.

Consumers: These are people that consume resources but produce nothing (or produce far less than they consume). Children, the infirm, beggars, the unemployed, retired, disenfranchised or anyone else otherwise out of the work force. Do not make the mistake of thinking that women in a male-dominated culture are inherently Consumers. They will likely be Producers or Neutrals. Members of an active military are likely to be Consumers rather than Neutrals because of their fairly high upkeep. Most of the time, children (and possibly the elderly) will count as a person in terms of total population, but half a person in terms of food required.

EXAMPLE: A farmer who can support 3 people can support himself and 2 other adults, or himself, 1 other adult and 2 children. If a farmer with this level of production wants to support more children, then some of the children he has have to start working in the fields. It's *not* a coincidence that many of the educational systems of the world (and some armies) have a recess that coincides with the most labor-intensive parts of the agricultural season...

Neutrals: These are people that produce ephemeral or intangible benefits, and generally shuffle existing resources around. They end up somewhere in between Producers and Consumers. Bureacrats would be an example. Someone who changes a resource from one form to another without significantly altering its value would be a Neutral.

Exactly who falls in what category is not as important as recognizing that the categories are there. A church that collects mandatory tithes might be a Consumer, but if it provides free education or social stability, it might be a Neutral. Children in some societies might be Consumers, but in others they can be put to work at an early age, making them Neutrals and eventually Producers. How you define a group affects not only the approximate number of that group in a society, it can also affect the way people feel about that group, *or* the way that group feels about everyone else.

EXAMPLE: If a population can only support five percent of its numbers as Consumers, then that is a built-in elite, who have some power, status or both that allows them the luxury of "not producing". This might be a priesthood, a military, an aristocracy, or some combination of the above. They may be providing an essential service, but they are still set apart from normal society in some way. If the positions are hereditary, then it means that future generations of this elite will exist their whole lives as "non-producers", and come to see themselves as separate, different or better than those who make their Consumer lifestyle possible...

The best way to work with this is to make some assumptions about the nature of society, and then draw some results from there. The nature of society as defined below is a measure of both social and environmental conditions, and how much ability or tolerance there is to support individuals who are a net drain on a community's resources.

Society is:	Producer	Consumer	Neutral
Very harsh	+0(761)	-8(64)	-5(175)
Harsh-	*-1(700)*	*-7(90)*	*-5(210)*
Harsh	-1(660)	-7(90)	-4(250)
Average-	*-1(660)*	*-7(90)*	*-4(250)*
Average	-2(500)	-6(125)	-3(375)
Average+	*-2(500)*	*-6(125)*	*-3(375)*
Benevolent	-3(325)	-5(175)	-2(500)
Benevolent+	*-4(250)*	*-4(250)*	*-2(500)*
Very benev.	-5(175)	-4(250)	-2(575)
Society is "-ist"		special	

What these numbers mean is that you can take the total *non-farming* population in terms of a Size level, apply this modifier, and the result is how many people will fall into that slot. If you have a remainder, put it in the Neutrals slot. If you have a shortage, take it from the Producers slot. The numbers in parentheses are how many people out of 1,000 would fall into each slot using those guidelines.

EXAMPLE: If you have a "benevolent" society, then for each 1,000 non-farmers there will be 325 Producers, 175 Consumers and 500 Neutrals.

Very harsh: Societal mores are such that your life is worthless if you are not pulling your own weight or contributing to the good of the community. If you are too feeble to work, you are worthless. Those who cannot or will not work will be abandoned without a second thought. Children are tolerated because they will grow into someone who can work, and they are put to work as soon as they are able to do so. A very harsh society will have absolutely no problems with infanticide, cannibalism, euthanasia or the death penalty. However, even in very harsh societies or conditions of absolute privation in other societies, the practices of infanticide, cannibalism and euthanasia are usually not *normal* (except for possible ritual purposes), but they are *accepted as sometimes necessary*. It is worth noting that when such extreme privation is localized, those outside the affected areas are often quick to condemn or demonize the people who resorted to these practices.

EXAMPLE: There is evidence for cannibalism during famine or extreme privation from ancient Egypt, to the Great Famine of 1315, to the Indian Famine of 1630, to the Siege of Stalingrad in WWII.

Harsh: Life is hard, and people need to be hard as well. If you cannot work, you can be supported by your family, you can beg, or starve, and no one cares which of these happens to you. In terms of the extremes, cannibalism is out, infanticide and euthanasia may be frowned upon but seen as sometimes necessary, but the death penalty is still common. In a historical sense, most human cultures up until about the end of the Industrial Era would be considered Very Harsh or Harsh societies (think of the Crusades, the Inquisition, slavery, etc.).

Average: Life has hard times, but is not quite a burden that is simply endured. There is time for work, and time for play. *Work hard, play hard*. Children are valued, but not necessarily coddled. The elderly are given respect, but not necessarily a free ride. The death penalty is not uncommon, but subject to appeals and some protests. The first forms of organized, public health care may show up.

Benevolent: Society values the individual, even if they are unable to "produce". The unemployed, disabled, etc. often get financial assistance, and health and retirement plans are common. The death penalty is used rarely enough be a stastistically insignificant number of serious felons. The United States circa 2000CE falls into this category.

Very benevolent: Life is held in the highest regard, and the right to individual expression is nearly sacred. Society provides for those who do not choose to produce, children have free education to virtually any level, and the disabled and retired are well-provided for. Many European nations circa 2000CE fall into this category.

Note - The benefits of the more benevolent societies are *expensive*, and come out of the tax revenue collected by the government. This makes certain society types difficult to manage at lower tech eras. Also, failure (or the perception of failure) to provide these benefits equally can result in unrest.

Note - A change in society type is usually *not* a smooth transition. Altering the ratio of people in the Producer, Consumer and Neutral categories often comes from (or results in) radical changes in the way people think and work, and can cause grinding in society's gears for generations. Consider changes brought about by the printing press (Bibles average people could buy and read and *interpret for themselves*), changes in society from industrialization, or the turmoil associated with abolition, women's rights and the civil rights movement.

Society is -ist: What this means is that there is a cultural adjustment because of some aspect of society that pulls people out of the Producing category. The simplest example would be "sexist". If your culture doesn't think women are capable of or should be doing certain jobs, then women are automatically excluded from a segment of the workforce. If you revere the elderly, then they don't have to work until they drop. If you place a high value on children, you don't put them to work in the mines or garment factories. An -ist is more common among urban populations, and more so among the upper classes than the lower ones. It might not be proper for a "lady" to cook and clean, but no such limit is placed on the "servant girl". An -ist isn't necessarily bad, but it does drop the number of people that can produce things. This can be offset by any increased happiness or smug superiority it makes people feel. A society can have more than one -ist (up to three). Any -ist or -ists that affect half the population to a great degree is worth a -2 instead of the normal -1, and a society can have a number of minor -ists that add up to a -1 effect.

EXAMPLE: A society might be residually racist and also exclude women from combat roles in its military. This would make it slightly racist and slightly sexist, enough to add up to a single -1 effect.

The way an -ist works is that the total population Size is dropped by -1 per -ist (-ists of -1, -2 and -3 represent about 30%, 50% and 65% loss of potential production). The people who are affected by the -ist are removed from the "workforce". They may still be Producers, Consumers or Neutrals in *some* sense, but they are *not* income-earners and do not hold jobs in any particular economic sector, *or* their contribution is less than the average due to discrimination factors. They effectively become invisible Neutrals.

EXAMPLE: If you say a society is very "sexist", you would apply a -2 to the total population Size (sexism affects half the population, and thus gets a -2). So if you started with a population Size of +18 (1,000 people), the sexist nature of the society would drop the workforce down to a population Size of +16 (500 men). The other 500 women effectively become unemployed Neutrals. These women *are* doing the absolutely necessary tasks of cooking, cleaning, child-rearing and so on, but get little or no pay for it.

Later, we're going to do the full numbers for a town of population Size +27, and since that town is also part of a sexist culture, of the potential workers, only a population Size of +25 are going to be considered employable. So, 12,000 people will be removed from the tax-producing economy right from the start. These 12,000 people may still be working quite hard, but for little or no money or respect, and will contribute very little to the town's cash economy.

Note - Based on 2000CE census figures for the people employed and nature of employment, the United States would be considered a "benevolent" society that is "age-ist". The young are protected from having to be part of the work force, which also allows more time to be spent on their education. There may also be minor amounts of sexist and racist tendencies left, for another possible -1 effect. Whether or not you consider the United States as "benevolent" is a personal matter, but for **Stuff!** purposes, that's where it falls.

Remember that a society that is racist or sexist or whatever is *not* hindered in its food production in any way. Women or slaves or children can toil in the fields as well as anyone else. Civilization design at this point in the rules is concerned with economy rather than food. While you might be saving money by having an underpaid or oppressed segment of the workforce, since these people are underpaid, they can't buy as many things as fully compensated workers. There is not as much money available in the economy, so the amount that is available for investment in long-term projects is also smaller, and so on. So, while most cultures do have their -ists (even today), it is on the whole bad policy in terms of overall economic growth. However, an -ist can be very profitable for a small segment of the population (like slave owners) or convenient to a group that has an lock on the reins of power (like men). In cases like this, people are quite willing to sacrifice an *overall* benefit for a much greater *personal* (or sub-group) benefit. It's just a thought to keep in the back of your mind if you are designing a civilization from scratch.

EXAMPLE: We're going to create a "civilization" that is a Dark Ages fief, with a total population of 1,000 people. We already know from previous examples that half of them are going to be farmers. This will be the male head of household on the farms, some effort from his wife, and any children old enough to do useful work in the fields but not old enough to move out and live on their own. The number of Producers, Consumers and Neutrals comes from the remaining 500.

This 500 people is a "Size" of 16. If we say that this is a "harsh" society (but not sexist), then we have Size 15 in Producers (-1 modifier), Size 9 in Consumers (-7 modifier) and Size 12 in Neutrals (-5 modifier). Looking at the Universal Chart, we see that our total of 1,000 people breaks down like this:

Farmers: 500
Producers: 350
Consumers: 45
Neutrals: 125

This totals close enough to 1,000 people for our needs. Since the actual total is 1,020, we could lose 20 people off the Producers slot, leaving 330 people there. Of our total of 500 non-farmers, we have 330 Producers. These are going to be the wives of the farmers, who when they are not directly involved in farming activities, are doing plenty of work in terms of spinning, food preparation, and so on, plus a few necessary craft people like blacksmiths. The farmer's family is likely helping in the fields, contributing time towards "intensive utilization" for higher yields, or taking up slack so the farmer can fulfill feudal obligations. We have 125 Neutrals, which will be children old enough to literally "earn their keep", and resource conversion services like a miller. And we have 45 Consumers, who in this place and time will probably be the local clergy, the local lord and his retainers, plus children too young to work (each of whom is half or less of a full Consumer in terms of food eaten). So, while we had a 50% food surplus (each farmer supports 2 people), that really only gives us a a *maximum* of 4.5% support for strictly consuming items like military might.

Note - This is actually a case where the hunter-gatherers have an edge. If your food needs are met by your skill with weapons, then your "farmers" are also to some degree skilled as soldiers. So, a tribal hunter-gatherer group can field a much higher proportion of its population as skilled fighters than an agricultural society can. Your "hill tribes" might be able to effectively intimidate agricultural frontier communities many times their tribe's size. However, the hill tribes can afford to suffer far fewer *actual* losses than the agricultural community, leaving them vulnerable after possibly a single large defeat.

WHERE ARE WE AT? - At this point, you should have some idea of the size of your "civilization", how many people this much land can support, how many farmers it takes to work the land, and of the remainder of people, *approximately* how they are split up. With this, you can work on the wealth that society can generate. You need food production to support concentrations of people, but you need wealth to support concentrations of just about everything else.

Production - An area's wealth is not only in its ability to produce food. Any society is going to require some form of material wealth unless it imports everything that isn't made of ubiquitous goods like wood, leather, stone or cloth.

People who do mining or other non-food resource production are "specialists", and the number of them available will depend on the efficiency of food production and the nature of society. For general gaming purposes, the exact nature of a resource doesn't matter. What matters is if an area is more rich in resources than its neighbors. You can rank each country or political unit in a region from +3 to -3, positive numbers being better. All this means is that any given specialist working to extract that region's resources gets a bonus of the listed amount to the credit value of the resources. Saudi Arabia might have a +3 for its oil, while nearby Israel has only minor mineral resources and might be +0 or -1. You also need to consider the intangibles. A country that has a serious "-ists" like Saudi Arabia can lose much of its potential production because it has lost half its work force. But all in all, a region with an "average" amount of resources compared to its neighbors will be +0.

If you are developing a civilization over time, remember that some resource wealth is dependent on technological advancement. Having vast oil resources deep underground is useless to you unless you have the technology to extract it. Reserves of uranium or plutonium are useless to you unless you have atomic power. If you can't use a natural resource and your neighbor can (and needs it), then things can get interesting...

The "per capita" income of an area will be based on the tech era, the richness of resources, and the government type. Numbers on this table will use the Money column of the **EABA Universal Chart**. This income also reflects the wealth of the government, its ability to fund public works and the like. Maximum possible government wealth would be per capita income times the number of people (at a 100% tax rate and zero corruption). *Actual government income will likely be less...* Per captia income times the number of people is a society's "taxable productivity".

Remember that is is an *average* income. If on average, one breadwinner is supporting three non-working dependents (a family of four), then the *average* income per *working* member of the population will be four times higher. However, if there are social factors that pull a group of people out of the potential workforce (even if they want to work), this will drag the average income down.

Technological Era	Yearly income
Primitive	-3
Basic	+0
Industrial	+3
Atomic	+6
Post-Atomic	+9
Advanced	+12

Modifiers	Amount
Early part of an Era	-1
Late part of an Era	+1
Agricultural efficiency	special
Society type	special
Each -ist in the society	-1
Richness of resources	+3 to -3
Tyrannical gov't	-7
Oligarchic gov't	-5
Communal gov't	-4
Representative gov't	-3

This per capita income is really a measure of the industrial and economic might of a region, the overall ability to buy or build expensive stuff, or support a social system with a high cost (health care, free education, etc.).

Tech era: Base income is determined by the tech era of the society.

EXAMPLE: Our Dark Ages example from the previous page is a Basic Era society, for a modifier of +0.

Agricultural efficiency: This is the same number you figured out earlier, the Size level of how many people a farmer can feed. If more people are supported, the average person spends less of their working day just putting food on the table, which raises the overall average income of the society.

EXAMPLE: Our Dark Ages farmer had a result of +0 (2 people supported per farmer), so for our per capita income purposes, agricultural efficiency is +0.

Society type: This is the modifier from the "Producer" column on that table, and represents the fraction of the non-farm population engaged in resource-generating activity.

EXAMPLE: Our Dark Ages fief from the previous page was a harsh society, which has a "Producers" modifier of -1, which represents the fraction of the population out there generating significant income.

Each -ist: If a society is racist, sexist, ageist or has some other belief system that pulls capable people out of the workforce or pays them substandard wages for their work, this will tend to drop per capita income accordingly. The people who *are* working may be making just as much, but there are fewer of them...

EXAMPLE: Our Dark Ages example had no -ists, so this modifier is +0.

Richness of resources: As described earlier, a measure of how "rich" the area is in exploitable wealth. Remember that this is not just in the form of raw materials, but can also represent location. Even though trade is just goods changing hands with no new items being produced, it still generates wealth for the trader. So, if you are designing a small region, its potential as a trade hub or stop on a trade route should be considered. The -3 to +3 spread gives an eight-fold difference in wealth based on the richness of resources.

EXAMPLE: If we say that the Dark Ages fief had average resources, this would also be a +0 modifier. Remember that this is different than any agricultural efficiency. If you have two areas of equal farming potential, and one is on a major trade route, then one will have better resources than the other, even if they produce the same amount of food.

Government type: The type of government in an area will have a big effect on the production. This is due to differences in efficiency, as well as how well the average Producer feels they are rewarded for their hard work. Most governments break down into one of the four types listed.

A *tyranny* is any sort of authoritarian, top-down rule, with the power concentrated in the hands of a single individual or small group who are themselves largely above the laws they impose on others. Warlords, bandit kings, dictators and most types of monarchies fall into this group.

An *oligarchy* has power concentrated in the hands of a small group. While it is possible that the oligarchs are elected, it is more likely that their positions are effectively hereditary (regardless of what the original intent of the system was). This is theoretically more accountable to its people than a tyranny and oligarchs have a better chance of being subject to the same laws and restrictions as everyone else. Oligarchies can also be allied tyrannies (like a country made of dukedoms).

A *communal* (not communist) government is rule by consensus, a set of shared beliefs enforced by community action. This system is efficient on the small scale, and can work for monasteries or small, tightly-knit communities with a unified set of beliefs, but it breaks down on the larger scale, mandating a split of the community or adoption of another form of government. Most communal systems often have some sort of oligarchic body that arbitrates disputes within the community.

Representative government is one with the will of the people expressed through a set of elected officials who can theoretically be replaced if they don't measure up. Representative governments with difficult to unseat incumbents may become oligarchies in fact if not in name.

Government	Income	Corrupt.	Max. size
Tyranny	-7	-11	+40(2 mil.)
Oligarchy	-5	-10	+46(16 mil.)
Communal	-4	-12	+11(90)
Representative	-3	-10	+55(360 mil.)

Each of these governments has a maximum population that it can efficiently manage. This number is adjusted by the tech era modifier on its income. Each government also has a "corruption index". This is how much of the area's production simply vanishes into private pockets in the form of bribes, smuggling, embezzlement, kickbacks, pork-barrel politics, stealing of pens and paperclips, and so on. The rating is a modifier on per capita income, and the result is saved and used later on.

"Corruption" also represents some of the near-mandatory government expenditures necessary to keep an unhappy population in line, either in the form of "bread and circuses", increased internal security forces, or both. Most of the time, corruption will be a very small amount, but it *does* affect how much the government has after it taxes people, and can also be used as a measure of the strength and pervasiveness of organized criminal activity.

The corruption index goes up by 1 point for each 2 levels of population (round up) that a government type cannot effectively manage. The number in parentheses is the population represented by that Size level.

EXAMPLE: Let's work with our Dark Ages society and the modern example. If the Dark Ages fief is a tyranny (which can be a quasi-joint rule by Church and nobility), then production per capita is:

Modifiers	Money
Basic Era	+0
Agricultural efficiency	+0
Harsh society	-1
Tyranny	-7
Total(65 Credits)	-8

The per capita income is 65 Credits. So, for a total population of 1,000 people, this region generates 65,000 Credits per year in the nebulous item we call "taxable productivity". If we applied the current United States government type to the Atomic Era case, we get:

Modifiers	Money
Atomic Era	+6
Agricultural efficiency	+10
Society is benevolent+	-4
Rerpresentative govt	-3
Total(23,000 Credits)	+9

The per capita income in this region would be 23,000 Credits. So, for a population of 1,000 people, this region will generate 23,000,000 Credits of taxable productivity per year.

Note - Some would argue that the United States is now closer to a benevolent oligarchy than a benevolent+ representative form of government, but that's a matter of your personal political opinion. The income numbers would be the same for the above example.

The per capita income is only important as a *relative* measure. An income of 65 Credits probably went a lot farther in the Dark Ages than it did today. On the other hand, the most impoverished areas on Earth in the early 21st century are not a *lot* higher than that 65 Credit figure. Also remember that these are *per capita* figures, not *per worker* figures. The average "family income" will be the per capita figure times the average family size for each culture.

Let's look more closely at the corruption and maximum population indices.

EXAMPLE: Let's work with the late Roman Empire, somewhere in the first few centuries CE. By some estimates, the population of the Empire is about 60 million people, a Size level of +50. We'll use an agricultural efficiency of -1 for sake of the example.

Modifiers	Money
Primitive Era	-3
Late part of era	+1
Agricultural efficiency	-1
Harsh society	-1
Oligarchic gov't	-5
Total(45 Credits)	-9

Per capita income/productivity starts at a Cost level of -9, or 45 Credits per year. The corruption index of an oligarchy is -10 below this, or a siphoning off of a Money level of -19 from government tax revenue per person. This is only 1.5 Credits, or about 3 percent of per capita income. This does not subtract from personal income, but *does* count as an equivalent tax on the money the government collects from its taxes on the people. We'll get into that a little later.

However, the largest population an oligarchic government can *efficiently* manage is a Size level of +46 plus the tech era modifier (-3), for a total of +43 (5.6 million people). The *actual* population of this vast, far flung empire is +50 (64 million people). This is +7 more than the maximum. The corruption index will be increased by half this (+4), raising it from a level of -19 to a level of -15. A Money level of -15 is 6 Credits. *When compared to per capita income of 45 Credits, this means that about an eighth of the potential tax revenue is disappearing down a black hole!* Or, more likely into the pockets of Senators, with some fraction going to things like coliseums and other diversions to keep the minds of the impoverished masses off of how poor they are and how rich their leaders have become.

What's going to happen is that effective per capita income will be reduced by government taxes, and government income will be "taxed" by the corruption index, which in this case is a Cost level of -15.

It is worth noting that per capita income is not necessarily "salary". It is the net value of resources that an individual accumulates through work, investment or other means. Per capita income has its equivalent value in barter or social obligations in societies that do not use hard currency. Similarly, just because it is "income" doesn't mean you get to keep it. You might be a millionaire in terms of yearly income, but end up spending most of it to pay employees, buy equipment, and so on. Our Dark Ages lord is at the top of his heap in terms of income, but by the time he pays all his bills and feudal obligations to the lord above him, he may not have a lot left over.

Note - **EABA** has an optional rule that cost of goods drop by about a factor of four per tech era (or about one and a half per fraction of an era). This would mean that our Roman citizen with an income of 45 Credits has a"buying power" in terms of **EABA** prices of about 2,000 Credits per year. *This is still desperately poor by any way you want to look at it.*

Income distribution - Now that we know how much the per capita income is, we should get an idea of how it is distributed. We'll correlate this with the type of society. If you keep track of exact numbers and it comes out to be too many, take the excess from the Very Poor column. If there are not enough, add any necessary amount to the Average column.

Society	V.poor (≤-6)	Poor (-3)	Avg. (+0)	Rich (+6)	V.rich (≥+12)
	-4	-3	-3	-13	-16
Very harsh	-4	-3	-3	-12	-17
	-4	-3	-3	-12	-17
Harsh	-4	-3	-3	-11	-18
	-5	-3	-3	-10	-18
Average	-5	-3	-3	-9	-17
	-6	-4	-4	-8	-17
Benevolent	-6	-4	-4	-8	-17
	-7	-3	-4	-8	-18
Very benev.	-8	-3	-4	-8	-18
	-8	-3	-3	-8	-19

Modifiers	
Tyrranical gov't	-2 rows
Oligarchic gov't	-1 row
Communal gov't	+1 row
Representative gov't	+0 rows

The column header is the shift in the Money level of a person's income, and the row result is a modifier on the total population level to get the number of people in that particular income bracket.

Okay, so how does this work? We'll use our Dark Ages fief and a late 20th century American town as examples.

We have 1,000 people in our Dark Ages fief, and we know that it is a harsh society with a tyranny form of government. A group of 1,000 people is a Size of +18. We go to the "harsh society" row, then go *up* two rows because of the tyranny. This puts us on the "very harsh" row. This means that that while we earlier figured an *average* income per person of 65 Credits per year (Money level of -8), the *actual* distribution across the 1,000 people looks like the table below. This is listed as Size and Money levels, with the number of people out of 1,000 and actual personal income in parentheses.

Income bracket	People	Money
Very poor	+14(250)	-14(8Cr)
Poor	+15(350)	-11(23Cr)
Average	+15(350)	-8(65Cr)
Rich	+6(16)	-2(500Cr)
Very rich	+1(3)	+4(≥4KCr)

So, out of our 1,000 people, we have 3 who are ludicrously wealthy by that culture's standards, at 64 times the per capita income or more. There are 16 people who are wealthy, at 8 times per capita income. There are 350 people at around the normal income, 350 people somewhere around a third of normal income, and 250 people scrabbling out an existence at an eighth the normal income. In our fief, the highest income certainly belongs to the lord of the manor and family. The second highest level of wealth might be associated with the Church, an especially useful retainer like an exchequer or a guard captain, or a trade that can make a profit from the entire community, like a miller (but they would still be "inferiors" compared to the elite terms of the social scale. The average and poor are the farmers and any normal armed retainers, and the very poor are slaves, young children, or the elderly who are supported by their families.

For the Atomic Era town, we have a slightly more than benevolent representative government. A group of 1,000 people is a Size of +18. We go to the row below the "benevolent society" row, with no modifier for government type. This means that that while we have an average income per person of 23,000 Credits per year (Money level of +9), the actual distribution across the 1,000 people looks like the table below.

Income bracket	People	Money
Very poor	+11(90)	+3(2.8KCr)
Poor	+15(500)	+6(8KCr)
Average	+14(350)	+9(23KCr)
Rich	+10(64)	+15(175KCr)
Very rich	+0(2)	+21(≥1.4MCr)

The proportion of extremely wealthy is reduced, but so is the number of extremely poor, and more people have moved up to the "rich" bracket. Remember that some of the *merely* "rich" could be millionaires, but simply be supporting a large family (6 rich people in one household could represent 1 working millionaire and 5 non-working dependents).

In *all* the distributions you can generate with this system, a large fraction of a society's wealth is going to be concentrated in a small number of hands. There is anywhere from 35% to 60% of the total wealth in the top two brackets, with anywhere from 9% to 25% being in the hands of the uppermost bracket. And within that bracket, there may be a small number of *extremely* wealthy individuals, the rest being just *very* wealthy. There are *millionaires*, and there are *billionaires*...

That handles Producers. Now to Neutrals and Consumers.

Neutrals - This covers the people whose net production is about zero. They do not produce a good or a long-term intangible, but are still needed to keep things moving. They have income, which gets plowed back into the economy, and that is about it. Bureacracy and service jobs are a good example of a neutral job. They consume resources and provide a necessary service, but at the end of any day, nothing has been created or destroyed. No matter how many times the garbage truck comes by to pick up the trash, there is always more trash to be picked up the next day. *And you will know exactly how necessary a service this is if they go on strike...*

Consumers - Consumers are people who, while they *may* provide a necessary service, are a net drain on an area's resources. The most obvious example of a *necessary* service would be an army, while an equally *unnecessary* service would be a hereditary nobility.

Note - You can define what jobs fall into what slots as you wish. It is seldom that a particular job always falls into one category. An army, normally a Consumer, might be a pillaging horde, which on the whole, imports money into their region. A trader, who normally is a Producer, might in modern times, move their operations overseas, and could up siphoning money out of a region (a negative trade balance). A religion, which is normally a Neutral, might have the power to exact tithes, and become a Consumer. We're just looking to give you an *overview* of the civilization you had in mind.

DEATH & TAXES - So, you have a per capita income, a total population and a corruption index. *What do you do with them?* Well, first you set a tax rate. This will be a level shift from per capita income, and becomes the per capita *government* income. Then, you count the cost level of government corruption as a tax rate on government income. What is left is the cost level that the government gets per person in the society, with which it pays for public services and infrastructure. *Sounds pretty complicated, right?* It's not. Look at the table below:

Tax rate	Income effect	Tax rate
≥-6	none	≤12%
-5	-1	≈18%
-4	-1	≈25%
-3	-1	≈35%
-2	-2	≈50%
-1	-3	≈70%
+0	all of it...	≈100%

EXAMPLE: If we use our Roman Empire example from two pages ago, we had:

Item	Money
Per capita income(45Cr)	-9
Corruption index(6Cr)	-15

So, if our empire taxes its citizens at 25% (or the -4 level), per capita income drops 1 level (to a Money level of -10, or 30 Credits).

Item	Money
Per capita income	-9
Effect of a tax rate of -4	-1
Total income (30 Credits)	-10

Government income per person is the per capita income level of -9 adjusted by the tax rate of -4, or a Money level of -13(11 Credits).

Item	Money
Per capita income	-9
Tax rate of 25%	-4
Raw gov't income per person(11Cr)	-13

The corruption index of -15 is the same as a government income of -13 with a -2 tax rate. This has a negative effect on government income of -2.

Item	Money
Subtotal gov't income	-13
Effect from corruption index of -15	-2
Total gov't income per person(6Cr)	-15

That is, government income comes from a tax on the people, and corruption is effectively a tax on government income. You figure the tax effect of corruption in reverse. In this case, our government income of -13 and corruption of -15 gave us a difference of -2, which became the "tax rate" on government income. You could do all of this with actual figures in Credits instead of Money levels, and it comes out about the same.

What do you do with it? - Since Consumers are already taken into account in what a type and tech of society can support, this government income is largely spent on infrastructure items. Infrastructure is a bunch of things, but the simplest definition is "the stuff people depend upon and expect to be there when they need it". If you pick up a phone you expect there to be a dial tone, when you flip a light switch, you expect there to be electricity and when you turn the tap, you expect clean water to come out. Even though some of these services are private industries, they are also likely to be heavily regulated or influenced by government policy, and you should think of them as infrastructure.

INFRASTRUCTURE - We only deal with two types of infrastructure, technical and social.

Technical infrastructure: Some of a society's resource production is going to represent "public works", like roads, bridges, sewers, dams and so on. These are usually government spending (from tax revenue) and are part of the things that lead to the increased efficiency of more advanced tech eras. Railroads and bridges help move goods, dams power hydroelectric generators or mitigate floods, telegraph lines speed the flow of information, sewer systems lead to increased health and productivity and so on. While these items have to be built by someone, it is assumed that a region has the items appropriate to its tech era. These would generally be as follows. *Not all areas will have all items in the listed infrastructure.* Generally, only the largest population centers will have the best quality items, and everywhere else is somewhere lower on the list or has some reduced capacity with that type of infrastructure (big cities get high speed internet before the rural farms do).

Tech era	Infrastructure
Primitive(-17)	Trails, irrigation
Late Primitive(-16)	Dams
Early Basic(-14)	Roads, water distrib.
Basic(-13)	
Late Basic(-12)	
Early Industrial(-10)	Sewers
Industrial(-9)	Railroads
Late Industrial(-8)	Telegraph
Early Atomic(-6)	Electricity, telephone
Atomic(-5)	Highways, airports
Late Atomic(-4)	Computer networks
Early Post-Atomic(-2)	
Post-Atomic(-1)	Spaceports
Late Post-Atomic(+0)	Beanstalks
Early Advanced(+2)	
Advanced(+3)	
Late Advanced(+4)	

Infrastructure is one case where you *can* be ahead of your time. If your civilization has the money to support it, you can have infrastructure beyond your actual tech era (within reason). So, you could have aqueducts in the Primitive Era, or a sewer system in the Base Era, if you had the money to support it.

Infratructure has an "erosion rate". This is some combination of how natural disasters, technological advances and social instability render a given piece of infrastructure useless unless it is maintained or upgraded. *What would Florida look like if people stopped repairing hurricane damage to bridges, roads, power, telephone, water and sewer lines?*

Something "eternal "would be +0. It is beyond the capability of the existing culture to modify, upgrade, or even destroy. A network of impervious interstellar portals left behind by a mysterious alien race might qualify. They don't wear out and cost nothing to maintain. Everything else is subject to entropy, from +1 for things that wear out very slowly, like a canal, to +6 for things that are a major effort just to keep running, like a coastal highway in an earthquake zone. In temperate climates without a lot of natural disasters to worry about, durable infrastructure can usually go with a +2, and most technology-dependent infrastructure would be +4.

The number next to the tech era plus the erosion rate is the Money level *per year per person* to maintain the infrastructure. This is typically taken from the money the government has available after corruption is taken into account. Remember that corruption doesn't directly hit the average person in their pocket, but it does subtract from the amount of taxes collected, so governments may have to tax extra to offset their own inefficiency.

If the total is actually equal to or more than the government income per person, it simply can't be maintained regardless of the tax rate. Governments that wish to maintain this infrastructure will have to lend themselves money somehow, but spending beyond your means is never a long-term solution.

If infrastructure cannot be maintained, it will eventually fall into ruin, a process that will take perhaps a Time level of 54, minus the erosion rate, minus the cost of the infrastructure (note that negative infrastructure modifiers will *add* to the time level). There are so many ways things can fall apart, or miraculously stay together, that this is a general guideline. Remember that especially durable and low-tech infrastructure can stay viable with reduced maintenance far longer than most high-tech kinds. Stuff doesn't fall apart all at once.

Social infrastructure: This is a lot easier. The society type simply adjusts the effective cost of the technical infrastructure. A "very harsh" society has a social infrastructure shift of -1. Each full shift of the society type is a +1 modifier ("harsh" is +0 cost, "average" is +1 cost, etc.).

EXAMPLE: A "very benevolent" society will have a technical infrastructure cost of +3 more than a "harsh" society. This covers social infrastructure like universal health care, free university education, pension plans and so on.

Note - Money for nothing. *Neither a borrower nor lender be*. Governments that cannot meet their infrastructure, military or social spending needs have hit upon the dodge of loaning themselves money, in the form of bonds or other interest-earning items that get them extra money *now* in exchange for paying more *later*. This is a monkey that very few governments get off their backs once it is perched there. A government can usually get a +2 to its own overall income in exchange for a +1 to its corruption index, which in this case represents the expense of servicing a national debt. In the short term, this is wonderful for an efficient system.

EXAMPLE: If you have a per capita government income level of +6 (8,000 Credits) and a corruption loss of -2 (500 Credits), you can increase the per capita *government* income to a level of +8 (16,000 Credits), an 8,000 Credit increase, by raising the corruption loss to -1 (700 Credits), which is only a 200 Credit rise.

The problem is that you only get the increase in government income for *five* years, but the increase in the corruption index hangs around for *ten* years. If you spend this extra money on improvements that increase productivity sufficiently (rural electrification, interstate highways), *the loan more than pays for itself*. But if the money is spent unwisely, even a nominally efficient government like the United States can quickly be reduced to the point where 1 out of each 6 Credits of tax income is simply paying *interest* on past debts. If you toss in costs for infrastructure maintenance, unexpected military expenditures, crop failures or other natural disasters, you can end up in an economic death spiral, where government has to borrow just to cover the interest expense from previous borrowing...

The self-loaning of money also takes the form of debased currency. In the simplest case, the royal mint takes 100 Credits worth of silver, adds some lead, and makes say 110 Credits of "silver" coins from the mix, which it then uses to pay its debts. More money in the economy spurs inflation, and prices go up, including for things the government was paying for. *So they might debase the currency again...and again.* Governments with abstract currency like paper money can do this to ludicrous levels. While you can only debase coinage so far, you can print an endless supply of paper money. Governments can and will do this to pay their debts, sometimes to ludicrous levels. *Whether you are a person or a nation, don't spend money you don't actually have...*

EXAMPLE: The Romans were famous for their roads and aqueducts. The very best roads linked the most strategic places, but there were still a *lot* of roads. Roads and water distribution have an infrastructure cost of -14, +2 for erosion, for a total Money level of -12, or 16 Credits per year per person. From the previous example, we know that we only have a Money level of -15 available (6 Credits per person per year) to pay for this. This leaves the empire with some unhappy options. They can choose to only maintain about one-third of their infrastructure, or they can debase their currency to artificially prop up government income, or they can raise taxes. Or maybe do a little of each, and hope the metaphorical chickens don't come home to roost until after those particular imperial officials are dead and beyond caring...

If we debased the currency once, it would raise the effective per capita government income from a Cost level of -13 to -11 (from 11 Credits to 23 Credits per person), at the penalty of increasing corruption from a Cost level of -15 to -14 (from 6 Credits to 8 Credits). This boosts government income:

Item	Money
Per capita gov't income(debased)	-11
Effect from corruption index of -14	-1
Total gov't income per person(16Cr)	-12

So, adding some lead to the silver to stretch it out will pay the bills...for a few years. But six years from now, the corruption index will stay at a Cost level of -14, but per capita government income will drop back down to a Cost level of -13.

Item	Money
Per capita gov't income(normal)	-13
Effect from corruption index of -14	-3
Total gov't income per person(4Cr)	-16

This means that debasing the currency has bought the government five years to plunder some other country for its wealth to feed the needs of the empire, or it will have to debase its currency even further, raise the tax rate on its citizens, or some combination of the above. Eventually, the empire will no longer be able to support its infrastructure and it will begin to go downhill. When the empire collapses and no one is maintaining things any more (and people steal the paving stones to make buildings with), the roads will fall into total disrepair in a time level of 66 (time level of 54, minus *negative* 14, plus 2). So it would be *250 years* before the roads and aqueducts fall mostly into disrepair. Some stretches may remain intact for several centuries, while others will be plundered within decades. But, the ability to move goods at full efficiency *across* the Empire is gone.

EXAMPLE: Our Atomic Era town is serviced by nice paved roads, but it probably doesn't have an airport. The infrastructure cost is -5 per person per year, +4 for erosion, for a Money level of -1, about 700 Credits out of a per capita income of 23,000 Credits, which is no big deal. Even with a +2 to the Money level for a Benevolent society, it is only raised to a Money level of +1 (1,400 Credits). At the lowest tax rate on the chart (12%), the government per capita income is a Money level of +3 (2,800 Credits), so there is still plenty of money left over, at least for this hypothetical community.

However, if there were a disaster that wiped out civilization, this infrastructure would decay far more rapidly than the Roman roads, and if we wanted we could apply separate erosion rates to things like the roads and the electric power grid, the latter of which is likely to suffer serious harm after the next hurricane or ice storm.

Note - The guidelines for government borrowing and loss of infrastructure use increments far higher than you would find in the real world. Infrastructure or economic collapse can be a very long and drawn out process that is too fine-grained for you to simulate with a system like **EABA**.

Urban niceties - In addition to generally better infrastructure, cities also have a concentration of skills outside those needed for subsistence. To make things simple, we are going to assume that even though not everyone works (consider children), they are part of a family that does, and they count towards a particular sector of the economy.

EXAMPLE: If you have an average family of 4 and only the head of the household works, then the quantity of workers is going to be 4 levels less, but the money earned by that person will be 4 levels higher (to keep the per capita income the same).

The actual number of workers may be 2 or more levels less, depending on average family size and whether both parents work, and this also influences actual income rather than per capita income.

Sector	Importance	Quantity
One	Essential	-3(350)
Two	Essential	-4(250)
Three	Important	-5(175)
Four	Important	-6(125)
Five	Secondary	-8(64)
Six	Secondary	-11(23)
Seven	Non-essential	-15(6)
Eight	Non-essential	-20(1)

The possible sectors are:

Commerce(neutral)	Food(neutral)
Durables(producer)	Clothing(producer)
Government(consumer)	Services(neutral)
Entertainment(neutral)	Luxuries(producer)

This works much like the other tables, but it is geared more towards diverse urban zones. The quantity is the modifier to the population size to get the total number of people in that sector, and the number in parentheses is how many out of 1000 people that would actually be. If there is less than 1 person in a sector, you can assume the area does not have enough of an economy to support that sector.

EXAMPLE: If "luxuries" were assigned to sector 8 (non-essentials), then you can have one producer of luxury goods for each 1,000 people. A village of 500 would have no provider of this particular service, or maybe every other village of this size would have one provider of that service.

Within each category, there will be some hierarchy of success and penetration into the upper reaches of society. You can split these up into the various sectors as you see fit. Not everyone who is in the "merchant" sector is wealthy. Many are just the "service" clerks behind the cash register or similar jobs that have limited potential for upward mobility.

Keep in mind that these proportions are really just vague generalizations. A banking city like Venice is going to have different proportions than a grain belt faming town which will be different than a company-run mining town or a small town with a big college. Tech eras, levels of education, proximity to trade routes and far too many modifiers to take into account will adjust the proportions of the sectors of employment.

Losing any "essential" sector will cause the local economy to collapse. Losing an "important" sector will cause economic hardship, while loss of the other sectors may cause minor hardship or force travel to other areas to get the services provided by that sector.

EXAMPLE: If the gold mine peters out, the once-thriving mining town soon becomes a ghost town. If the company in a "company town" moves its operation overseas, then not only are lots of people put out of work, these people no longer have cash to spend elsewhere in town.

In order to take a specifics into account, you assign the proper priority to each of the sectors. The sectors are generally defined as follows:

Food: This is not farming, which is already blocked out, and is not all that urban anyway. No, this represents what is best described as "food enhancement". The miller who grinds grain into flour, the brewer or vinter or baker.

Commerce: Or merchants. They buy low (often from elsewhere) and sell high. They provide a central selling point for goods that people do not have time to make for themselves or track down, because they have their own job specialty to attend to.

Clothing: This is an essential item in most climates, but is a manufacturing task which many people in low-tech societies do for themselves. In urban areas, clothing can become a "fashion" statement or symbol of status or profession, and there are many possible specializations of clothing, from the making of cloth to each type of garment or garment-like item (gloves, shoes).

Durables: Just about anything that has physical substance and isn't clothing or food. Weapons, armor, refrigerators and so on. This is a general "manufacturing sector". Areas may specialize in a *particular* durable good (like an automobile plant), but this generally does not happen until at least the Industrial Era.

Government: Overhead associated with maintaining an urban area. Police, health inspectors, tax men, soldiers, lamplighters, bureacrats and so on.

Services: This can sometimes be part of the government, but does not have to be. A public bus is a service, but so is a gypsy cab driver. A herald provides a service, but so does an operator at a customer service call center. A short-order cook, a cashier or a peasant fulfilling feudal obligations is doing a service job.

Entertainment: This can also cross the line into services, depending on how you define them. Movie theaters, bars, brothels, opera houses, cable television providers, local bands, etc.

Luxuries: This is a subcase that can encompass other categories. It is effectively a provider of some other service that caters only to the upper class. A jeweler, a royal haberdasher, a maker of exotic weapons, an enchanter of magic items, etc.

EXAMPLE: Using the modern United States as an example, census figures show the priorities are *something* like this:

Sector	Type	Quantity
One	Services	-3(350)
Two	Government	-4(250)
Three	Durables	-5(175)
Four	Commerce	-6(125)
Five	Entertainment	-8(64)
Six	Clothing	-11(23)
Seven	Food	-15(6)
Eight	Luxuries	-20(1)

The US census actually breaks things down into over a dozen sectors, so we had to do some mixing and estimating, but it serves as an example.

EXAMPLE: We can't do our Dark Ages fief that effectively using this sytem. It's a non-urban agricultural community where the entire economic system is reliant on farming rather than other sectors of the economy. But let's take a medieval town and arrange it:

Sector	Type	Quantity
One	Services	-3(350)
Two	Durables	-4(250)
Three	Commerce	-5(175)
Four	Clothing	-6(125)
Five	Government	-8(64)
Six	Food	-11(23)
Seven	Entertainment	-15(6)
Eight	Luxuries	-20(1)

If we set up the town with 1,000 *working* people we can just use the numbers in parentheses and make some guesses about the town. Remember that the population is significantly larger than 1,000, since we have 1,000 people holding down jobs of some kind, *plus* their families.

Services: People who are working for someone else. A cook, a servant, a wagon driver, a clerk, scribe or apprentice. Inns and taverns would be somewhere between services and entertainment.

Durables: With a quarter of the employed population making durable goods, this is obviously a town that makes a lot of stuff, and probably exports much of it.

Commerce: A little over a sixth of the working population is involved in buying and selling things, usually other than something they are involved in making themselves. The blacksmith makes durable goods, but probably sells much of it directly. If he sells nails by the keg to someone else, and they in turn sell them for export, then that person is involved in commerce.

Clothing: With about an eighth of the working population somehow involved with the garment industry, there is far more clothing than townsfolk would use themselves. Clothing industry might also includes spinners, weavers, tanners and cobblers. Because low-tech clothing is so labor intensive, labor costs money, and low-tech societies are often cash-poor, far more of the population would be using their own time to make their own clothing. The knitting techniques and tools your grandmother might have used to make you a sweater are about the same as those used in the 14th century.

Government: With only six percent of the employable people involved in the government or government services (like a town watch), it is clear that the government is small, probably with a strong central power, and not a lot of outside threats to deal with or services provided. There is probably a town council, a handful of bureaucrats and a small number of "town guard" with duties like collecting tolls or guarding the docks.

Food: Perhaps a bit less than realistic, but we deal with the slots we have available. In town, there are 23 people like bakers or brewers or millers, most of whom will sell their goods to the commerce sector for resale.

Entertainment: The town can support 6 people whose job involves keeping people amused or entertained. Minstrels, storytellers, town criers, that sort of thing.

Luxuries: With only 1 person in this sector, you have to choose the nature of the luxury. It might be a gold or silversmith, a maker of weapons beyond the blacksmith's ability, a wizard or enchanter, or some service that only the wealthy in town can afford to use on a regular basis. A skilled individual like a physician does not produce a durable good, but in many times and places the service of a skilled physician is certainly a luxury.

Depth of services - Not all professions are equally common. Within a certain classification like Entertainment or Luxuries or Commerce, some possibilities are just less likely than others. You can split things into eighths. There may be eight very common jobs within a sector of employment. One of those slots is uncommon jobs, which has eight subdivisions, and one of those is rare jobs, which has eight subdivisions, and so on.

EXAMPLE: If you have 4,000 people making Durable goods, you can split them up into eight types of goods. The last of these is "uncommon goods", and this has eight slots, one of which is "rare goods".

Goods	Workers
Common #1 through #7	500 each
Uncommon #1 through #7	62 each
Rare #1 through #7	8 each
Ultra-rare #1 through #8	1 each

So, out of our 4,000 people, we have 500 making some form of uncommon or rare goods, and of those 500, there are 62 making a rare good, about 8 people on average *per* rare good, and 1 person each for some ultra-rare good. That gets you 29 different goods available within the Durables category, which should be more detail than any gamemaster will ever need.

Keep in mind that a rare or uncommon good or service is *not* necessarily an *expensive* good. Shoes don't wear out that often, so cobblers may be rare, but they are seldom rich. As the saying goes, "just because you're necessary doesn't mean you're important."

URBAN AREA - How big an urban area is will depend on its population and tech era. The table below assumes the "central" part of an urban zone. In early eras, it would likely be the area "inside city walls", while in later areas it might be a "business district". Cultural and geographic factors that affect overcrowding can adjust these figures up or down a level or two. Cities that got their start in earlier eras are likely less to be built up than ones founded later, and the higher the tech era, the more populated a particular hectare can be (think skyscrapers).

Tech era	City size level in hectares
Primitive	Population level - 14
Basic	Population level - 15
Industrial	Population level - 16
Atomic	Population level - 17
Post-Atomic	Population level - 18
Advanced	Population level - 19

Urban areas that are not "walled in" will tend to sprawl out +3 Size levels past their center in terms of suburbs, slums, industrial parks or "tax zones" simply appropriated by a city to give it a bigger income. When you take sprawl into account, *average* urban population density can be up to several levels less. Hectares convert to a diameter in meters from a central point by taking half the Size level in hectares (round towards zero) and adding 13 levels.

EXAMPLE: If you create a Basic Era city with a population of 100,000 (a population Size level of about +31), then it is a safe bet that the most heavily populated area of the city will cover about 500 hectares (a Size level of +16), or about 5 square kilometers. If it were a sprawling city founded in the Primitive Era, this number of people might cover 7 square kilometers instead (a Size level of +17). To convert the hectares to a diameter take the half the Size (+8) and add +13. The resulting Size of +21 means the city proper is 2.8 kilometers across.

The speed and availability of personal transport is the main factor in terms of *modern* urban sprawl. If people have to walk (or stay inside city walls), urban areas will be more uniformly dense than if people are commuting an hour by car. If there is sprawl, roughly half the population will live in the city center, and half in the sprawl. The nature of this sprawl is up to you. For reference, in modern urban areas, single family units average about 12-25 per hectare, town-homes (adjacent walls, tiny yards) are about 50-100 per hectare, and apartments are 100-200 dwelling units per hectare. Each dwelling unit can hold a "family", and how many people this actually is depends on how many relatives you can tolerate.

LET'S SEE IF IT WORKS - We're going to do a bottom to top design of a small urban area. This will be the medieval town of Exampleton, somewhere in Europe in the Basic Era. Aside from that, we make the assumptions that the town itself has a total population of 23,000 (a population Size of +27), and the area around it has an average ecosystem and average crop yields. We'll put the town at the fork of a river and say it has a fair amount of outside trade, and life is somewhere between harsh and average, living under some form of monarchy, but with its own local laws.

Farming: We have an urban population of 23,000 to support, none of which are farmers. The farmers live on the lands surrounding the town. We're going to assume there is about one house-hold per "farmer".

Modifiers	Size
Basic Era	+0
Default crops	+0
Intensive agriculture(x1.5 effort)	+2
Average ecosystem(temperate)	+0
Total(4 people)	+2

This means that our farmers can support 4 people per hectare. In this case, the intensive farming methods mean that the farmers have a ready supply of high quality fertlizer in the waste generated by the nearby city of 23,000 people. We'll be generous and say that it is *treated* waste. The area this requires is:

Production	Basic *area*
Agriculture	-2
Basic Era	+0
Intensive agriculture(x1.5 effort)	+2
Total(2 hectares)	+0

A Size level of +0 is 2 hectares, so each farmer is tilling 2 hectares to feed 4 people. It means we need at least 8,000 farmers and 16,000 hectares (160 square kilometers) of cropland to support the city of 23,000 people. However, the farmers have to feed themselves, which is 1 person out of the 4 supported. If the farmers have an average family size of 3 full-value food consumers (themselves, a spouse and 2 children), then each farmer can support one person outside his family, and we would need 23,000 farmers and 46,000 hectares (460 square kilometers) of cropland. This last case would be a circular area with a radius of about 12 kilometers, which is well within the daily delivery capability of Basic Era transport.

We can see that this situation is actually doable, and also that any incremental improvements will make a *big* difference. For instance, the" rich crops", "rich ecosystem" or "late use" modifiers will all make supporting this city a *lot* easier. Similarly, we can see that any disruption is going to hurt a lot. Unless there is a surplus of farmers during *normal* years (which implies that part of the economy is involved in exporting agricultural products (including things like wine), there are going to be a lot of hungry people if anything happens to overall crop productivity.

Now, to the city itself. Since we've completely segregated the farm population from the urban population, things are a little easier. We said that life is somewhere between harsh and average.

Society is:	Producer	Consumer	Neutral
Average-	*-1(660)*	*-7(90)*	*-4(250)*

The "sexist" modifier is going drop the potential workforce from a population Size of +27 to +25, so for an adjusted population level of +25, this means we have a workforce of:

Type of people	Level	Quantity
Producers	+24	8,000
Consumers	+18	1,000
Neutrals	+21	2,800

To figure out the per capita income, we'll assume that the commercial resources are +1, since we defined the area as being a decent spot on a trade route. This gives:

Technological Era	Yearly income
Basic	+0

Modifiers	Amount
Agricultural efficiency	+2
Society type	-1
Sexist	-2
Richness of resources	+1
Tyrannical gov't	-7
Total	-7

This gives us a per capita yearly income level of -7, or 90 Credits. Armed with that, we can get a general population breakdown in terms of relative wealth and poverty. Remember that per capita income is an average, which is lower than *actual* income because of people like children who generate zero income, and in this case women, who are working but not generating any significant income that the local government can tax. The corruption index of -11 for a tyranny means the government revenue lost will be a Money level of -18 (per capita income minus the corruption index).

We would use the *Average-* row on the income distribution table (page 6.17), and since the overall government is Tyrannical, we go up 2 rows to the Harsh row. You might also try going up 1 row to average between the effects of a distant tyrannical government and a local representative one, but we're going to stick with the tyranny.

Society	V.poor (≤-6)	Poor (-3)	Avg. (+0)	Rich (+6)	V.rich (≥+12)
Harsh	-4	-3	-3	-12	-17

This gives us a breakdown that looks like this for the population as a whole. Remember that since women in Exampleton are out of the financial loop, actual income per worker is probably double this. That is, a husband and wife each have a per capita income to determine family wealth, but the actual case is that the man earns double the per capita income and has control of how the income is spent.

Income	# of people(level)	% of total
11Cr	5,600(23)	24%
32Cr	8,000(24)	35%
90Cr	8,986(24)	39%
700Cr	350(15)	1.5%
5.6KCr	64(10)	.3%

Also remember that we put any surplus in the Average column. If you work out the total amount of money available using the above table, then a sixth of the community's wealth is in the hands of the 9 wealthiest individuals, and a third is in the hands of the top 2% that make up the two upper class brackets.

If we say that we have some Early Basic Era infrastructure in the form of a road network and public wells with maybe a few bits of plumbing piped here and there, with a normal erosion rate of +2, then it means the per capita cost per year is a money level of -12, or 16 Credits (Money level of -14 for Early Basic Era and +2 for the erosion rate). Since this is effectively a Harsh society (with +0 social infrastructure modifier), there will be no additional social infrastructure cost.

So, we need a tax rate that can handle a Money level of -12 in taxes. This would be a tax rate of -5 from per capita income (see page 6.19). This gives us the government income needed, and the corruption cost of -18 is small enough that it can be almost ignored (equivalent to a -6 tax rate). However, the *personal* tax rate is sufficient to drag per capita income down from -7 to -8 (from 90 Credits to 64 Credits).

Total tax revenue for Exampleton is somewhere around 23 Credits times 23,000 people, equals 529,000 Credits a year, or 1,450 Credits per day in payroll and supplies, or a bit less than a tenth of a Credit per day per person. That still seems like a lot of money for a normally cash-poor Basic Era society to maintain dirt roads with, but we are also talking about roads to service the thousands of farms covering an area of nearly 500 square kilometers, plus upkeep of any city walls, salary for the town guard, primitive plumbing or sanitation systems (hauling waste out to the farms), and so on.

Recap - The average per capita income in Exampleton is 90 Credits per year, but since women are excluded from the workforce, the figure for actual wage-earners is closer to double this, or 180 Credits. Of that, about 46 Credits is taxed away, meaning the average take-home for people who are part of the workforce is about 134 Credits a year or .4 Credits per day for a six-day work week. In Atomic Era terms, the average wage is about 1 Credit per hour, comparable to sweatshop wages, with a standard of living about what you would expect on those wages.

Now we get to the subjective notion of who works where. The town cannot exist without its food base, so there will have to be enough of a government sector to support a decent military to ensure that farmers are not terrorized by bandits. It is on a trade route, so both commerce and durable goods have importance, and the business of transporting food into Exampleton is going to be a major sector of commerce. Remember that out of the total population of 23,000, only 11,000 are in the workforce (a population Size of +25). As a sexist society, there are 12,000 women counted as Neutrals, who while excluded from the most productive sectors, nonetheless are doing something that keeps them out of the Consumer category. Many of the lowest income Producers will be child labor, and the Consumers are going be those too young or too feeble to work, the extremely wealthy who do not work, and the town guard or whatever martial force Exampleton has to defend itself.

After tinkering with it, we end up with:

Sector	Level	# of people
Services	+22	4,000
Commerce	+21	2,800
Durables	+20	2,000
Government	+19	1,400
Food	+17	700
Clothing	+14	250
Entertainment	+10	64
Luxuries	+5	11

Most of the population is involved in working for someone else, and odds are this has to do with commerce or is indirectly tied to manufacturing. Dock workers, store clerks, barmaids, cart drivers, sewage haulers, and so on. The most likely things of interest to characters will be the fraction of the government that is defense-related, and the nature of any particular luxury providers.

Each sector is going to have some mix of Producers, Consumers and Neutrals. For instance, most of the Government sector will be Neutrals. If we give Exampleton a business model of small family businesses and some Guild-run crafts, we can start making assumptions about family size and job hierarchies, like an inn (entertainment) run by a husband and wife (Producer & Neutral), with maybe a few children in Neutral and Consumer roles.

Or, the Glover's guild, where you have some very poor apprentices, poor journeymen, and middle-class guildsmen. The apprentices and journeymen probably don't have enough money to support families yet.

On the upper end, we have 11 people involved in the luxury trades, and there are only 64 people in Examplton who are "wealthy". But, we can assume those in the upper middle class will occasionally splurge on a luxury good. If we split the luxuries category into eighths, we might have one person in eight different luxury sector, with a few sectors having a pair of practitioners, and this is the sort of thing that would be of interest to adventurers. For a fantasy setting, this might be the following list of luxury professions, each with one or two practitioners or an apprentice or two:

1) Physician/healer
2) Jeweler
3) Scribe
4) Enchanter
5) Tailor
6) Sage
7) Specialty merchant
8) Furniture maker

Some of these are services that anyone might need (like a tailor), but the luxury trade would involve the upper echelons of skill and custom services that the average person would not need or more importantly, could not afford. While every household would need a table and some stools, any carpenter could make these. A finely carved wardrobe of exotic woods is another matter, especially if takes a few months of a craftsman's time to make. There is not a huge market for these in Examplton, but since the craftsman can only make a handful of them each year, there doesn't need to be a lot of demand for them...

Examplton is quite large for a Basic Era town, and so it has a pretty good depth of luxury services, but even so, there is probably not more than two or three practitioners of the more esoteric professions, and adventurers who end up annoying all of them could easily find themselves unable to find *anyone* to help them when that service is needed.

Last, we have the size of Examplton itself. This is based on its population and tech era:

Tech era	City size level in hectares
Basic	Population level - 15

Our population level of +27 gives a result of +12, (125 hectares), with a sprawl zone of Size +15(350 hectares). If we convert this to a diameter, we get a circle about 1.4 kilometers across, and a diameter of 2 kilometers for the sprawl. The city center has half the population (11,500), giving a density of about 9,200 per square kilometer (92 per hectare). The area of the sprawl is about 225 hectares (its area minus that of the city inside it), so with 11,500 people it has a population density of about 5,100 per square kilometer (51 per hectare). You can compare these figures to the "best guess" quoted by various scholars of a medieval average of about 100 people per hectare in urban areas.

So, we have the "old town", somewhere around 1.5 kilometers across and possibly walled, and the "new town", which has expanded beyond the original city limits for several hundred meters up and down the roads leading into Exampleton.

This gives the gamemaster all the raw material they need to set up a "Who's Who" for the area, ideas of how far out adventurers will be before they see the outlying farms, how much money is floating around in terms of weekly payrolls, what services are likely available, and so on.

FINAL NOTES - While all the other chapters deal with "things" that you can touch, feel and measure, this one has a lot of subjectivity to it. It makes a lot of assumptions, and more than a few cynical observations about past & present human culture and behavior. *If the shoe fits, wear it*. Since we only have human culture to examine, it is the only one we can test with the system. If you use this chapter for an alien civilization or some non-human fantasy race, you will end up with very human-looking results, which might not be what you want. So, you will have to go in and tweak certain variables and basic assumptions, like "what is the difference between a harsh or benevolent society?", or "how do I handle government type modifiers among a telepathic species?", or "how do I build and maintain infrastructure for a race that operates on social obligations instead of currency?". We can't really answer these questions for you, but the system will at least give you repeatable results once you adjust the basic parameters.

As with all the other chapters, remember to only use what you need, as you need it. If you've got a rugged few hundred kilometers of mountain range and just want to know how many Yeti it will support, then just do that. Don't worry about the Yeti economy unless you are actually going to need it. Or, if you want to know how much tribute a town can pay to buy off a besieger, you don't need to worry about the farmers, or if you want to know how many wealthy people there are in town, you don't have to figure out how many Producers and Consumers there are. But, if you want to built an entire tribe or town or kingdown up from nothing more than its base geography and agricultural potential...you can.

EABA

Autocalc on

DESIGN PAGE 6 - If you are viewing this page as a pdf, it has forms that allow you to do most of the aspects of civilization design right here on the page, and then print off your finished specs. It may not cover *all* the advanced topics, but will give you the basics to work from.

Insert civilization name here				
Early	Basic Era	0	d+	-1
Default crops		0	d+	0
Semi-nomadic		1	d+	1
Normal effort		0	d+	0
Normal utilization		0	d+	0
Average ecosys. (temperate)		0	d+	0
Middle use of ecosystem		0	d+	0
Insert critter name here		1	d+	0

Insert critter name here	0
Insert critter name here	0.0
Society is average	
2 societal -ists	
Government is communal	
Natural resources at +0	
Tax rate equal or less than 12%	
Corruption at +0	
Late Primitive Era infrastructure	
Infrastructure erosion of +1	
Workforce at 100% population	

Insert critter name here	Insert critter
Luxuries	0
Luxuries	0
Food	0
Luxuries	0
Luxuries	0
Luxuries	0
Luxuries	0
Luxuries	0

Page 6.18 example	Mongol Horde
Exampleton	Elven forest

Insert critter name here

Insert critter name here	5.7
Insert critter name here	181.0
Insert critter name here	32.00
Insert critter name here	0
Insert critter name here	0
Insert critter name here	0
Insert critter name here	0
Insert critter name here	0
Insert critter name here	0

	Insert critter nc	Insert critter nam	
Insert critter nc	0	16	0
Insert critter nc	0	45	0
Insert critter nc	0	128	0
Insert critter nc	0	1,024	0
Insert critter nc	0	8,192	0

Insert critter name here	0	0
Insert critter name here	0	0
Insert critter name here	0	0
Insert critter name here	0	0
Insert critter name here	0	0
Insert critter name here	0.0	0
Insert critter name here	0.0	0
Insert critter name here	0.0	0

EABA Universal Scale

Level	Attribute cost	Lifting capacity	Kick damage	Distance	Size or movement	Time	Money	Information
-18	-	.2 kilograms	-	-	.004 meters	-	2Cr	-
-17	-	.25 kilograms	-	-	.006 meters	-	3Cr	-
-16	-	.3 kilograms	-	-	.008 meters	-	4Cr	-
-15	-	.4 kilograms	-	-	.011 meters	-	6Cr	-
-14	-	.5 kilograms	-	-	.016 meters	-	8Cr	-
-13	-	.6 kilograms	-	-	.022 meters	-	11Cr	-
-12	-	.8 kilograms	-	-	.031 meters	-	16Cr	-
-11	-	1 kilogram	-	-	.045 meters	-	23Cr	-
-10	-	1.3 kilograms	-	-	.06 meters	-	32Cr	-
-9	-	1.6 kilograms	-	-	.09 meters	-	45Cr	-
-8	-	2 kilograms	-	-	.12 meters	-	65Cr	-
-7	-	2.5 kilograms	-	-	.18 meters	-	90Cr	-
-6	-	3 kilograms	-	-	.25 meters	-	125Cr	-
-5	-	4 kilograms	-	.06 meters	.35 meters	-	175Cr	-
-4	-	5 kilograms	-	.09 meters	.5 meters	-	250Cr	-
-3	-	6 kilograms	-	.12 meters	.7 meters	-	350Cr	-
-2	-	8 kilograms	-	.18 meters	1 meter	.5 seconds	500Cr	-
-1	-	10 kilograms	-	.25 meters	1.4 meters	.7 seconds	700Cr	-
0	0A	13 kilograms	0d+0	.35 meters	2 meters	1 second	1KCr	1 word
1	1A	16 kilograms	0d+1	.5 meters	3 meters	1.4 seconds	1.4KCr	
2	2A	20 kilograms	0d+2	.7 meters	4 meters	2 seconds	2KCr	2 words
3	3A	25 kilograms	1d+0	1 meter	6 meters	3 seconds	2.8KCr	
4	5A	32 kilograms	1d+1	1.4 meters	8 meters	4 seconds	4KCr	5 words
5	7A	40 kilograms	1d+2	2 meters	11 meters	6 seconds	5.6KCr	
6	9A	50 kilograms	2d+0	3 meters	16 meters	8 seconds	8KCr	10 words
7	12A	63 kilograms	2d+1	4 meters	23 meters	11 seconds	11KCr	
8	15A	80 kilograms	2d+2	6 meters	32 meters	16 seconds	16KCr	20 words
9	18A	100 kilograms	3d+0	8 meters	45 meters	23 seconds	23KCr	
10	22A	126 kilograms	3d+1	11 meters	64 meters	30 seconds	32KCr	40 words
11	26A	159 kilograms	3d+2	16 meters	90 meters	45 seconds	45KCr	
12	30A	200 kilograms	4d+0	23 meters	125 meters	1 minute	64KCr	80 words
13	35A	252 kilograms	4d+1	32 meters	175 meters	1.4 minutes	90KCr	
14	40A	318 kilograms	4d+2	45 meters	250 meters	2 minutes	125KCr	160 words
15	45A	400 kilograms	5d+0	64 meters	350 meters	3 minutes	175KCr	
16	51A	504 kilograms	5d+1	90 meters	500 meters	4 minutes	250KCr	320 words
17	57A	636 kilograms	5d+2	125 meters	700 meters	6 minutes	350KCr	
18	63A	800 kilograms	6d+0	175 meters	1 kilometer	8 minutes	500KCr	640 words
19	70A	1.0 tons	6d+1	250 meters	1.4 kilometers	11 minutes	700KCr	
20	77A	1.3 tons	6d+2	350 meters	2 kilometers	15 minutes	1MCr	1,250 words
21	84A	1.6 tons	7d+0	500 meters	2.8 kilometers	23 minutes	1.4MCr	
22	92A	2.0 tons	7d+1	700 meters	4 kilometers	30 minutes	2MCr	2,500 words
23	100A	2.5 tons	7d+2	1 kilometer	5.6 kilometers	45 minutes	2.8MCr	
24	108A	3.2 tons	8d+0	1.4 kilometers	8 kilometers	1 hour	4MCr	5,000 words
25	117A	4.0 tons	8d+1	2 kilometers	11 kilometers	1.4 hours	5.6MCr	
26	126A	5.1 tons	8d+2	2.8 kilometers	16 kilometers	2 hours	8MCr	10,000 words
27	135A	6.4 tons	9d+0	4 kilometers	23 kilometers	3 hours	11MCr	
28	145A	8.1 tons	9d+1	5.6 kilometers	32 kilometers	4 hours	16MCr	20,000 words
29	155A	10.2 tons	9d+2	8 kilometers	45 kilometers	6 hours	23MCr	
30	165A	12.5 tons	10d+0	11 kilometers	64 kilometers	8 hours	32MCr	40,000 words
31	176A	16 tons	10d+1	16 kilometers	90 kilometers	11 hours	45MCr	
32	187A	20 tons	10d+2	23 kilometers	125 kilometers	16 hours	64MCr	EABA rules
33	198A	25 tons	11d+0	32 kilometers	181 kilometers	1 day	90MCr	
34	210A	32 tons	11d+1	45 kilometers	250 kilometers	1.5 days	125MCr	160,000 words

EABA Universal Scale

Level	Attribute cost	Lifting capacity	Kick damage	Distance	Size or movement	Time	Money	Information
35	222A	41 tons	11d+2	64 kilometers	362 kilometers	2 days	175MCr	floppy disk
36	234A	50 tons	12d+0	90 kilometers	500 kilometers	2.5 days	250MCr	320,000 words
37	247A	65 tons	12d+1	125 kilometers	725 kilometers	4 days	350MCr	
38	260A	82 tons	12d+2	181 kilometers	1000km	5 days	500MCr	640,000 words
39	273A	100 tons	13d+0	250 kilometers	1450km	8 days	700MCr	Bible
40	287A	126 tons	13d+1	350 kilometers	2000km	11 days	1BCr	1.3 mil. words
41	301A	159 tons	13d+2	500 kilometers	2800km	16 days	1.4BCr	
42	315A	200 tons	14d+0	700 kilometers	4000km	22 days	2BCr	2.5 mil. words
43	330A	252 tons	14d+1	1000km	5600km	1 month	2.8BCr	
44	345A	318 tons	14d+2	1400km	8000km	45 days	4BCr	5 mil. words
45	360A	400 tons	15d+0	2000km	11,000km	2 months	5.6BCr	
46	376A	500 tons	15d+1	2800km	16,000km	3 months	8BCr	10 mil. words
47	392A	640 tons	15d+2	4000km	23,000km	4 months	11BCr	
48	408A	800 tons	16d+0	5600km	32,000km	6 months	16BCr	20 mil. words
49	425A	1000 tons	16d+1	8000km	45,000km	8 months	23BCr	Encyclopedia
50	442A	1250 tons	16d+2	11,000km	64,000km	1 year	32BCr	40 mil. words
51	459A	1600 tons	17d+0	16,000km	90,000km	16 month	45BCr	
52	477A	2000 tons	17d+1	23,000km	125k km	2 years	64BCr	80 mil. words
53	495A	2500 tons	17d+2	32,000km	180k km	32 months	90BCr	CD
54	513A	3200 tons	18d+0	45,000km	250k km	4 years	125BCr	160 mil. words
55	532A	4000 tons	18d+1	64,000km	360k km	5 years	180BCr	
56	551A	5000 tons	18d+2	90,000km	500k km	8 years	250BCr	320 mil. words
57	570A	6400 tons	19d+0	125k km	700k km	10 years	350BCr	
58	590A	8000 tons	19d+1	180k km	1 mil. km	16 years	500BCr	DNA molecule
59	610A	10k tons	19d+2	250k km	1.4 mil. km	20 years	700BCr	DVD
60	630A	12.5k tons	20d+0	350k km	2 mil. km	32 years	1TCr	1.25 bil. words
61	651A	16k tons	20d+1	500k km	2.8 mil. km	40 years	1.4TCr	
62	672A	20k tons	20d+2	700k km	4 mil. km	64 years	2TCr	2.5 bil. words
63	693A	25k tons	21d+0	1 mil. km	5.6 mil. km	80 years	2.8TCr	
64	715A	32k tons	21d+1	1.4 mil. km	8 mil. km	125 years	4TCr	5 bil. words
65	737A	40k tons	21d+2	2 mil. km	11 mil. km	160 years	5.6TCr	
66	759A	50k tons	22d+0	2.8 mil. km	16 mil. km	250 years	8TCr	10 bil. words
67	782A	64k tons	22d+1	4 mil. km	23 mil. km	320 years	11TCr	
68	805A	80k tons	22d+2	5.6 mil. km	32 mil. km	500 years	16TCr	20 bil. words
69	828A	100k tons	23d+0	8 mil. km	45 mil. km	640 years	23TCr	
70	852A	125k tons	23d+1	11 mil. km	64 mil. km	1000 years	32TCr	40 bil. words
71	876A	160k tons	23d+2	16 mil. km	90 mil. km	1250 years	45TCr	
72	900A	200k tons	24d+0	23 mil. km	125 mil. km	2000 years	64TCr	80 bil. words
73	925A	250k tons	24d+1	32 mil. km	180 mil. km	2500 years	90TCr	
74	950A	320k tons	24d+2	45 mil. km	250 mil. km	4000 years	125TCr	160 bil. words
75	975A	400k tons	25d+0	64 mil. km	350 mil. km	5000 years	180TCr	
76	1001A	500k tons	25d+1	90 mil. km	500 mil. km	8000 years	250TCr	320 bil. words
77	1027A	640k tons	25d+2	125 mil. km	700 mil. km	10k years	350TCr	
78	1053A	800k tons	26d+0	175 mil. km	1 bil. km	16k years	500TCr	640 bil. words
79	1080A	1 mil tons	26d+1	250 mil. km	1.4 bil. km	20k years	700TCr	
80	1107A	1.3 mil. tons	26d+2	350 mil. km	2 bil. km	32k years	1QCr	1.25 tril. words
81	1134A	1.6 mil. tons	27d+0	500 mil. km	2.8 bil. km	40k years	1.4QCr	Libr. of Congress
82	1162A	2 mil. tons	27d+1	700 mil. km	4 bil. km	64k years	2QCr	2.5 tril words
83	1190A	2.5 mil. tons	27d+2	1 bil. km	5.6 bil. km	80k years	2.8QCr	
84	1218A	3.2 mil. tons	28d+0	1.4 bil. km	8 bil. km	125k years	4QCr	5 tril. words
85	1247A	4 mil. tons	28d+1	2 bil. km	11 bil. km	160k years	5.6QCR	
86	1276A	5 mil. tons	28d+2	2.8 bil. km	16 bil. km	250k years	8QCr	10 tril. words
87	1305A	6.4 mil. tons	29d+0	4 bil. km	23 bil. km	320k years	11QCr	

EABA Damage Conversions

EABA™	Typical	$3G^3$™	CORPS™	GURPS	HERO System	Action!	Core	Savage Worlds	JAGS
0d+0		0	0	0d+0					1
		2	1				5		
0d+1		4		1d-2		0d+2	8	2d6-2	
		6	2				9		
0d+2		8	3	1d+0	0d+1	1d+0	11		2
		10		1d+1	1/2d+0		12		
1d+0	.25ACP	12	4		1d-1	1d+2	13		3
		13		1d+2			14		
1d+1	9mm short	14	5	2d-1		2d		2d6-1	4
	.32ACP	15					15		
1d+2	.22 long rifle	16			1d+0		16		5
		17	6	2d+0					
2d+0	.45ACP	18		2d+1		2d+2	17	2d6	6
		20	7						
2d+1	9mm	21		2d+2	1d+1	3d	18		7
		23	8	3d-1			19		8
2d+2	.357 Mag.	24		3d+0					9
	4.7mm HK	26	9			3d+2	20		10
3d+0	5.7mm FN	27		3d+1	1d+2			2d6+1	11
		29	10	3d+2		4d	21		12
3d+1	.44 Mag.	31		4d-1	2d-1		22		13
	12ga slug	33	11	4d+0		4d+2	23		15
3d+2	.30 carbine	35	12	4d+1			24	2d8	17
		38	13	4d+2		5d			19
4d+0		41	14	5d+0	2d+0	5d+2	25		21
	5.45mm Soviet	44	15	5d+1		6d	26		24
4d+1	5.8mm Chinese	46		5d+2		6d+2	27		26
	5.56mm NATO	50	17	6d+0		7d	28		29
4d+2		53	18	6d+2	2d+1	7d+2	29	2d8+1	32
	7.62mm NATO	57	19	7d+0		8d	30		35
5d+0		61	20	7d+1		8d+2	31	3d6	39
	.338 Mag.	66	22	8d+0		9d	32		44
5d+1		70	23	8d+2	2d+2	9d+2	33	2d10	49
		75	25	9d+0		10d	34		54
5d+2	.460 Mag.	80	27	10d-1	3d-1	11d	36		60
		86	28	10d+2		12d	37		67
6d+0		91	30	11d+0		12d+2	38	3d6+1	74
		98	33	12d+0		13d	39		83
6d+1	12.7mm US	104	35	13d-1	3d+0	14d	40	2d10+1	92
		112	37	14d-1		15d	42		102
6d+2		119	40	15d+0		16d	43	3d6+2	114
	14.5mm Soviet	128	43	16d+0		17d+2	45		127
7d+0		137	46	17d+0	3d+1	19d	46	2d10+2	141
	15mm	147	49	6dx3		20d	48		157
7d+1		156	52			21d	50	3d8+1	175
	20mm	168	56	7dx3		23d	51		195
7d+2		179	60			24d+2	53		217
		192	64	8dx3	3d+2	26d	55		241
8d+0		205	68			28d	57	4d6	268
		220	73	9dx3	4d-1	30d	60		298
8d+1	30mm	234	78			32d	61	3d8+2	332
		252	84	10dx3		34d	63		370
8d+2		269	90	11dx3	4d+0	36d+2	65	4d6+1	412
		289	96	12dx3		39d+2	68		458

EABA

EABA DAMAGE CONVERSIONS - The following is a short explanation of the systems on the table.

3G^3 notes - **3G^3** is the grandaddy of **Stuff!** and does weapons in a far more detailed and real-world based way. The **3G^3** damage value of a bullet is:

$$((\text{Energy in Joules} \times .735)/\text{diameter in cm})^{.5}$$

For this table, a projectile is assumed to have a diameter of 10mm. Other game systems that take bullet diameter into account may need a scaling factor if you want to get an accurate comparison to the **3G^3** value. This would be to multiply the **3G^3** value by 1/(square root of bullet diameter in cm). Since this factor is applicable to some of the *other* game conversions, we'll just print it once here and refer to it elsewhere:

Bullet	3G^3 multiplier	Row shift
5mm	x1.40	+5 rows
5.5mm	x1.35	+4 rows
6mm	x1.30	+4 rows
7mm	x1.20	+3 rows
7.5mm	x1.15	+2 rows
8mm	x1.10	+1 rows
9mm	x1.05	+1 rows
10mm	x1.00	+0 rows
11mm	x.95	-1 rows
12mm	x.90	-1 rows
13mm	x.85	-2 rows
15mm	x.80	-3 rows
18mm	x.75	-4 rows
20mm	x.70	-5 rows
23mm	x.65	-6 rows
27mm	x.60	-7 rows
30mm	x.58	-8 rows
33mm	x.55	-9 rows

The way you use this if another system has a damage that varies with both energy *and* caliber is that you either multiply the **3G^3** value by the listed amount, or more conveniently, shift that game's damage by the listed number of rows (or a function of that many rows). A row for this purpose is *not* a full 0d+1 **EABA** damage interval, but one of the *actual* rows on the table.

EXAMPLE: GURPS damage is based on energy *and* the area the energy is concentrated over (i.e. bullet diameter), but in a different way than **3G^3**. **GURPS** uses *half* the row shift. So a **Stuff!**-designed weapon that is a 7.5mm rifle with an **EABA** damage of 4d+2 would shift one row to get the appropriate **GURPS** damage of 7d.

CORPS™ notes - **CORPS** is a system from **BTRC** that is far less complex than the **TimeLords** system that preceded it, and both **CORPS** and **TimeLords** contribued in the development of **EABA**. **CORPS** damage values are simply one-third the **3G^3** values.

GURPS notes - This is **Steve Jackson Games'** generic role-playing system. **GURPS®** is a trademark of **Steve Jackson Games** for their generic role-playing system and is used with permission.

To minimize clutter, all die types are removed from the **GURPS** entries. **GURPS** uses d6 for all rolls, including damage. **GURPS** damage is based on a factor of the square root of the energy in kilojoules divided by caliber in millimeters, with further scaling factors and special modifiers based on caliber (see **GURPS High Tech™** for details). The **3G^3** scaling factor is not quite the same. If converting from **GURPS** to **EABA**, use *half the listed row shift*, rounding towards zero. If converting from **EABA** to **GURPS**, the row shift is in the opposite direction and special effects will be based on the caliber of the **GURPS** weapon.

EXAMPLE: A 5.56mm assault rifle doing a **GURPS** damage of 5d6 would get a +2 row shift to get the appropriate **EABA** damage. A 12.7mm machinegun doing a **GURPS** damage of 14d would get a -1 row shift to get the appropriate **EABA** damage. If moving an **EABA** weapon with a damage of 3d+1 to **GURPS**, and the **GURPS** equivalent is a 13mm pistol, then you take a +1 row shift to get the **GURPS** value.

HERO SYSTEM FIFTH EDITION notes - This is **Hero Games'** universal role-playing system. **Hero System®** is a trademark of **Hero Games** for their generic role-playing system and is used with permission.

To minimize clutter, all die types are removed from the **Hero System** entries. **Hero System** uses d6 for all rolls, including damage. **EABA** and **Hero System** damage relates almost perfectly as follows:

1) 1d+2 (or +5) in **EABA** is 1d+0 in **Hero System**.
2) Each +7 in **EABA** is 1d+0 in **Hero System**.
3) Each +2 in **EABA** is a +1 in **Hero System**.
4) Each +1 in **EABA** is the difference between **Hero System** damages like 2d6+2 and 3d6-1.

This can generate or convert any **EABA** or **Hero System** damage, even if not on the previous table. For more details on modern weapons in the **Hero System**, see the **Dark Champions** supplement.

EXAMPLE: An **EABA** damage of 11d+0 (or +33) is an **EABA** +5, plus four **EABA** +7's (a total of +33). The **EABA** +5 is a **Hero System** damage of 1d6+0, and the four **EABA** +7's are +4d in **Hero System**, for a final **Hero System** damage of 5d6+0.

notes - This is **Gold Rush Games'** multi-genre, OGL open license role-playing game system. **Action! System**™ is a trademark of **Gold Rush Games** for their generic role-playing system and is used with permission.

To minimize clutter, all die types are removed from the **Action!** entries. **Action!** uses d6 for all rolls, including damage. **Action!** damages are based on:

$$((\text{foot-pounds} \times .9996) / \text{bullet diam. in cm})^{.5} / 7.32$$

This gives a result in d6 of damage. Fractional remainders of less than .4 are ignored, fractions from .4 to .7 become +2 damage, and fractions larger than .7 round up to the next die.

EXAMPLE: A .44 Magnum (1.12cm) with an energy of 900 foot-pounds would have a damage of 3.87, which rounds to 4d6.

The scaling factor for **Action!** is the same as that for **3G^3**, and no row shifts are required to convert damage from **Action!** to **3G^3** or **EABA** and vice versa.

notes - This is **Dream Pod 9's** generic role-playing system. **Core**™ is a trademark of **Dream Pod 9** for their generic role-playing system and is used with permission.

The **Core** conversion is originally derived from a conversion to **3G^3**, and was (**3G^3** damage$^{.5}$ x 4). An alternate conversion (courtesy of Stéphane Boyer) that gives higher DM's for **3G^3** values of more than 70 is (**3G^3** damage$^{.66}$ x 2). The best conversion to and from **EABA** is to assign a **Core** value of 17 to an **EABA** damage of 2d+0. Each +1d in **EABA** adds the full dice of the new value, plus 1. Do this for *each* +1d of increase in the **EABA** value.

EXAMPLE: An **EABA** damage of 2d+0 is a **Core** value of 17. An **EABA** damage of 3d+0 becomes a **Core** value of 17 plus 3 (the **EABA** dice) plus 1, equals 21. An **EABA** damage of 4d+0 adds to this 4 (the **EABA** dice) plus 1, for a **Core** value of 26. An **EABA** damage of 8d+0 would do this process four more times, and result in a **Core** value of 56.

Each +1 in **EABA** damage would be one-third of the difference *for that 1d interval*, rounding nearest.

EXAMPLE: EABA damages of 2d+0 and 3d+0 are **Core** values of 17 and 21. *For this interval*, +1 in **EABA** is 4/3 of a point in **Core**. This means that 2d+1 and 2d+2 in **EABA** are **Core** values of 18 and 20.

Since **Core** does not factor in bullet diameter for damage, no row shifts are required to convert from **Core** to **3G^3** or **EABA** and vice versa.

notes - This is **Pinnacle Entertainment's** generic role-playing system. **Savage Worlds**™ is a trademark of **Pinnacle Entertainment** for their generic role-playing system and is used with permission.

Savage Worlds is a pulpy kind of multi-genre system suitable for cinematic role-playing. The level of realism is somewhat abstract, but it is internally consistent and *quite* suitable for damage translation across systems. The best conversion from **EABA** is to assume an **EABA** damage of 2d+0 is a **Savage Worlds** damage of 2d6 (average of 7 on the roll). Each +5 in the **EABA** damage is +2 to the *average* **Savage Worlds** roll, alternating between +3 and +2 in **EABA** being +1 in **Savage Worlds**. You then figure out the type and number of **Savage Worlds** dice that generates this average for damage. Any **EABA** damage conversion should use the simplest possible roll, all dice should be the same type, and no dice bonus is larger than +2.

EXAMPLE: Both 2d6+2 and 2d8 have the same average result (a total of 9), so you would use 2d8 instead of 2d6+2.

Savage Worlds uses several die types, and the average is below.

Die type	Average per die
d6	3.5
d8	4.5
d10	5.5

EXAMPLE: A 2d+0 **EABA** weapon does 7 points of **Savage Worlds** damage. A 3d+0 **EABA** weapon (+3 more than the **EABA** base of 2d+0) would do 8 points of **Savage Worlds** damage, and a 3d+2 **EABA** weapon (+5 more than the **EABA** base of 2d+0) would do 9 points of **Savage Worlds** damage. The 8 point result would be 2d6+1, and the 9 point result would be 2d8.

If converting **3G^3** results, a **Savage Worlds** average damage of N converts to a **3G^3** value of:

$$1.5^{5.6 + ((N - 5) \times .833)}$$

and if you actually use this equation, we'll leave it to you to figure the conversion in the other direction...

EXAMPLE: If you plug in 8 as the value of N, you get a result of 27 for the **3G^3** value.

EABA

JAGS™ notes - This is Marco Chacon's generic role-playing system. **JAGS**™ is a trademark of **Marco Chacon** for his generic role-playing system and is used with permission.

An **EABA** damage of 1d+0 is a **JAGS** damage of 3. Each +1d in **EABA** multiplies the **JAGS** damage by 1.90. Each +1 in **EABA** multiplies the **JAGS** damage by 1.24.

EXAMPLE: A weapon with an **EABA** damage of 4d+1 would start with a **JAGS** damage of 3, then multiply it by 1.9 three times (to 20.6), multiply by 1.24 (to 25.5), making the final **JAGS** result 26.

In general, if converting damages involving real-world calibers, you need to apply the row shift when converting from **JAGS** to **EABA**, and reverse it if converting from **EABA** to **JAGS**.

EXAMPLE: A 5.56mm rifle with a **JAGS** damage of 17 would go down 4 rows to become an **EABA** damage of 4d+1. A 12.7mm machine gun with an **EABA** damage of 6d+1 would go *down* 2 rows (reverse the modifier) to become a **JAGS** damage of 114.

This will give a **JAGS** damage result that is more accurate in terms of energy delivered, for purposes of harming a target, but the unadjusted **JAGS** number is probably more accurate in terms of penetrating ability.

EXAMPLE: An **EABA** damage of 4d+1 for a 5.56mm weapon would probably have an ability to penetrate armor like a **JAGS** value of 26, but for purposes of damage, it is probably closer to the row-shifted value of 17.

OTHER SYSTEMS - There are a few other systems worth noting, but not enough space on the table to include them.

imPresa & genreDiversion i notes - These are Politically Incorrect Games' generic role-playing systems. **genreDiversion**™ **i** and **Impresa**™ are trademarks of Politically Incorrect Games for their generic role-playing systems and are used with permission.

Like **CORPS**, the **Impresa** system derives damage values linearly from **3G³** numbers. **Impresa** damage is 1/6th the **3G³** value, rounded to the nearest whole number, and can thus easily be compared to other systems. The other way to look at it is that **Impresa** damage equals:

$$1.5^{(\textbf{EABA}\text{ dice }-1)} \times 2$$

EXAMPLE: A **3G³** value of 24 is an **Impresa** damage of 4, and an **EABA** damage of 2d+2.

Albedo™ - This is Sanguine Productions' role-playing system set in the universe of Steve Gallacci's **Albedo** comic. **Albedo**™ is a trademark of Steve Gallacci. The **Albedo:Platinum Catalyst** rpg is ©2004 by Sanguine Productions and game references are used with permission.

The damage system in **Albedo** is unusual and not easily translatable to and from **EABA** because weapons have separate damage and penetration numbers. The best results for Penetration are if you take the **EABA** damage in full dice and add 5. Best results for Damage are to add +1 to the Penetration for anti-personnel weapons and use a Damage of double the Penetration for anti-vehicle weapons.

EXAMPLE: A weapon with an **EABA** damage of 4d+1 would have an **Albedo** Penetration value of 9 and a Damage of 10. Since **Albedo** weapons are listed as Damage+Penetration, this weapon would have a damage rating of 10+9. An anti-tank rifle with an **EABA** damage of 6d+1 would have an **Albedo** rating of 22+11, and a light cannon with an **EABA** damage of 8d+0 would have an **Albedo** rating of 26+13.

General Notes - If using **EABA** or **3G³** as a basis for a damage system or comparison, both systems generally equate penetrating power with damage. Each +1d of damage in **EABA** represents about a two hundred twenty-five percent in energy delivered over the previous die total, and each +1 in **EABA** is about a thirty-one percent increase over the previous die total. This means the difference between any two models or ammunition types for the same weapon is unlikely to be more than a +1 difference in **EABA** terms.

EABA

August 1, 2004

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