The Artifact

Engineer's Resource

Created By: **Emmett O'Brian**

Written By: **Emmett O'Brian**

Interior Art: **Emmett O'Brian**

Edited By: **Cody Pelz**

A Note: This book is designed as a game, in no way are the aliens, monsters, powers, places, and/or governments real. This book does not in any way reflect the author's or company's attitudes or beliefs. If you find any material in any way offensive we give you our sincere apologies. The game enclosed is designed to be fun, and a fantasy version of things in the future.

Dedicated to: **Kiara, my little engineer.**

The Artifact Engineer's Resource Table of Contents

Table of Contents

Engineer's Resource

This Resource is to clarify the role of the Character Occupation of Field Engineer. Although some information is given in the description of the CO this resource greatly expands on what a Field Engineer does and how to do it.

The Field Engineers can be given an enormously wide array of tasks to accomplish supporting the fighting forces from Earth and their allies the Scimrahn. Normally, in modern militaries the jobs of Military Engineer and Mechanic have separate responsibilities, but because of the limited manpower available on The Artifact, these two roles have been combined into one. The primary job responsibilities of the Field Engineer are as follows.

1. Mobility – Both facilitating friendly troop movement and impeding enemy movement.
2. Hazardous Ordinance Disposal – Disposal of enemy ordinance
3. Defense – Fortification construction
4. Demolition – Destruction of enemy fortifications and structures
5. Maintenance - Supporting fighting vehicles

The Field Engineer has access to any and all materials that are available and will support these goals, including using troops and combat vehicles when these are not already in use in combat roles. This authorization has paved the way for the Field Engineer to use Hosent to develop tools that would not normally be available to them. Because of the Field Engineers training, they are in a position to design and build both vehicles and weapon systems on location without a long supply chain, thus greatly enhancing the mobility and fighting power of small units.

This resource will assist the player in using a Field Engineer character. It will step through the five goals to flesh them out and give a better understanding of how to use the environment of The Artifact to their advantage. To do this, the Engineer must understand the materials that are available to them, both supplied and native. The next section will address how the Engineer can obtain materials and general techniques to build using those materials.

Note to Players: Although this sourcebook does it's best to simplify the tasks an Engineer would perform, the job of the Engineer is a technical one and that is reflected in this book. To use these rules to their fullest, the player should enjoy dealing and thinking about strategic and technical problems.

The Engineering Team

Engineers are often deployed in groups. These groups consist of several engineers, footsoldiers, E-Suits and any other support vehicles and their crews. Each element of the team is under orders to take direction from the engineers and work to complete any tasks that the engineer needs to complete their mission. That mission may be to accompany and support a larger unit or it may be deployed ahead of a main force to prepare the way for them. Because of this the engineer can be a plot driver for the game. If there is a larger regular forces unit, and their success depends on the engineer, the CO may authorize the engineer to use more or all of the regular forces to complete their tasks. In a combat situation, the engineer must defer authority to regular forces.

The ASO engineering team normally consists of 5 engineers, 10 footsoldiers, 2 E-Suits and whatever support vehicles are deemed necessary for the task assigned dependent on availably. I-CA engineering teams are often twice that size but are more often assigned much larger tasks such as developing defenses and housing for colonies.

The Engineer does the planning and instructs others on how to accomplish assigned tasks. Any direction they give to regular forces must be for unskilled labor and instructions must be detailed enough for enlisted forces to complete the task. Any work that requires skilled labor must be done by the engineer.

Footsoldiers are both for the defense of the team and to assist the engineer with manpower needed to complete the task at hand. They take all direction from the engineer unless it is in a combat situation. The ranking officer of the regular forces assigned to the team is also responsible for security and surveillance, but must balance these responsibilities with accomplishing the engineering tasks that the engineer directs.

E-Suits are used to defend the team and when other specialized support vehicles are not available, they are used for heavy lifting and earth moving. These E-suits are

often supplied with one or more optional systems for construction purposes. The choice of these systems is up to the engineer.

Measuring Work

Much of the work described in this sourcebook is defined in manhours. This is the work of one man over one hour. However it in almost all cases can be divided among the people working on the job that are skilled in the task at hand. Unskilled tasks do not require any skill. E-Suits are equal to unskilled labor but count as 20 men.

For example, a designated task requires 1000 manhours. An ASO Engineering Team has the equivalent of 55 men (5 engineers, 10 footsoldiers, 2 E-Suits). The number of manhours (1000) divided by 55 men would take less than 19 hours to complete.

A Command Skill roll can reduce the time that a project takes to complete (A Commanding Officer can make this roll or the Engineer). A roll on the Full Fraction column reduces the total time by 5%. A roll on the 1/2 Column reduces the time by 10%. A roll on the 1/4 Column reduces time by 15% and 1/8 Column reduces time by 20%. However this requires the Engineer or Commanding Officer to supervise the task from start to end.

Measuring Energy

This book uses a unit of energy that is roughly equivalent to 14 HP or 10,000 Watts of power. These units tend to work well on the scale that the engineer will work with. These units are simply called Energy Units. To learn more about generating power for engineering applications see: Building -> Generating Power.

Mobility

The importance of mobility is easy to understand. The Engineer must promote the mobility for friendly forces by constructing bridges and roads where needed and removing obstacles such as choked passages and enemy blockades.

The first option is always to go around an obstacle but in some instances the obstacle is large and engineering a way through it may be more cost effective. This is especially true when fuel must be conserved.

Every 300 KM traveled roll on the table below.

1D100	Path obstruction table
1-20	Heavy rubble
21-50	Overhead hazards
51-65	Grade impassable
66-80	Cracked Hexes
81-100	Vertical Travel required

Heavy Rubble

This obstacle represents a wide field of rubble from combat in the area or fallen CCC that is large enough to prevent or seriously slow vehicular traffic. Clearing the obstruction will take 1D100x5 Man hours planning the route takes a road building skill roll, but the labor is unskilled. Going around will increase the distance needed to travel 1D100x10 KM. A failed Road construction skill roll will double the time that it takes to clear the obstruction.

Overhead Hazards

This obstacle represents an area in which the roof of the hexes are damaged and loose CCC is hanging. These hazards should be cleared before traveling underneath or a rock fall can occur. Going around will increase the distance needed to travel 1D100x10 KM.

Clearing overhead hazards requires a Structural Recognition Roll to determine what must be removed. Usually overhead hazards can be removed with explosives, which requires an Explosives Skill roll. It takes 1D10 manhours to remove each rock and an explosives skill roll for each rock blasted out There must be some way for the engineer to reach the ceiling to place the charges. This is often done with an AG vehicle such as a Skiff.

In a path with an unstable ceiling, there can be 3D10 stones that will need to be removed.(An addendum to the Random Encounter Tables: A structural recognition roll can identify the “falling rocks” encounters.)

Grade Impassable

Structural damage has caused hex floors to tilt to such a degree that vehicles that are not capable of flight cannot safely travel up or down the slope. This is usually a pitch of 30-40 degrees or more. The engineer may use lifting equipment to carry vehicles over the obstacle or they can make a switchback road using earthmoving equipment and a road construction skill roll. Clearing the obstruction will take 1D100x5 Man hours planning the route takes a road building skill roll, but the labor is unskilled. Going around will increase the distance needed to travel 1D100x10 KM. A failed Road construction skill roll will double the time that it takes to clear the obstruction.

Cracked Hexes

The Hexes being traveled through are cracked, leaving a gap 2-12 meters across (2D6 meters). A bridge must be built or the company will have to go the long way around. Going around will increase the distance needed to travel 1D100x10 KM.

Vertical Travel Required

To arrive at a designated point moving up a number of floors is required. The group must move vertically 3D6 hexes. Some vehicles will be able to move vertically on their own but wheeled vehicles must be lifted or lowered by some other means.

The following sections outline how many of these obstacles can be overcome. These are not the only methods that will be effective but they should be considered the standard to follow. Engineers are given the operational flexibility to make decisions based on technical challenges they face as they have the technical knowledge to accomplish their mission goals.

Road Building

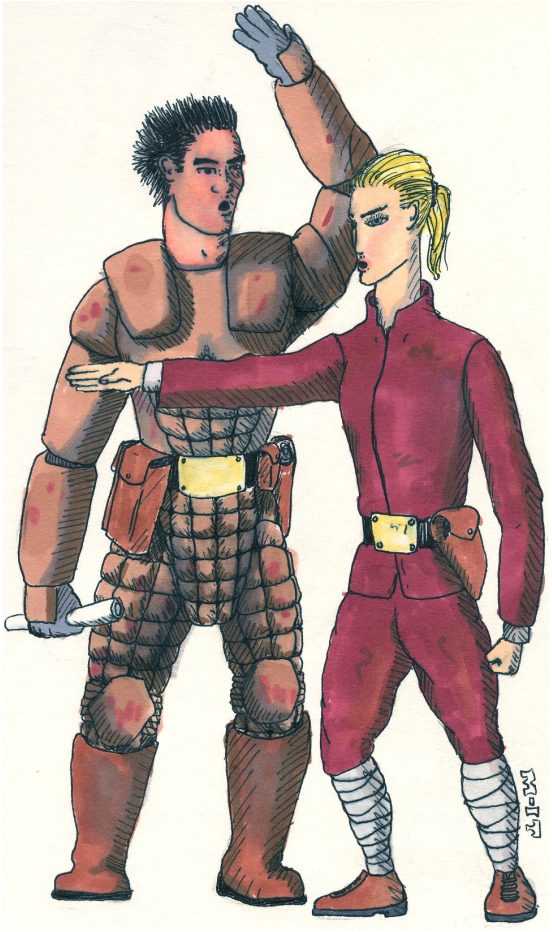
Most heavy combat vehicles are designed to be all terrain, however even these suffer less wear and can move faster over flat ground. The Artifact is a manufactured environment and even Agri Hexes have roads built into the structure of the hex. However, in some instances point to point travel may traverse an area not on one of these paths. Especially in Agri Hexes the soil can be very wet and vehicles such as heavy trucks may become stuck. In other areas broken ground may impede movement. Clearing a path and providing a smooth pass is often the job of a field engineer.

Another important concern in preparing routes for friendly forces is clearing over head hazards. In Hexes where there has been seismic disruption, it is the Engineer's responsibility to clear any hazards such as loose pieces of CCC that could fall.

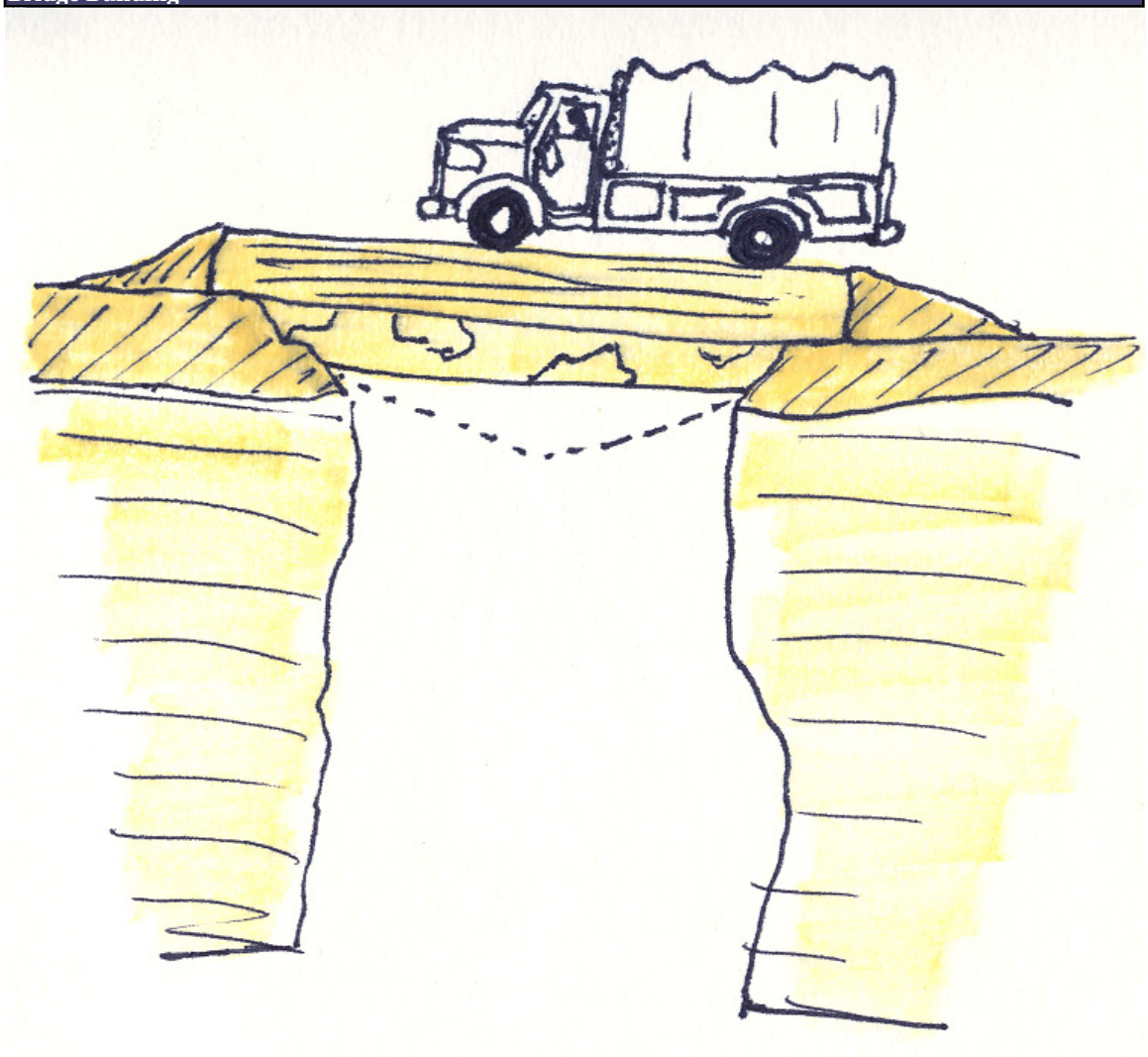
In most instances packed soil or CCC fill with soil over are the quickest method for building a road. This can be surfaced with thin (1-3 cm) CCC slabs at a later time if needed.

The Engineer must make a successful Road Construction roll to properly build a road. If the roll is failed then there is the risk of vehicles passing over it getting stuck or damaged. It takes one (1) manhour of unskilled labor per square meter to build a road for dirt and fill. One lane roads are often a minimum of four (4) meters wide. A two lane road would be double that or eight (8) meters wide. This means that for every meter of a one lane road takes four (4) manhours to construct and a two lane road takes eight (8) manhours for every meter long.

For CCC Slab cutting see: Building – CCC



Bridge Building



In some locations, the structure of a Hex or many Hexes has failed creating an obstacle to travel. If the obstacle cannot be negotiated or if it will cause significant delays on a regular route a bridge or bridges may be required.

It is highly recommended that local CCC is used to build bridges. A span of CCC thirty (30) cm thick and three meters long can support a vehicle up to 30 metric tons. When determining the load that a bridge can support, it is important to calculate for a heavier load than the vehicles that are expected to travel over it for safety. This safety factor should be a factor of two or more.

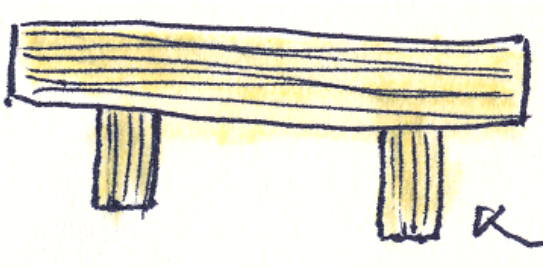
Slab

To calculate the needed strength of a span, the weight of the heaviest vehicle that is expected to go across the bridge and the distance that the bridge will have to span must be deturmined.

Take the weight of the heaviest vehicle in tons and multiply by two (2). One ton is equal to 1000 Kg. This is the required carrying mass of the bridge.

Step 1. Take the required carrying mass of the bridge (in tons) and multiply it by thirty (30).
Step 2. Now determine the length of the span.
Step 3. Divide step 1 by step 2. This is the thickness the slab needs to be in centimeters to support the mass of the people or vehicles.

Braced



Bracing a slab adds strength to the bridge so the normal calculation for the slab is done, and the extra weight capacity of the braces is added. To calculate the strength of the braces you will need the number of braces, the thickness and depth of the braces (in cm) and the length of the span.

Step 4. Multiply the thickness of the brace (in cm) by it's depth (in cm).
Step 5. Multiply the result of step 4. by the number of braces.
Step 6. Divide step 5 by step 2. Add this to the tons that the slab can support. This is the number of tons (1 ton = 1000 Kg) that the bridge can support.

For CCC Slab cutting see: Building - CCC

Repairing and Starting Hex Conveyors

In the large openings in hex walls, there are several vertical tubes. In these tubes is a conveyer belt with platforms. When functioning one side of the conveyer is going up while the other is going down, this facilitates movement between hex floors. In many cases these conveyors are no longer functioning. This may be because of power loss, wear on the mechanism or both.

In a few instances the conveyer may simply be turned off, this is rare but it does happen. To turn a conveyor back on, a command must be entered into the terminal located near the conveyer or at the mainframe itself along with the conveyor number.

In many cases if power is still available, the conveyor is simply worn out from centuries of unattended operation.

Roll 1D100

	Cause of Failure
1-22	No power
23-37	No power and belt snapped
38-52	No power and platform jammed
53-67	No power and motor failure
68-69	No power and turned off
70-79	Belt snapped
80-89	Platform jammed
90-99	Motor failure
100	Turned off

Fixes

No power - Electrical power must be supplied to the hex for the conveyor to operate. Restoring power from the plasma lines is often not be feasible although the possibility should be investigated. The conveyor can be powered by another source of electricity such as a powerful generator. The conveyor requires 1713 power units (24,000 Horse Power or just under 18 million watts) to operate at full power, or a minimum safe power level of 480 power units (6,700 Horse Power or 5 Megawatts).

At this power consumption rate The Artifact can only power 19,333,333,333 conveyors (assuming 348 Pettawatts of solar input or two of earths suns) and there are 1.5 trillion hexes or at least 9 trillion conveyors with a total power consumption of 162,000,000,000,000,000,000 watts (162 Exawatts). So it would be likely that the Conveyors were not designed to run all the time. (Possibly only once an hour) These figures are not accurate as Tose and Humid are much closer to the planet and the magnetospheres are aligned to deliver power into the poles. This would provide greater amounts of energy than being simply in orbit. In addition, the planet is significantly closer than earth is to the sun. Since the Earth's Sun has a total luminosity of 386 Yottawatts, Tose would have a roughly equivalent output. Humid might be slightly less. Even if the Artifact could capture 20% of the output of these stars (which would be a lot) it would capture 154.4 Yottawatts. Even at that rate the Conveyors would use 10% of the power consumption of The Artifact if left on all the time. Recent findings point towards, The Artifact not being powered primarily from the collector wells and power is actually coming from the industry pods.

Belt snapped - The belt may be repaired by taking undamaged links from conveyors in nearby hexes. The belts are modular and sections weigh ten (10) metric tons. The entire belt is made up of four thousand (4,000) links. The entire belt weighs forty thousand tons (40,000,000 Kg) but the conveyor has a locking mechanism to prevent the entire belt from falling. The collapsed section can be no more than one hundred (100) links and

therefore weights between ten (10) and one thousand (1,000) tons. Roll 1D100 to see how many links must be lifted to re-connect the belt. It requires 1000 Manhours per link to re-connect the belt

Platform jammed - The conveyor has misaligned and jammed itself against the wall of the tube. The Engineer must make a successful Repair Machinery roll to re-align the conveyor. The work takes 1D100 x 10 man hours to complete (See: Manhours Section).

Motor failure – The electrical motor for this conveyor is burnt out. It may be possible to rebuild it with a successful repair machinery roll, otherwise it will have to be replaced. The motors weigh thirty seven (37) metric tons but can be moved in 5 parts (approx 7,400 Kg each). This is an extremely time consuming process and requires 3000 man hours per motor component swapped out.

Turned off - A command must be entered into the terminal located near the conveyer or at the mainframe itself along with the conveyor number. Turning the conveyor back on requires a computer operation roll.

Vertical Transport of Heavy Equipment

Travel between Hexes vertically is difficult for vehicles not capable of flight. In some cases a Scimrahn freighter with a hoist rig can be used to lift vehicles but have difficulty moving tanks. Some engineers have built rigs to allow two freighters to lift a single tank, but piloting the two freighters together can be very difficult. On occasion heavy lift helicopters are used to transport vehicles between levels.

In some circumstances, the motor from a hex conveyor can be removed and placed near a location to lift or lower vehicles. See: Repairing and Starting Hex Conveyors for information on disassembling and moving the motors. Modifying the motor to pull a cable takes 1D10x10 manhours and a successful Repair Machinery roll.

Then a sufficiently strong cable must be obtained or made. The power cables in a hex are able to suspend approximately 1000 Kg. However this does not take into account shock loads so for safety the safe load of these cables should be considered 300 Kg. The cables may be wound together to make a stronger cable. It takes 1 manhour to collect 5 meters of cable.

The preferable mode of transport is an AG Mass Transit but these can be difficult to locate.

Time requirements of this task vary and will have to be estimated by the GM.

Overcoming Enemy Defensive Blockades

While it is the role of regular forces to fight enemy forces, it is the Engineer's role to overcome any defensive structures that have been erected to impede movement of Friendly forces. This includes blocked passages, walls, any hardened buildings that the enemy may be hiding in, and disarming any traps that are identified before being sprung.

First, common Chezbah Defenses will be reviewed and then Kelrath Defenses. These are not the only defensive measures that the characters can encounter but are intended to give the Game Master a quick way to introduce enemy engineering techniques quickly.

The engineer should be given access to this information as it would be trained in how to overcome enemy defensive blockades.

Common Chezbah Defenses

The Chezbah have procedures on defending cities and other assets. They emphasize non-destructive fortifications, that is, fortifications that do not mar the structure of the hexes they are in. They will however disassemble some structures and then re-assemble them when done.

Chezbah Warrior Bunkers

Chezbah Civilians will transport powdered CCC to a location and then use local Hosent to build a domed structure three meters tall by 6 meters diameter. This structure is used as an outpost for camped Chezbah Warriors. In some instances a seldom attacked location may have conscripts instead of Warriors.

The structure has 10 closeable window slots designed to be fired out and a force field that can protect one quarter of the building.

Bunker stats

AR 50
HP 1000
Window Shield stats
AR 30
HP 70
Force Field
HP 300
Battery power for one hour

Effective Strategies:
Berm - Constructing a Berm in between friendly forces and the Chezbah bunker will give cover and allow friendly forces to use indirect fire weapons on the bunker in safety such as missiles, grenades, mortars and artillery.

Cut Communications – Although it may be guarded, the Hex mainframe should be disabled as quickly as possible to prevent the Chezbah from reporting back for reinforcements. Initial jamming can be done by Communications Officers, but it is the Engineer's role to disable the hex mainframe

Lookouts

Chezbah will set up an E-Suit lookout in an overhead air duct. This is often little more than a forward lookout position and the E-suit will rarely engage unless attacked. Most often the pilot will signal for re-enforcements.

Effective Strategies:
No Engineering Role - Since there is no structures that need to be overcome, simply being aware of this countermeasure and notifying Regular forces to be on the lookout is all that is required.

Hull Down Positions

The roads in Agri Hexes are actually built into the floor of the hex and dirt fills the basin that is in between the roads. As a result the roads make excellent barriers for hull down positions. A hull down position is a concealing position where only the top portion of a vehicle is visible. The vehicle can normally fire from this position but are under soft cover.

Effective Strategies:
Berm – In this type of hull down position, line of sight weapons such as lasers and Plasma are greatly hindered by barriers, while projectile artillery (Air Burst rounds) are able to fire over barriers and still hit their target. Berms are mounds of earth that form a barrier. It is important that the Berm is above grade and not simply a hull down position like the Chezbah defense. This elevation difference gives friendly forces hard cover while the Chezbah are in their hull down position.

See: Countermobility - Berms

Hound Holes

Hound Holes are a defensive measure where a large number of hounds are buried under dirt in a hibernating state. They remain hidden until enemy troops pass over them and then are signaled to attack the flank of the enemy. (5D10 Hounds in the hole)

Effective Strategies:
Ground Penetrating Radar/Sonar - The Engineer may be able to locate a Hound Hole with ground penetrating radar or sonar systems and alert regular forces to their existence.

Earth or CCC Barrier - The Engineer may aid regular forces by preventing the hounds from breaking out with a barrier of earth or CCC. In most cases a one meter layer of earth will effectively prevent the hounds from breaking out. This must be done quickly or the hounds will break out before the barrier is in place. A CCC barrier of only ten to fifteen (10-15) cm thick is effective in preventing the hounds from breaking out.

Artillery - Once located, a hound hole can be shelled with artillery killing the hounds before they break out. The shelling is partly absorbed by the dirt over and around the hounds and therefore requires that ten percent (10%) more damage (22 HP per hound) is done to kill the mass of hounds.

Buried Demolisher

On occasion the Chezbah have completely buried a demolisher as a forward operating base in enemy territory. Usually the Demolisher's role is to spy on the area and to attack only if discovered. The Demolisher takes fifteen seconds to a minute and a half to break out of the ground (1D6 turns)

Effective Strategies:
Ground Penetrating Radar/Sonar - The Engineer may be able to locate a buried

Demolisher with ground penetrating radar or sonar systems and alert regular forces to their existence. However this is subject to ECM rolls by the Demolisher's pilot

Shaped charges – If the Demolisher is located before it has emerged from the ground. Digging down only a few centimeters a shaped charge can be placed on the hull of the Demolisher.

Common Kelrath Defenses

The Kelrath are very interested in defensive positions. Most defenses are designed around defending against Chezbah attacks.

Towers

The Kelrath build heavy tower fortifications in the center of Argi Hexes. At the entry ways are large earth berms (mounds of earth that form a barrier) that block the view into the hex. The top of the tower has a mirror array and is just visible from over the top of the berm. The berm is ramped so that there is no place to hide when entering the hex. The mirror array allows the defenders in the tower to see with great magnification anything at the doors of the hex, it is also used to aim a laser emplacement at any targets coming in the doors. The bottom of the tower usually has between four (4) and ten (10) Rall4s defending it. The goal of the tower is to delay an invasion, not stop it. At first sight of an enemy the Rall4s will try and close the distance between the attackers and the tower, while the Laser strikes at anything entering the hex.

Power Supply: Electrical Power from Hex
AR 30
HP 10,000

Laser

	PB	S	Med	L	Ex
Damage	1,500	1,400	700	450	250
Range	Class E				
Rate of fire	1				
Fire Arc	1-8				

Effective Strategies:
Cut power to the hex

There is usually some kind of patrol along power and communication lines, but this is often easier to overcome than the full force at the tower. This strategy may be difficult to implement if the power lines lead away from your position.

Structural Recognition

Identifying potential weak spots in the tower (Structural Recognition roll) and directing regular forces to strike at the tower in these locations allow greater damage to be done (10% more).

Assault on the Tower

If an assault on the tower is successful it is the responsibility of the engineer to demolition the structure to prevent falling to enemy hands. If this is not possible due to time or material constraints, then disable the Laser and set booby traps as the opportunity presents itself.

Plugged Hex Passages

Wherever possible, the Kelrath will plug the entrances to hexes both in hex walls and service passages in the floor. This is done with huge amounts of soil and one meter diameter and smaller chunks of CCC. On occasion they will miss blocking an overhead passage because these are difficult and dangerous to collapse.

Industry and Agri hexes often have the vertical passages in the walls filled to prevent moving up and over defenses.

Cities and Towns especially will have two entrances on opposite sides and a secret exit for Rantaa' and Kaloord.

These plugs can be very difficult to clear, however Kelrath patrols may be light on either side of them if they are not expected to be breached. An engineering crew can burrow through them at a rate of 20 meters a day. The last 20 meters can be removed with explosives, but this will alert the enemy. This may be preferable if a patrol is likely to discover the breach, allowing for a surprise attack.

In key locations, the Kelrath will cap a plug on the inside with CCC. This can add considerable strength to the plug and resist an explosive charge. A smaller core should be taken prior to blasting to ensure that there is no cap. If there is a cap, then the entire plug must be removed and the cap can be removed mechanically, or by blasting.

Plug thickness
3D6x10 meters

Effective Strategies:
Tunneling

Tunneling through the plug is a slow and labor intensive task, but it is the primary method of defeating this countermeasure. Blasting will quickly alert the enemy and can

therefore only be used at the very end of the plug. One manhour of tunneling will yeald a passage 40cm deep. This is unskilled labor, but an engineer must make a structural recognition roll every 3 meters to prevent a dangerous collapse.

Scouting For Missed or Poorly Plugged Tunnels

Although not the responsibility of the Engineer it is often the fastest strategy to try and find a passage that has not been blocked. It may also be possible to check for a passage that does not have a thick plug, or light fill has been used. Determining the thickness and mobility from such a plug is the engineer's responsibility.

Casemate Lookout

A casemate is a fortified gun emplacement. The Kelrath burrow Casemates high into walls of Filtration Hexes and Power hexes there may be several on each wall of a hex, but there is usually minimal crew to work guns that are stationed at them. The crew will drive through tunnels bored in the walls on Zemot to move between emplacements.

Hitting these targets is difficult, they are small targets and under cover. In addition they are often a kilometer up the walls, putting them just out of range of Range Class C weapons.

Power Supply: Electrical Power from Hex

Laser

	PB	S	Med	L	Ex
Damage	750	700	450	225	110

Range Class E
Rate of fire 1
Fire Arc 1

Effective Strategies:

Cut power to the hex

There is usually some kind of patrol along power and communication lines, but this is often easier to overcome than the full force at the Casemate. This strategy may be difficult to implement if the power lines lead away from your position.

Locate the entry

Locating the entry for the crew will allow the Casemate to be stormed, but fighting can be difficult up the narrow passages because the Casemate crew has the advantage.

Flying insertion

Flying up to the Casemate is the most straightforward method of entry. This allows the engineer to enter and begin destroying the guns

Boobytraps

In some situations, the Kelrath will leave boobytraps in areas they are not able to patrol regularly. The preferred method of protecting these sites is to use Kerdi, but not all Rantaa' have access to them. These can often be extremely dangerous and if detected early, every possible caution should be taken to avoid triggering them.

A favorite tactic is the use of chemical weapon mines. These can be small devices, but most often are designed to trigger a large release in the center of a hex and block all passage through it.

Uniforms should be re-coated with nano-encapsulators and gas masks (See: Player's Handbook) and any openings should be properly sealed before any other action taken if such a device is discovered.

There are a large number of Booby traps that have been employed by the Kelrath, but they are not often very elaborate. In some cases weapons or parts from vehicles (most often Rall4s) are used to set up a kind of laser mine that triggers when a certain event occurs. In some cases the trap is disguised as wreckage from a battle. This can sometimes be noticed by evidence of the wreckage being moved to the location, or other inconsistencies.

Most smaller traps are located in the four large passages in hex walls. This makes it safer to use smaller passages in the walls when possible.

Explosive mines or traps are often containers of LCF with some kind of trigger. These are often crude and have a high misfire rate.

In some instances a fast boobytrap that Geetin sometimes set up is to flood a section of a hex and then put an electric current through it. This is often most effective against hounds and will slow footsoldiers until the water can be drained or the electricity cut.

Effective Strategies:

Disposal

In the case of a chemical weapon plasma or napalm should be used to destroy the mine. If a boobytrap is overtly obvious it may be a decoy or meant to trigger another trap when approached or disturbed.

Berms

Berms are mounds of earth that form a barrier. These are often employed to direct or restrict the movement of enemy troops and provide cover. Geetin often will create a mound of earth one (1) to three (3) meters tall around a city to protect them against attack. In addition the roads in and out of a city are most likely lined with berms to direct attackers in a straight line.

Some berms are reinforced with slabs of CCC.

A berm is not an impenetrable barrier. It serves two purposes, one to provide cover for troops, and two slowing enemy movement. A berm must be sufficiently steep that it is difficult for footsoldiers and land vehicles to drive over it to do so it must have an incline of over thirty degrees (30) and be over 1.3 meters high. Pilots driving their land vehicles over the berm must make a piloting roll -10 for every meter in hight over 1.3 meters. If the roll is failed they cannot get over the berm that turn.

Foot soldier's speed is cut in half while moving up the side of a Berm.

Effective Strategies:

If regular forces can establish a foothold in the hex, armored bulldozers (or C-Suits) can move the berm to provide cover for friendly forces.

Gates

At the entrances to a city there are usually heavy gates that are built into the Hex passages. These will sometimes be left open, but can be closed in less than two minutes (1D6 Turns). Passages that have a gate usually have a forward observation point built into the vertical shafts which are filled with dirt. Gates usually have firing ports in or around them to allow firing on the enemy.

Effective Strategies:

Explosive charges at the hinges of the gate can quickly defeat this countermeasure, but help from regular forces to suppress enemy fire is required to successfully plant explosives.

Magnetic Mines

The Kelrath make extensive use of magnetic mines to defend their cities and outposts. These are often placed in or near the doorway entering a hex. As the enemy enters the city, the magnetic mine reduces or eliminates the effectiveness of their shields.

Effective Strategies:

The Engineer can use a gauss meter to locate the mine and an explosive charge designed to penetrate the ground it is in can be used to destroy the mine.

Countermobility

In addition to aiding the mobility of friendly forces, it is also the Engineer's responsibility to impede the mobility of hostile forces. Some common methods are listed below.

Walls

Walls are everywhere in The Artifact, this makes the Engineers role much easier since with very little effort, a durable barrier can be imposed. Kelrath techniques may be the most well developed to this end and should be considered the model to follow when plugging Hex passages. However in most cases an Engineer will not have the resources to properly emulate the massive effort that the Kelrath employ to defend a city.

There are several stop gap measures that can be taken to impose a temporary barrier in short order. Traps are most effective when placed in hex passages as they virtually ensure the enemy passing within a fixed distance of the trap. When explosives are readily available, holes can be drilled to a depth of 90 cm every 5 meters (or every 25 square meters) and with a charge of explosives doing 200 points in each hole. At least 300 holes must be drilled to dislodge enough CCC to block a small hex wall passage.

Wire obstacles are fast and easy ways to block a passage from foot traffic. See: Player's Handbook - Razor Wire

It should also be noted that several of these measures can be used to prevent or control Seeter attacks on colonists.

Mines

Mines are the quickest method of slowing an enemy's advance. However passages between hexes are solid CCC and a good deal of effort is needed to bury the mines and camouflage them. The fastest method of cutting a hole large enough to bury a mine is with explosives, this is noisy and leaves the matter of camouflaging them. This requires an Explosives Skill roll to cut the hole, another Explosives Skill roll to lay the mine, and a Camouflage roll to cover them. Often a mound of loose dirt across a Hex wall passage may be mined making an effective deterrent. This naturally camouflages the mine's position since the whole plug is disturbed dirt and leaves no visual indicator of where the mines are placed.

Loose Dirt

Bulldozers can quickly create a large mound of dirt in the passageways of a hex while actually filling a passage like this is a major undertaking, creating a partial barrier that is mined can greatly slow enemy advancement.

See: Berms

CCC Plug

A large block of CCC can be cut out of the wall of a hex directly above a door so that it falls into the doorway. If time permits, earth can be heaped up behind the plug to reinforce it. This method can be done quickly but cutting the block correctly is crucial to it falling in place properly.

A CCC plug the size of an hex passage has the following attributes.
AR = 10
HP = 500 per cm in thickness

Wire Obstacle

Where there are enemy foot soldiers anticipated, a wire obstacle can be quickly put in place to slow their advance. This is often used in concert with mines. Wire obstacles are fences of razor wire, while most armor is effective protection from the wire, Armor becoming tangled in the wire will still slow enemy movement.

Enemy infantry attempting to move through a wire obstacle must make a successful Agility roll and one turn to overcome the wire obstacle.

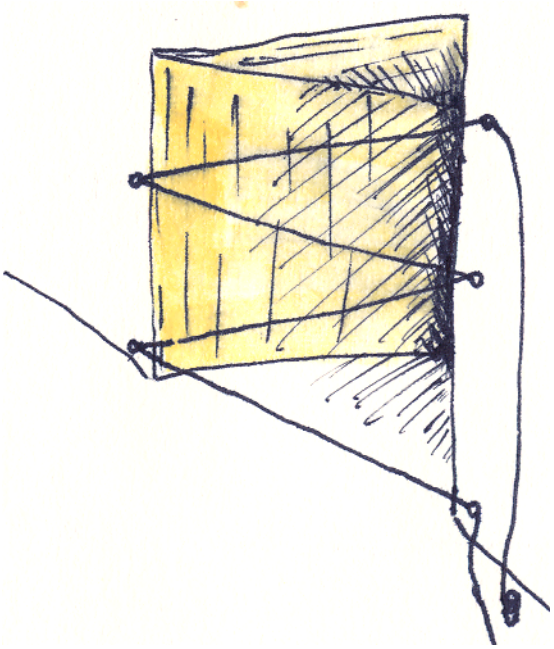
Several wire obstacles may be placed, one after the other. It takes one manhour to lay 50 meters of wire obstacle.

Flooding

Flooding an area of an Agri-hex even to a shallow depth of a few centimeters can slow forces considerably (3% per cm), especially e-suits that have a very small footprint compared to their mass. This is ineffective against flying vehicles.

Flooding can also be used to force E-Suits into the air and make them vulnerable to surface to air missiles.

Electric Wire Fence



The electrical power supply in the incremental cities makes any connected and uninsulated conductor an effective electrified fence. If the conductor is thick enough, it will be able to carry lethal charges and can even be used to disrupt vehicles.

Damage 25 per turn touching the fence, Armor is only 70% effective against the electrical attack and does critical damage to vehicles.

Traps

There are numerous kinds of traps that can be devised. There is a wide variety of effects that can be engineered but four basic concerns apply.

Durability – A trap that is easily removed by weapons fire will not cause much of a delay. However the more durable the trap is the more time it will take to put it together.
Speed of Construction – A trap that is easy to put together can be put together many times and provide redundancy.

Simplicity – A simple trap has less opportunity for failure, however simpler types of traps often require more brute strength to be effective.

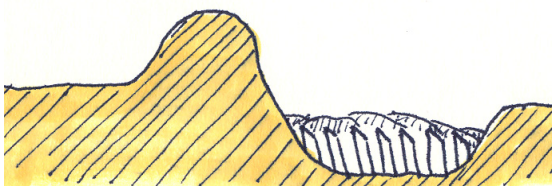
Strength – The amount of force that a trap can exert greatly defines what it can do, however a trap often becomes more complex or requires more materials as it is made stronger.

Using large external weights can have a strong psychological impact if the damage done is particularly severe. Therefore even a small number of devices can turn a larger force away if more traps are anticipated. Although these devices can be very simple mechanically, they generally require a large amount of energy to build.

Trap Components

Mechanical Force

Nearly all traps use some manner of mechanical force to work, this can be obtained in any number of ways but the most common are below. Notable exceptions to this would be traps that use energy weapons as the damage inflicting components.



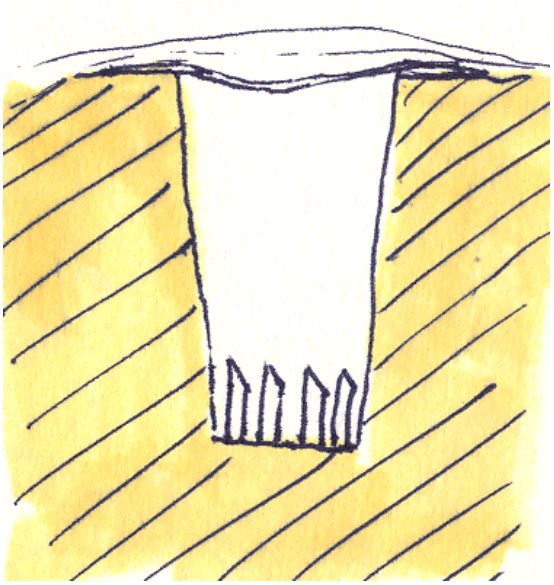
Weight

Either the weight of the target itself can be used to do damage or another heavy object can be used to do damage by falling. This falling energy can be used to generate motion, through simple machines like pulleys or levers and drive other components of the trap, or they can be used to do damage directly.

Using the weight of the target is usually good for a trap that resets itself, using an external weight is usually only good for single use traps. This kind of trap can be very useful for vehicles as the forces they generate are usually very large, but tend to become

jammed in a trap when disabled by them usually rendering the trap inert. These are most often the simplest traps to implement.

Using large external weights can have a large psychological impact if the damage done is particularly severe. Therefore only a few devices may be able to turn a force away if more traps are anticipated. While these traps can be very simple mechanically, they generally require a large amount of energy to build.



Damage from falling objects is complicated and is based on both the mass and the height the object is falling from. Increasing either variable (mass or height) will increase the damage done. However when dropping an object increasing the height makes the fall time greater and thus it is more difficult to accurately hit a target.

The table below shows the relationship between height, the time it takes an object to fall, and the speed of the falling object. The speeds shown are approximations. Damage is calculated by multiplying the mass in Kg of the falling object by the speed and then divide by 500 and round up to the nearest whole number. This applies to items dropped on a target and if the target falls.

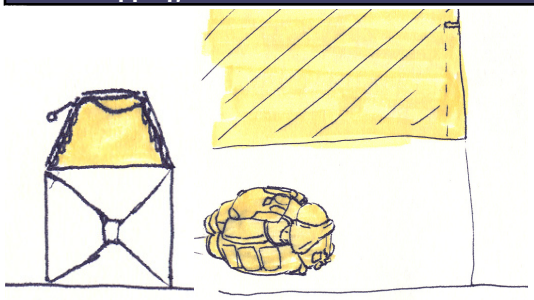
Meters to Fall	Fall Time in Seconds	Dodge Modifier	Speed Km/h
<5	<1	+0	35
5-20	1-2	+5	70
21-50	2-3	+10	115
51-75	3-4	+15	140
76-125	4-5	+20	180
126-175	5-6	+25	210

Spikes

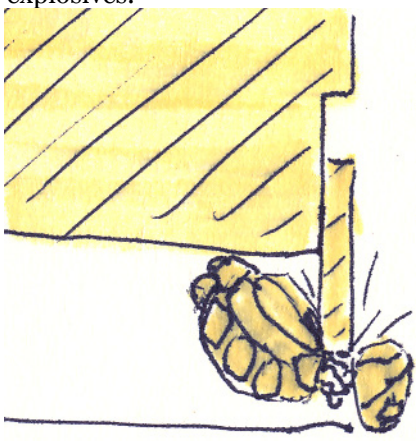
Spikes may be added to the bottom of a pit or on the striking side of a falling weight. Spikes will cause 1d10 points of damage or 15% more than the damage of the trap, whichever is greater.

It takes two (2) manhours to cover 1 square meter with spikes.

Block Dropping



Block Dropping is a Scimrahn technique where a large block of CCC is cut out over a door and then sheared off when an enemy is passing through. This traditionally took great skill to time correctly so that it struck the target, but with the addition of explosive charges to this technique, the timing can be done with a fair amount of accuracy. This technique is most often used against Chezbah Demolishers but works with any target. A successful Explosives skill roll must be made and one manhour to set the explosives.



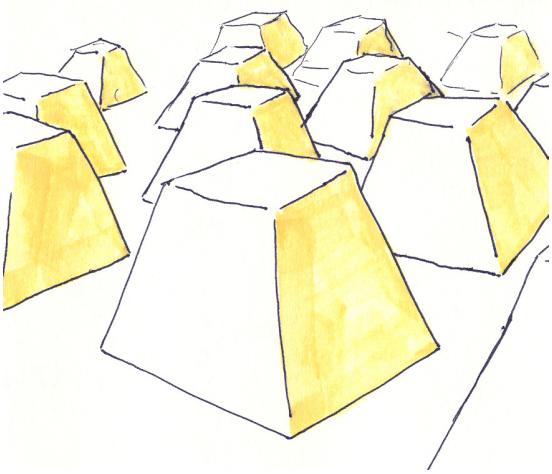
If a large Hex doorway is used then the block will be falling in the door for 76-125

meter fall. This means the block would be traveling at approximately 180 k/ph. To destroy a Demolisher it would take a damage of approximately 5000 hp. This would require a block with a mass of 13889 Kg. (180 k/ph x 13,889 Kg / 500 = 5000 HP)

Vehicle Impact Traps

This same rule applies to using a vehicle's own momentum to damage it. The mass multiplied by velocity of the vehicle divided by 500 can be inflicted by a properly engineered trap (roll Construction Vehicle Trap). When the trap is struck by a vehicle the trap takes damage equal to the damage inflicted on the vehicle once the trap is destroyed it can do no more damage. For Example: A trap consisting of a palisade of spikes has an armor rating of 40 and 10 Hit Points can only do a maximum of 50 damage before it is destroyed. Traps using this method are usually very simple and may be intentionally obvious. Examples include the Czech Hedgehog and Tiger Teeth antitank traps.

For vehicle impact traps it takes one manhour per ten AR of the material the trap is built from (this does not include material acquisition time) multiplied by every one hundred (100) Hit Points the trap has. Building these traps properly is skilled labor and everyone working on it must have Construction Vehicle Trap.



E-Suit Leg Snares

E-suits have a very high degree of maneuverability and can usually fly over obstacles that would block other vehicles. Leg snares consist of small traps that do relatively little damage (40-90 hp) but each one has the potential to do a critical hit and each stands a small chance of disabling a leg of the E-suit. Leg snares are vehicle impact traps and construction of them follows those rules, however the leg snares can also be designed to snag the E-suit's legs if the time taken to build them is doubled. The effect of this is that the pilot must make a piloting skill roll or the e-suit will fall. The pilot is unable to take action until a successful piloting roll is made.

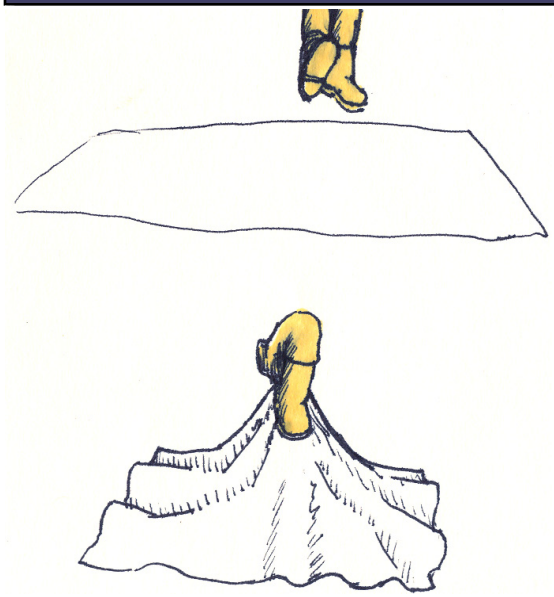
Springs

A spring is a way of storing mechanical force. A large number of traps for catching animals use springs to deliver energy. However with a few exceptions springs do not do well in storing large amounts of energy and therefore are usually only useful for man sized targets. Thin strips of CCC are flexible enough to anchor on one end and then bend acting as a spring.

With very few exceptions, spring based traps are single action traps.

Springs made from CCC can inflict a maximum 12 points of damage per spring, but using multiple springs makes the harder to build. A trap with one spring can be built in one man hour. For multiple springs, multiply the number of springs by itself and this is the number of man hours it takes to build. For Example: A trap with two springs takes four hours to build (2x2=4) and a trap with four springs takes sixteen hours to build (4x4=16).

Snares



A snare is any kind of trap that holds onto its target. This can be accomplished by entanglement, mechanical constriction, adhesives or mechanical vice. The snare must either be durable, threaten harm if disturbed or have a great deal of redundancy to be effective.

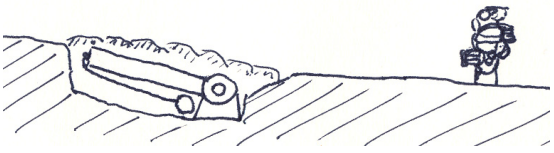
Entangling Snare traps usually use the targets own weight and a large redundant number of thin strands to slow enemy movement and possibly inflict damage. Examples of this type of trap are nets, barbed wire and concertina wire. Adhesive traps that stick to any body part it touched on a target is a variant of a net with an added adhesive.

The function of a snare is highly dependent on the materials used to build them but tend towards being complex to construct so building a Snare trap takes a Construction Man or Vehicle Trap and one manhour. The GM will have to determine if the player has sufficient materials to construct a snare trap and it's effect once the victim is snared.

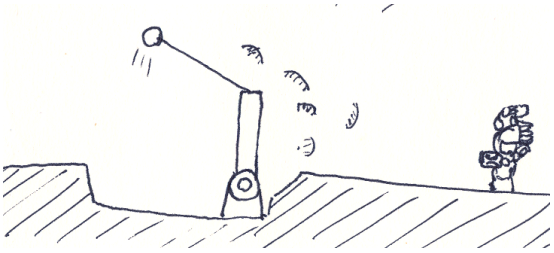
Heavy Glue

This is a method of slowing or disabling both ground forces and flying vehicles. It can be used in conjunction with other materials. Heavy Glue is a material that is made from mixing a thick black reactant agent with water. The Foam is filled with water and is therefore very heavy when applied in a thick coat and will slow ground movement and can ground flying vehicles. The reactant agent is a foaming fast drying glue that sets to a gel quickly when in contact with air. The Glue is pumped at high pressure out of nozzles or can fill a depression to a depth of several cm to meters deep.

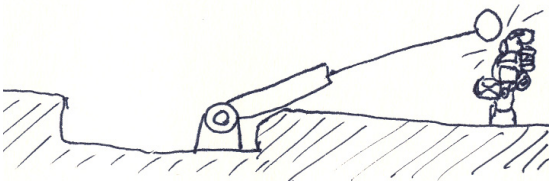
Powered



Using powered equipment can deliver very high forces and are usually able to be used more than once. This can be from hydraulic, pneumatic, electrical, combustion, heat, steam, plasma or chemically powered (explosive) and convert this energy either directly to damage or translate the energy to mechanical force.



Scimrahn tend to use electric motors in their traps either to spring them or more often, to retract them. The electric power may be supplied from hex power, but will almost always be backed up by a battery that can last through several actions.



See the section of this book on power generation for information on supplying power to the trap. For every one power point put into the trap, I can do 10 points of damage. The engineer must make a mechanical engineering roll to design the trap and if they roll under their 1/2, another 2 points can be done per power point. If they roll under their 1/4, another 3 points are done per energy point (not cumulative with previous bonus). If they roll under their 1/8, another 4 points are done per energy point (not cumulative with previous bonuses). It takes one hour to build a trap for every energy point the trap uses.

Planted Weapons

Weapons that self trigger are common on the battlefield. The most recognizable example of this is land mines. However the weapon that natives of the Artifact are used to is the laser.

Explosives

Explosives are the most common type of non-mechanical boobytrap. They can be tripped in any number of ways and can strike multiple targets with one device of low complexity. Explosive traps are single use traps.

Setting Explosives usually takes only a single turn per detonator and bomb pair.

Lasers

Lasers turned to extremely low power can be bounced back with a mirror to a detector near the laser itself. When the beam is broken, the laser increases the power and does damage. If the mirror is destroyed the laser fires until it has exhausted it's power supply or overheats.

Rigging a laser in this manner takes one manhour and an Electronics Repair skill roll.

Plasma Spray

Plasma is extraordinarily hard to move around so this type of trap is not very common, however it is as effective as explosive traps and if built properly can last through many uses.

Ducting plasma requires a tube of powerful magnetic material. Manufacturing the Ducts requires no exotic materials, but does require a great deal of time to construct. Every meter of duct from a plasma conduit takes 15 minutes to gather materials, 2 manhours to manufacture the parts with a Hosent and 30 minutes to assemble. It is often preferable to hide the plasma duct so laying the duct can take a very long time. This time is to be determined by the GM.

Magnetic Mines

The use of magnetic mines greatly increases the effectiveness of friendly fire on the enemy. Tanks have great range that keeps them outside of the radius of the mines. Footsoldiers can more effectively assault vehicular targets even while within the effect of the mines. It is recommended that while possible use magnetic mines when fighting in unshielded vehicles.

Burying a Magnetic Mine takes two manhours and if it is to remain hidden, a camouflage skill roll is required.

Hazardous Ordinance Disposal

The Engineer has the responsibility to detonate any unexploded ordinance and disposal of enemy stockpiles that are hazardous such as plasma devices and fuel. This is especially important when there is not enough time to remove the equipment from the site. There are instances where it may be important to keep an enemy's fighting capabilities intact if the collapse of a local power is holding back another. The commanding officer has the responsibility to identify if enemy ordinance should be destroyed or if it should remain.

Disposing of Plasma Weapons

Plasma weapons require caution when being disposed of because sudden release of plasma is hazardous and all personnel should maintain a proper distance (approximately 10m) during demolition.

Disposing of Fuel Stores

Due to the explosive nature of LCF, destroying stockpiles of the fuel is extremely dangerous. The blast radius is usually much larger than plasma (30-200 meters). Safely destroying these stocks requires an Explosives Disposal Skill roll.

Disposing of Laser Weapons

Although most lasers are electron excitement lasers, some Kelrath emplacement lasers are chemical lasers and can contain hazardous chemicals that must be taken into consideration during demolition so as not to put friendly forces in harm's way. To further complicate this, many larger laser systems use chemical coolants that may be mistaken as those found in a chemical laser. Even these coolants can be hazardous if not handled properly but are not as hazardous as the media in a chemical laser. An Electronics Engineering roll can determine the nature of the Laser or any chemicals present can be identified by a Chemistry Skill roll.

Disposing of Battery Stores

Like lasers Batteries can contain caustic materials, these are sometimes used by Kelrath and Scimrahn but almost never by Chezbah. Any chemicals present can be identified by a Chemistry Skill roll. The batteries containing hazardous chemicals are usually used in vehicles and some generators. It is rare that they are stockpiled in any significant quantities to pose a large demolition hazard. Chezbah use lithium ion batteries that pose no significant health hazard to troops disposing of them.

Disposing of Chemical or Biological Weapons

Chemical and biological weapons may be disposed of by means of incineration. This is often done with napalm, LCF, alcohol, or petroleum fuels. Alkali or oxidants can be alternatively be used to break down the chemical or biological agents. These may not negate the toxicity of a chemical agent, but often reduce the toxicity. Examples of Alkali that can be used is sodium hydroxide, potassium hydroxide, or calcium carbonate. Oxidizers such as nitric acid are also effective, successfully neutralizing biochem weapons with acids requires an acid skill roll.

Disposing of Nanotech Weapons

Nanotech weapons have never been reported to be used directly against earth forces so there are no proven methods for disabling or countering this type of attack. However, from examinations of other Chezbah nanotech, Plasma and very strong oxidizers (strong acids) can damage the molecular structures and most likely will render them inert. Indeed Kelrath reports indicate that plasma will either damage the nanotech, or make it enter a dormant phase. The fact that these reports only report a partial reduction in effectiveness is troubling. It may be that the Nanotech weapon used by the Chezbah replicates and if any is left it will grow back to cover an area.

Defense

Maximizing survivability of troops is one of the oldest roles for a military engineer. By building fortifications and controlling the available paths to those structures, the engineer can hold off an enemy much longer than would otherwise be possible.

Elevation

Elevation is an important advantage to any force, it allows increased line of sight and impedes the enemy's ground movement. However, in most cases the manufactured environment underground provides very little opportunity for this but earth mounds and tunnels into walls can provide elevation advantage.

Grade

Grade is the slope of a surface. In terms of defensive structures, Grade is usually used slow enemy approach by making enemy forces move up hill. This is usually accomplished with bermed Earth. Another use for a grade is to deflect fire and make penetration resistant walls.

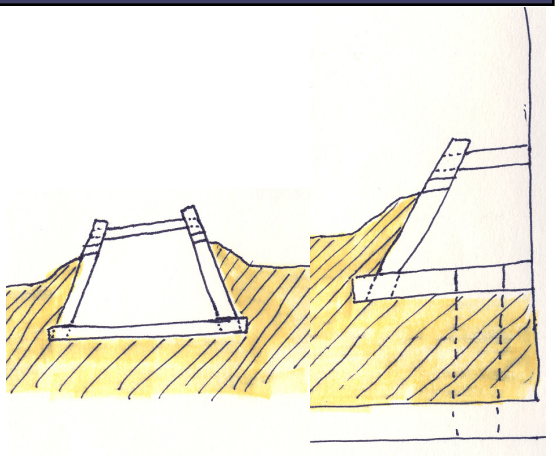
While moving up a grade the percent of the grade equals the percent that movement is slowed. Use of ropes will reduce this effect by 20% plus any climbing skill the character has.

When Earth is used to reinforce a wall, the Hit Points of the dirt is added to the wall. This is 10 HP for every 10 cm of Earth that is built up over the wall.

Channeling Enemy Approach

Controlling enemy movement is an important strategy for conserving resources. It allows the most effective use of mines and traps and greatly improves the defensive ability of small force. Channeling forces can be done through a wide variety of methods. Water can be an effective impediment to the movement of foot soldiers if it is at least 20 cm deep. Earthworks can also be used to control enemy movement. Anti-Grav vehicles can be very difficult to channel unless a confined passage is used.

Bunkers



Bunkers are defensive structures that are mostly below ground. Bunkers can be part of a trench system. They provide extra cover from aerial attacks. Forward bunkers are usually used as a machine gun or mortar emplacement. Rear position bunkers are used for command posts, storage and as field hospitals. While Hex tunnels can be used for a bunker with two ends plugged by pouring soil into them, this provides another avenue for attack that may be difficult to monitor since there is little opportunity to observe the bunker from an external location such as a scout post. Smaller bunkers can be

constructed with slabs of CCC to form the floor, walls and a thick slab for the roof and then partially burying the structure.

See: Building - CCC

Earthworks

Earthworks are any structure formed from massive quantities of soil or unformed stone (alternatively CCC rubble). On an alien world the use of this term may be questionable (there is no "Earth" in the work) but there is little need to coin a new word. Modern defensive earthworks are primarily trenches and berms. While soil is not particularly strong, in large quantities it can form a significant barrier to enemy attacks.

Vehicles such as a bulldozer or C-Suit for moving soil greatly reduce the time it takes to create such a structure, but in the history of military engineering the majority of this work fell to the foot soldier and in the absence of earth moving equipment, this method should not be forgotten.

There are two factors in moving soil. One is the volume of soil in cubic meters, the other is the distance that the soil is to be moved to its new location. It takes one Manhour to move one cubic meter of soil one meter using only shovels. Doubling the distance doubles the time unless devices such as wheelbarrows reduce the time that it takes to move the soil.

Trench

A trench is an excavation that creates a condition of hard cover for friendly troops along a line. A trench has an advantage over a berm in that it is very difficult to penetrate the barrier between enemy fire and friendly forces. However there is no elevation advantage to such a structure.

All objects in a trench are under hard cover.

It takes 3 manhours of unskilled labor for every meter of trench.

Caponier

A Caponier is a structure such as a bunker built into a trench system that is designed to fire down the trench. Usually the trench is built so that it is relatively easy to advance into, but more difficult to exit. Lasers are particularly useful in this role because when the Caponier is camouflaged the weapon may be difficult to notice.

Moat

Trenches can be flooded to turn it into a moat. In medieval times the moat would be filled with sewage to deter anyone swimming across. Petroleum fuel can be poured into a moat and then set on fire to deter anyone from crossing.

It takes 7 manhours of unskilled labor for every meter of moat.

Berm

Berms are mounds of earth that form a barrier. These are often employed to direct or restrict the movement of enemy troops and provide cover.

Berms can be reinforced with slabs of CCC.

A berm is not an impenetrable barrier. It serves two purposes, one to provide cover for troops, and two slowing enemy movement. A berm must be sufficiently steep that it is difficult for footsoldiers and land vehicles to drive over it to do so it must have an incline of over thirty degrees (30) and be over 1.3 meters high. Pilots driving their land vehicles over the berm must make a piloting roll -10 for every meter in hight over 1.3 meters. If the

roll is failed they cannot get over the berm that turn.

Foot soldier's speed is cut in half while moving up the side of a Berm.
It takes 3 man hours for every one meter of berm that is 1 meter tall. A 2 meter tall berm takes 9 manhours per meter long, and a 3 meter tall Berm takes 27 manhours per meter long. A 4 meter tall berm takes 81 manhours per meter of length. For example a berm 2 meters high and 80 meters long takes 720 manhours to build.

Foxholes

A foxhole is a defensive position that can be quickly constructed. The term refers to a range of structures from a mildly protective lean-to to a system of tunnels and structures that are part of the firing line. The term refers to any structure or hole that a soldier can take cover in.

A fox hole takes one manhour to construct and provides soft cover. Working another two manhours gives hard cover.

Turret Down and Hull Down Cover

These positions provide either soft or hard cover to vehicles. Hull down means that the vehicle can fire from its position behind cover giving soft cover, while Turret down means view of the vehicle is completely obstructed.

Casemates and Lookouts

A casemate is an armored gun position. On The Artifact this usually refers to a heavy or grenade machine gun position burrowed into a wall of a hex. Grenade machine guns can also be used from overhead air or water access tubes, but takes skill to hit a target (-80 to hit.). Suppressive fire can be maintained if enemy movement is accurately reported 10% chance of hitting targets on the outside of a formation (roll for each target normal dodge rules apply).

Demolition

Demolition of old structures and removal of enemy structures is the responsibility of the Engineer. Most CCC structures are simple in their construction, using slabs to form the walls floor and ceiling. Only very large military buildings over three stories tall are frequently built of more than one slab per wall. These structures are very durable from the outside and can withstand an enormous amount of plasma and laser fire, but do less well against explosive bombardment if they are not reinforced or hardened against such attacks. Demolition of old CCC structures is different from demolishing concrete and steel, but small kicker charges positioned to push out the walls of a structure from the inside will usually flatten the structure. Demolition of hardened CCC structures is a difficult process that has yet to be fully perfected by Earth forces.

Cutting Charges

Most explosive charges give a "kick" when they explode. These are useful in flinging materials away or out of a structure. However some structures that are reinforced are tied together so that these kicker charges do not dislodge structural members. More explosives may eventually dislodge them but cutting the material that is tying the structural members together is preferable. In some cases this can be done with bolt cutters or even particle beam cutters but this may cause a structure to fail with people inside. In most cases it is better to cut them with fast burning explosives. These cutting explosives have a very small and hot blast which cuts reinforcing ties and then using kicker charges a split second later can quickly topple most structures.

Cutting charges are usually in the form of cord that can be wrapped around the object to be cut.

Roll for Structural Recognition Skill

Full	1/2	1/4	1/8
10%	20%	30%	50%

The percent shown is what percent of the structures HP can be negated by using the cutting charges. A successful Explosives skill roll is then required to set the cutting charge and then another Explosives skill roll is required for the kicker charge.

Local Sources

Explosives may not be readily available in needed quantities. In these situations the Engineer should try and supplement their supply with locally available materials. The main source of which is LCF fuel which may be stored near vehicles.

If LCF is not available and time permits, manufacture of explosives may be possible with locally available materials. These will most likely be low grade but can still be effective.

Material Gathering

A chemistry roll is required to formulate and manufacture an explosive mixture. The fraction column rolled is referenced.

Complexity Modifier

Full	1/2	1/4	1/8
x4	x3	x2	x1

The base time required to gather materials is one hour per three (3) HPs that the explosive will do. Now multiply that time by the Complexity Modifier. For example: To gather materials for 300 points worth of explosives a character rolls for their chemistry skill. They roll under their full column. The base time for gathering materials for explosives doing 300 points of damage is 100 hours (300/3=100) now multiply that by 4 resulting in 400 hours. An explosives skill roll is required to package the explosive for use.

This work can be done by unskilled labor other than vehicles as long as the laborers are shown what to look for.

Shaped Charges

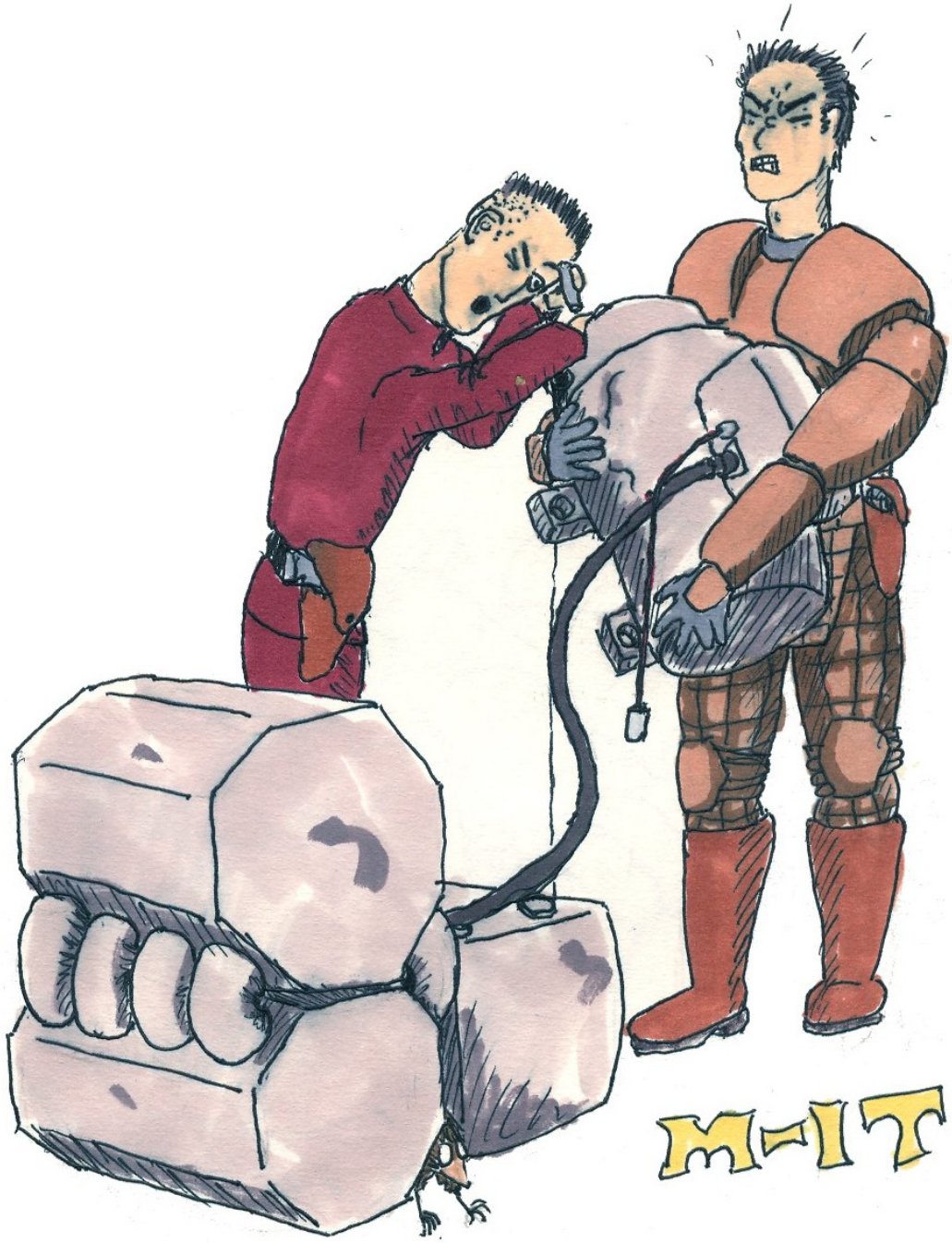
Some explosives can be shaped into a cone or wrapped around a copper core with one exposed side to concentrate more blast energy in one direction. This can also be accomplished by piling sandbags or dirt on the charge and one side being open to the target.

Shaping an explosive increases the damage in one direction by 25% and reduces the blast range class in other directions by one letter. For example, B becomes A. If the range class is A already, the explosive is entirely directed in one direction.

Maintenance

Vehicles require regular maintenance or they suffer from decreased performance and given enough time, can suffer catastrophic failure. In addition vehicles that are damaged in battle require repair. For general information on vehicle repair, see the end of the Vehicles section of The Artifact RPG.

To repair the basic function or maintain a vehicle takes a Repair Machinery skill. The Engineer must also have the parts that must be replaced and time to affect the repairs or the repair will only work for a short time. An assistant can cut the time that it takes to effect repairs down 25%. Individual systems can be repaired by separate crews at the same time.



Field Repairs

When in the field with no supply chain, spare parts are not always available. Every effort should be made to scavenge parts from disabled vehicles so there will be parts when needed. Tanks that have had their weapons damaged make good platforms for carrying large pieces of equipment once their turret and weapons are removed.

Even when taking these precautions it is possible to run out of vital parts. In these circumstances it may be possible to rig a vehicle so that it can be used for a little while longer. The engineer must make a successful Repair Machinery roll with a -30 CDF. The fraction column is then checked against the table below.

Full	1/2	1/4	1/8
1 hour	4 hours	16 hours	64 hours

This is the time that the vehicle can operate with the rigged repair. There is a 20% chance that the vehicle will not be able to be repaired again until proper parts are acquired.

Field Enhancements

In some circumstances it may be necessary to disable safety limits on vehicles and equipment to get temporary boosts in performance. This will often do damage to the vehicle or equipment and the gains may be meager.

Speed

The overall speed that a vehicle can travel can be increased at the expense of greatly reduced fuel supply and the possibility of engine or drive system failure.

The character must make a roll vs. repair machinery. The Fraction Column rolled under should be noted, because the increase in speed is calculated by the Column.

Fraction Column

Full	1/2	1/4	1/8
10	20	30	40

Multiply the vehicle's speed by the number in the appropriate column. Divide by one hundred (100), and then add the resulting number to the top speed of the vehicle.

The fuel capacity is decreased by multiplying the same column number used for speed by the total fuel capacity and then dividing by 75. Then the resulting number is subtracted from the fuel capacity.

In addition there is a chance of system failure. The character must make a second Repair Machinery roll. This is how often a roll on the system failure chart is made.

Fraction Column

Fail	Full	1/2	1/4	1/8
1 turn	4 turns	10 turns	40 turns	90 turns

System failure chart

Roll 1D100

1-20	No Failure
21-40	Engine damage, speed half original.
41-60	Drive damage, speed half original.
61-80	Engine failure, 2d10 hours to repair
81-100	Drive failure, 1d10 hours to repair

It takes one turn per 200 Kg of vehicle mass to increase the vehicle speed.

Shields

The shields on a vehicle can be boosted slightly but uses much more power.

The character must make a roll vs. Repair Electrical. The Fraction Column rolled under should be noted, because the increase in shield capacity is calculated by the Column.

Fraction Column

Full	1/2	1/4	1/8
5	15	20	25

Multiply the shield output by the number in the appropriate column. Divide by one hundred (100), and then add the resulting number to the top speed of the vehicle.

The fuel capacity is decreased by multiplying the same column number used for speed by the total fuel capacity and then dividing by 100. Then the resulting number is subtracted from the fuel capacity.

In addition there is a chance of system failure. The character must make a second Repair Machinery roll. This is how often a roll on the system failure chart is made.

Fraction Column

Fail	Full	1/2	1/4	1/8
1 turn	2 turns	4 turns	10 turns	20 turns

System failure chart
Roll 1D100
1-20 No Failure
21-50 Shield damage, output half original.
51-100 Shield failure, 2d6 hours to repair

It takes one turn per 50 HP of shield to increase the shield output.

Weapons

A weapon's damage may be increased but makes it likely that the weapon will fail.

The character must make a roll vs. repair artillery. The Fraction Column rolled under should be noted, because the increase in damage is calculated by the Column.

Fraction Column

Full	1/2	1/4	1/8
20	50	100	150

Multiply the weapon's damage by the number in the appropriate column. Divide by one hundred (100), and then add the resulting number to the damage of the weapon.

There is a high chance of system failure. The character must make a second Repair Artillery roll. This is how often a roll on the system failure chart is made.

Fraction Column

Fail	Full	1/2	1/4	1/8
Before Firing	After Firing	After 2 Firings	After 5 Firings	After 10 Firings

System failure chart
Roll 1D100
1-10 No Failure
11-30 Weapon will not fire.
31-60 Small explosion, 1/10th of weapon damage at 10 meters
61-100 Large explosion equal to system damage.

It takes one turn per 50 HP of weapon damage to increase the weapon's output.

Building

In building anything, there are two basic considerations, materials that are available and the time it takes to use those materials. The tools to build are available by employing active Hosent or disassembling Hosent.

Manufacturing

On The Artifact manufacturing is not something that only large organizations can do. Hosent lay idle everywhere and these enable anyone to procure raw materials and have nearly anything that is desired built in a matter of days or even hours. The astounding thing is, that in such abundance is that few have the engineering skills necessary to design complex systems. In a Scimrahn industry tribe, there are only handfuls that understand the design of the equipment they manufacture.

Hosent build primarily by using powdered CCC and reconstituting it. At first the CCC must be broken down by hand and then one or more Hosent will be employed to build grinding machines and crushers to pulverize blocks of CCC. This pulverized CCC is called “Meagieken” loosely translated as “stone for making”. A second stage of sifting the carbon from the ceramic is then done by the Hosent and an electron pump breaks down the carbon nanotubes into slurry. From this slurry, the Hosent has five arms that have piezo nozzles that spray layers of ceramic until a form or mold is formed for the desired part. Then layer after layer of carbon and ceramic is laid down by the piezo nozzles in a method similar to a 3D fast prototyping device that creates a three dimensional object by laying down thin layers of material over and over. Once the basic form is laid down, the ceramic mold is broken down again and the material re-used.

In a similar manner, electronic circuit boards are sprayed in place. Thin metal wiring and films are also sprayed in place, but for larger metal parts, the Hosent builds a mold and then uses an arc furnace to melt the metal into the mold.

While most parts or tools can be made out of CCC, usually a small amount of metal is required to build electronic components. This metal can be difficult to acquire unless it is scavenged. Any device that requires large amounts of metal will require a great amount of effort and resources as the prime source of metal is the methane wastes or the core. Small quantities of heavy metals and rare elements can be found in the Filtration Hexes from millennia of extracting them from air and water.

In essence the three elements of building on The Artifact are manpower to get materials to the Hosent, Time for the Hosent to build, and engineering skill to design.

Build Time

Besides the materials to build, the other factor in building is the time it takes to recycle the materials and re-assemble them as the desired form.

Material complexity:

The material complexity of a design heavily influences the time it takes to acquire materials. An engineer may have difficulty building a device using readily available materials, the better the engineering roll the easier it is to acquire materials.

Full	1/2	1/4	1/8
x16	x4	x2	x1

device mass / 15 x 1 min x engineering modifier

Raw Materials to Parts:

This is the time it takes the Hosent to use the raw materials and build the parts.

Full	1/2	1/4	1/8
x4	x3	x2	x1

device mass x 2 min x engineering modifier

Parts Assembly:

This is the time it takes to assemble all the parts. For items that can fit through the Hosent's door assembly is left to the Hosent. For projects larger than the Hosent's door sub-assemblies are made by the Hosent and then must be completed by hand.

Full	1/2	1/4	1/8
x4	x3	x2	x1

device mass / 10 x 1 min x engineering modifier

Design

The design of any item being built can effect the function of it. For every thirty manhours spent on design an Engineering Skill roll can be made to improve one of the systems performance.

Energy Efficiency Engineering Roll

Full	1/2	1/4	1/8
x.99	x.95	x.90	x0.85

This reduces the energy that a device requires to operate because it is being made more efficient.

Mass Engineering Roll

Full	1/2	1/4	1/8
x.99	x.98	x.97	x0.95

This roll represents efforts to reduce the total material in a device or substitute materials that are lighter where possible.

Materials

The biggest perceived limits to construction on The Artifact, is replacing familiar materials with native materials. The major construction materials are listed below.

Cement

Cement is a manufactured material made from calcium, silicon, aluminum and iron. On earth the calcium is derived from crushed limestone, which is not readily available on The Artifact except at the core, which is difficult to get to. However there are ways of extracting calcium from soil, but this requires processing a large quantity of earth or extracting it from water which usually does not produce significant amounts. Another possibility is locating an emptied reservoir, which can have several inches of mineral build up in the bottom of the hex resulting in hundreds of tons of calcium.

Cement is produced in limited quantities by earth forces in hidden locations for use by engineers. It is most often used as mortar for cementing rubble together to build structures.

In some instances the engineer may be asked to set up a cement producing facility. This is an enormous undertaking and requires a large investment of manpower. The process for doing so is roughly as follows.

1. A quantity of raw materials must be secured either by trade or by locating local sources. It is usually best to locate local sources as there is a significant overhead to transporting materials over long distances. Portland cement ingredients are as follows. The most problematic of which is aluminum which is also not readily available to Scimrahn and is therefore used in the lowest workable percentage.
60% to 67% Calcium
17% to 25% Silicon (from soil)
3% to 8% Aluminum
up to 6% Iron

This means, to produce 1,000 kilograms of concrete mortar (of which cement is only 12%) 120 kilograms of cement is needed. However 40% percent of the raw materials are lost in producing the cement. This means that to make 120 kilograms of cement, 200 kilograms of raw material are needed.
2. A fuel must be secured for heating the Kiln. Plasma from a conduit is often the best option, but methane, or hydrogen and oxygen using electrolysis with the electricity supplied from a Power Hex are also feasible but require more infrastructure.
3. A barrel type, rotating kiln must be constructed and mounted on a slant. In some cases, a plasma conduit is the ideal housing for this. The CCC in the Plasma conduit has a melting temperature of 3300°C degrees and the Kiln only needs to reach 1500°C so no further refractory is needed.
4. The raw materials are ground up. The grinding mechanism can be of any type, but Hosent grinders like those used for grinding CCC are acceptable. Instruction on how these are constructed is best learned from a Scimrahn industry tribe or from another engineer that has established such an operation before. Otherwise using CCC to build a wheel and table mill is the best alternative.
5. Raw materials are introduced to the kiln, their passage through the Kiln is controlled by the rotation and slope of the kiln. The material that exits the lower end of the kiln (called clinker) must be slowly cooled to a temperature that will allow it to be ground again to a fine powder. If Gypsum is available from a local source, this can be ground in at 2% of mass with the cement to enhance workability.

Mud Brick

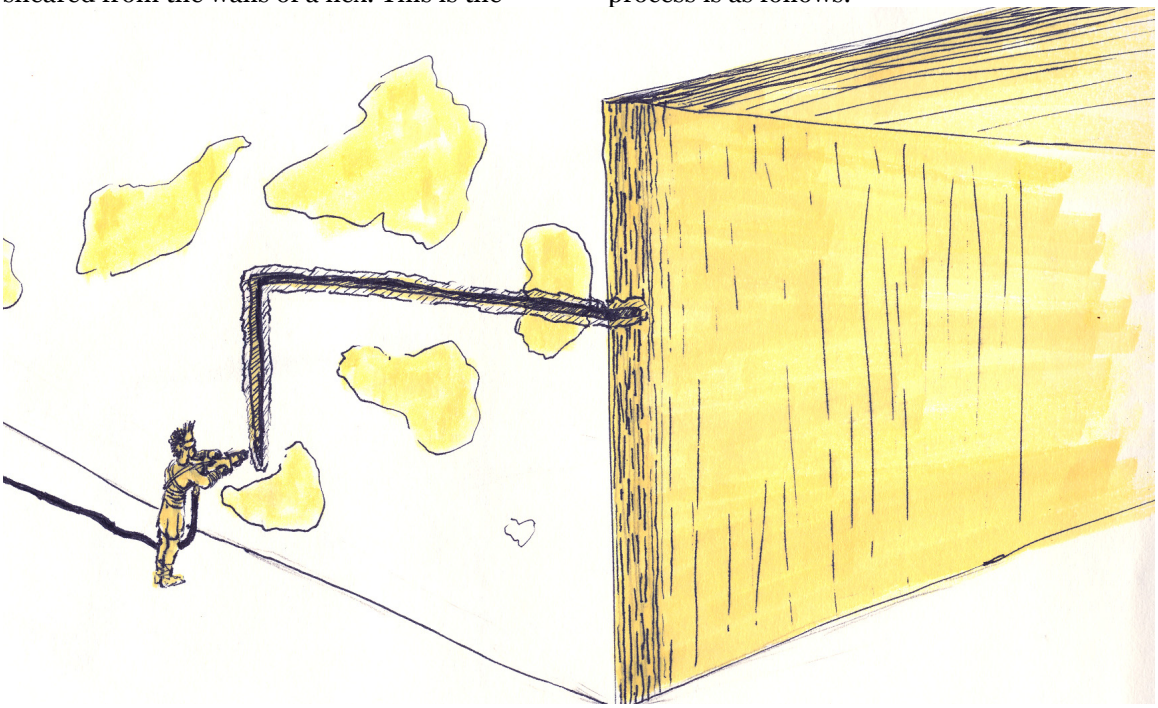
As an alternative to concrete construction, mud brick can be used to build structures, but has poor resistance to explosives and impact. Adding sloped earth can increase the explosive resistance of these structures. This is not often a serious consideration when defending against Plasma and Laser attacks but E-Suits can do significant damage by punching the structure. The roof of a structure cannot easily be made from mud brick and will not withstand vehicular impact attacks such as E-Suit punches. Some kind of mortar is needed to hold the bricks together.

CCC

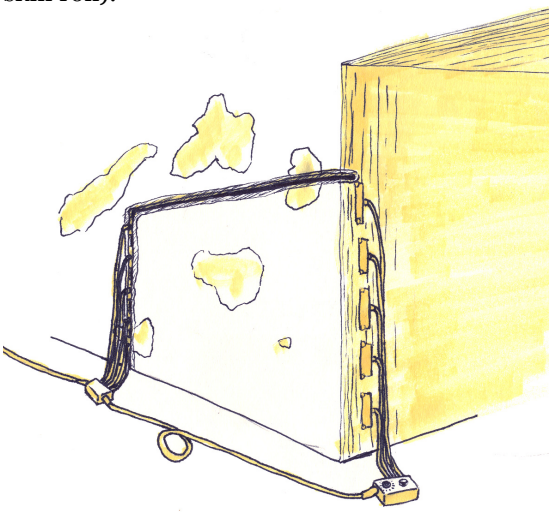
Carbon Ceramic Composite is a difficult material to get used to working with. It does have a number of traits that make it a useful structural material but because it has a grain to it and is very hard, it can also behave in unexpected ways. This has made many engineers reluctant to use it. In addition it has electrical properties that can in some instances have detrimental effects to radio and radar if these effects are not anticipated and designed around.

All this said, It is the most plentiful structural material on The Artifact, followed by the Carbon Foam in the structural

members. Bunkers are easily made from Slabs sheared from the walls of a hex. This is the most common method of harvesting CCC. The process is as follows.



1. A particle cutter is used to etch a groove several inches deep into a hex wall in the desired dimensions of the slab. The cutting is unskilled labor and takes 1 manhour for every 6 meters of cut 1 cm thick or 1 meters of cut for 6 cm deep.
2. If the CCC is to be used directly in bunker construction, the Slab is braced so that it will not fall to the ground once removed. This is to prevent accidental cracking. If it is to be broken up and re used for manufacturing, this step is not required.
3. The Slab is then sheered from the hex wall. Several methods are effective in doing this quickly. The Scimrahn and Kelrath use a device that pulses electrical current through a layer of carbon thereby heating it. It then cools and the process is repeated. The cycle causes the ceramic layer to loose strength and the slab sheers off. This process takes 30 seconds to an hour dependent on the size of the slab (30 sec per square meter 1020 square meters max). Earth forces have introduced drilling small holes behind the slab and using a string of small explosive charges to quickly remove the slab (this requires an explosives skill roll).



Cloth

Cloth is useful for tarps and light structures while not a structural material, it can provide protection from the weather and can be useful in building non-essential structures and camouflage. Cloth can be labor intensive to produce and the skill required to turn a plant like Giant Fern into fabric is non-trivial so it is advisable that cloth is obtained from Scimrahn supplies (this would be the responsibility of a purchasing officer or the commanding officer).

Dirt

Dirt is readily available in Agricultural Hexes and although is not ideal as a primary building material in all instances, it can serve as an effective barrier. A bulldozer or other

earth moving equipment like correctly equipped E-suits or C-suits can quickly move enough earth to be a protective barrier. Dirt is especially effective against lasers and plasma weapons due to it's high melting temperature. Some engineers have pioneered wetting down the front edge of a barrier to further absorb energy from these types of attacks, however this technique can have it's drawbacks. If a significant amount of energy is directed at a single point, the water rapidly heats and in turning to steam, can cause the barrier to explode.

Metal

Metal is a valuable material on The Artifact and not many know how to work with it. Steel was nearly unknown before the arrival of earth forces. Raw iron is the most common metal available to the Scimrahn followed by nickel. This results in the Scimrahn using nickel in many electronic circuits. Nickel is less than ideal for these purposes, but is serviceable.

Other metals such as copper, can be obtained but in very limited quantities through trading with the Kelrath through a Freetrader.

Plastic

The Scimrahn produce plastics in very limited quantities for batteries and a handful of other applications. Earth forces have been assisting them in producing plastic for other applications but distributing the information has been slow.

Structures

Engineers will frequently be called on to construct shelters for various purposes. The main considerations are how large and how durable does the structure need to be. The need in durability can range anywhere from needing temporary protection from chilled air to withstanding enemy bombardment. Size can range between sheltering just a few men to hangers for multiple vehicles.

Structure Location

It is generally preferable to build inside a structurally sound hex doorway as this provides a physical shelter and blocks approach in all but two directions. If manpower is low, then a small doorway should be chosen and both entrances should be monitored. If manpower is abundant then building in a large hex doorway may be an option as it provides additional evacuation avenues. All evacuation routes should be monitored.

Building deep inside the doorways is preferable if heavy firepower is available as it limits the angle that enemies can attack from. If heavy firepower is not available building near one of the ends of the doorway is preferable as it makes evacuation quicker.

In some situations it may be necessary to build protective structures other than in a doorway for use in monitoring an area.

Structure Size

The Engineer must determine how large the structure will need to be. When considering this, the use of the building is of primary importance. If a structure is only for temporary shelter, it can be far smaller than if it is for long term use or if people will need to work inside it.

For temporary shelter only, multiply the number of people housed by two (2). This is the Area in square meters the building needs to cover.

For longer term shelter or if people will work in the shelter, multiply the number of people that will use the structure by eleven (11). This is the Area in square meters the building needs to cover.

For vehicle storage multiply the length of the vehicle by the width of the vehicle multiplied by two (2) multiplied by the number of vehicles. This gives room to maneuver and for maintenance.

In almost all instances, structures that an Engineer will be called on to construct will be of single story construction as there is ample space available. The hight of the roof will need to be determined. If the structure is housing only people a roof hight near 230 cm (2.3 m) is adequate. If the structure is housing equipment or vehicles then a minimum of 50 cm (.5 m) should be added to the largest vehicle hight.

Add all the Area numbers together. This gives the total Area of the building. This number will be used to build the roof.

Multiply the Area of the building by it's hight. This gives the total Volume of the building. This number will be used to build the walls.

Selecting a Building Material

Some Materials work well for walls but are less suited for making roofs from. Examples of these are dirt and brick. If construction is to only consist of walls then these materials are fine, otherwise several building materials will be needed.

The Hit Points of a structure are based on the mass of the structure. If the Engineer wants to build a sturdier structure, they can add mass to the structure to add hit points.

Fabric

For temporary shelter until more permanent structures can be built fabric tents are the best option available to the engineer. Some kind of tent poles will be needed in most tent construction.

Fabric for tent making is usually available from any base with a teleporter. It is not normally practical to make fabric in the field.

Fabric structures offer next to no protection from attack, but they can be protected by walls of sandbags.

Walls
Mass = Structure Volume x 2

Roof
Mass = Structure Area x 1

Construction Time
Manhours = Mass / 8
Armor Rating: 0
Hit Points = Mass / 15

Dirt

Dirt or soil offers a fast and abundant resource for making protective walls. Construction can be done with unskilled labor.

Sandbags can be used to make walls of dirt. The bags can be loosely stacked or they can be sewn together with wire. Otherwise bermed dirt can be effective walls.

Another advantage to dirt construction is that there is nearly no material collection time as it is readily available in large quantities.

Walls
Mass = Structure Volume x 720

Construction Time
Manhours = Mass / 800
Armor Rating: 1
Hit Points = Mass / 15

Concrete

Although not readily available, concrete construction is desirable when possible because of it's durability and ease of use.

Walls
Mass = Structure Volume x 330

Roof
Mass = Structure Area x 330

Construction Time
Manhours = Mass / 300
Armor Rating: 4
Hit Points = Mass / 75

CCC

By far the most common native building material on The Artifact. It is stronger than steel by weight.

CCC works well as a structural support and for ceilings.

Walls
Mass = Structure Volume x 100

Roof
Mass = Structure Area x 100

Construction Time
Manhours = Mass / 400
Armor Rating: 10-60 (but usually 10 when harvested from hex walls)
Hit Points = Mass / 12

HDCCC

HDCCC is very hard and strong but is very difficult to produce and machine. The time to make parts from raw materials is five times longer than normal.

Walls
Mass = Structure Volume x 75

Roof
Mass = Structure Area x 75

Construction Time
Manhours = Mass / 100
Armor Rating: 100-250
Hit Points = Mass / 5

Brick

Although less desirable than concrete, dried mud brick is an acceptable alternative.

Walls
Mass = Structure Volume x 400

Construction Time
Manhours = Mass / 100
Armor Rating: 1
Hit Points = Mass / 15

Steel

Steel or even iron is relatively rare on The Artifact. Most Steel for construction will be teleported in from Gadios. Although it may be possible to produce structural steel with Hosent, it is generally a very slow process that would not fit into a Field Engineer's mission time frame.

The time it takes to collect materials for a steel hull is five times longer than normal, unless the engineer is using scrap that is already available. This may be the case if there are a large number of wrecked earth vehicles or equipment that can be salvaged.

Walls
Mass = Structure Volume x 25

Roof
Mass = Structure Area x 25

Construction Time
Manhours = Mass / 600
Armor Rating: 15-70
Hit Points = Mass / 15

Building Equipment

The following is a topical approach to designing and building various kinds of equipment. Where possible the statistics for common equipment is given as a reference. Most of the figures given are geared towards large applications rather than small mass produced items as it is unlikely that a Field Engineer would be tasked with anything other than a single instance design.

Mass produced items often preform better than the designs that the Engineer will be able to produce because they are time tested and refined.

Generating Power

In many engineering roles the need for generating power or using available electricity is readily apparent. Pumping water, site lighting, heating are all applications that an engineer needs to be able to accomplish to establish a site. Vehicles also need power to move and operate equipment. The power units used here equal 14 HP or 10,000 Watts of power.

12v Lead Acid Battery
Total Power = 0.24
Discharge Power per Turn = .005
Output = Electric
Mass = 10 Kg

Energy Clip
Total Power = 20
Discharge Power per Turn = .2
Output = Electric
Mass = 1 Kg

Energy Backpack
Total Power = 100
Discharge Power per Turn = 1
Output = Electric
Mass = 5 Kg

Plasma Clip
Total Electrical Power = .1
Discharge Power per Turn = .01
Total Plasma Stored = 8.3 Cu cm
Output = Electric and Plasma
Mass = 0.75 Kg

10 HP 4 Stroke

Gasoline or Ethanol powered.

Fuel: Gasoline
Power Output: 0.7

Fuel: Ethanol
Power Output: 0.84

Total fuel: 19 liters
Capacity = 50 hours
Engine Mass Dry = 11.8 Kg
Gasoline
Engine Mass Full = 24.1 Kg
Ethanol
Engine Mass Full = 26 Kg

100 HP V4

Gasoline or Ethanol powered.

Fuel: Gasoline
Power Output: 7

Fuel: Ethanol
Power Output: 8.4

Total fuel: 48 liters
Capacity: 22 hours

Engine Mass Dry: 140 Kg
Gasoline
Engine Mass Full: 173.6 Kg
Ethanol
Engine Mass Full: 178.4 Kg

300 HP V8
Gasoline or Ethanol powered.

Fuel: Gasoline
Power Output: 21.4

Fuel: Ethanol
Power Output: 25.7

Total fuel: 64 liters
Capacity: 11 hours
Engine Mass Dry: 380.8 Kg
Gasoline
Engine Mass Full: 425.6 Kg
Ethanol
Engine Mass Full: 432 Kg

300 HP Diesel
Fuel: Diesel
Power Output: 21.4

Total fuel: 64 liters
Capacity: 12 hours
Engine Mass Dry: 345 Kg
Engine Mass Full: 389.8 Kg

1000 HP Diesel
Fuel: Diesel
Power Output: 71.4

Total fuel: 64 liters
Capacity: 3.7 hours
Engine Mass Dry: 1,155.2 Kg
Engine Mass Full: 1200 Kg

TF-2394 Engine
Fuel: LCF
Power Output: 49.3

Total fuel: 4 liters
Capacity: 17 hours
Engine Mass Dry: 83 Kg
Engine Mass Full: 87.4 Kg

TF-2394 Extended Engine
Fuel: LCF
Power Output: 70.3

Total fuel: 4 liters
Capacity: 12 hours
Engine Mass Dry: 118.4 Kg
Engine Mass Full: 122.8Kg

TF-2394 Electric Motor
Total Power: 1776
Discharge Power Per Turn: 41
Battery Mass: 13.6 Kg
Engine Mass: 48 Kg

TF-2394 Plasma Engine
Total Power: 68,000
Power per turn: 37
Cubic cm of Plasma: 340
Mass: 20.4 Kg
Engine Mass: 186 Kg

Speeder-15 Plasma Engine
Total Power: 176,360
Power per turn: 37
Cubic cm of Plasma: 881.8
Mass: 52.9 Kg
Engine Mass: 186 Kg

Custom Power Generation

When common power supplies are inappropriate for the needed application, a custom power supply can be built.

Fuel
Power generation requires power to be stored in some manner. Whatever form that is will be considered the fuel for the generator.

Batteries
The amount of power that batteries can hold is considerable, but is still less than the chemical energy in liquid carbon or gasoline. One advantage of a battery powered vehicle is that it can be recharged anywhere electrical power is available. The biggest disadvantage to Batteries is that they usually require small amounts of exotic metal in their anode and cathode.
Batteries also cannot discharge their entire energy supply all at once, they can only discharge a small fraction of their total power in a turn.
Total Power = Battery Mass (in Kg) x 130
Discharge Power per Turn = Battery Mass x 3
Material Collection Time: Battery Mass x 6 hours

Fuel Tank
Fuel is chemical stored energy. The primary consideration in choosing a fuel is availability and energy density. The other factor is the volume of fuel that the vehicle can carry.

Diesel
Power/Liter 1100
Mass: 0.7 Kg per liter
Gasoline
Power/Liter 1,000
Mass: 0.7 Kg per liter
Liquid Carbon
Power/Liter 10,000
Mass: 1.1 Kg per liter
Ethanol
Power/Liter 1200
Mass: 0.8 Kg per liter
Methane
Power/Liter 800
Mass: 0.67 Kg per liter
Compressed Hydrogen
Power/Liter 500
Mass: 0.02 Kg per liter

Plasma Storage
Plasma power is easily obtainable in power hexes, it is also light. However, plasma is not a compact power source and not normally suitable for small vehicles.

Power/Cubic CM 200
Piloting Modifier -5 per Storage Cell
Mass: 0.06 Kg per Cubic cm

Powerplant
A powerplant is the engine that converts stored energy in fuel into mechanical or electrical power that can be used to do work.

Internal Combustion
Internal Combustion is any engine that uses chemical fuel in an enclosed cylinder and piston design regardless of configuration. Internal Combustion Engines output power through a rotating shaft. There are four factors of any Internal Combustion engine Fuel, Power Output, Mass and Efficiency.

Fuel is selected by the designer. It determines how much total fuel must be consumed to supply the power required.

Efficiency of an engine is based on the character's Mechanical Engineering skill.

Full	1/2	1/4	1/8
70%	80%	90%	95%

Power Output: The Power Output is selected by the designer.

Mass: The Power output and the type of fuel used determine the FCR (Fuel Consumption Rate) of the engine.

Fuel Consumption Rate
FCR = Power Output / Efficiency / Power per Liter of Fuel
Engine Mass = FCR x 16,000

Turbo Charging
Turbo charging uses exhaust gas pressure to increase the intake air pressure. The effect is to increase the FCR (Fuel Consumption Rate) without greatly impacting the engine mass.
Engine Mass = FCR x 15,000
Engine Build Time + Engine Mass x 2 min

Piloting Modifier -5 per Engine

Fuel Cell
Fuel cells turn chemical energy directly into electrical energy. The Fuel Cell is manufactured to use only one type of fuel, but they can be manufactured to use most combustible gas or liquids. Hydrogen is the simplest fuel for a Fuel cell to use. Other fuels require separate stages that complicate the fuel cell and increase build time.
Gasoline
Material Acquisition time x 3
Build time x 4
Diesel
Material Acquisition time x 3
Build time x 5
Alcohol
Material Acquisition time x 3
Build time x 3
LCF
Material Acquisition time x 4
Build time x 15
Methane
Material Acquisition time x 3
Build time x 2
Hydrogen
Material Acquisition time x 3
Build time x 1

Efficiency

Full	1/2	1/4	1/8
85%	90%	95%	99%

Power Output: The Power Output is selected by the designer.

Mass: The Power output and the type of fuel used determine the FCR (Fuel Consumption Rate) of the engine.

Fuel Consumption Rate
FCR = Power Output / Efficiency / Power per Liter of Fuel

Fuel Cell Mass: FCR x 17,000

Electric

Electric motors are simple and highly efficient. They are necessary if using batteries or a fuel cell for a power supply. Electric motors convert electrical energy to physical energy by outputting power through a rotating shaft.

Efficiency

Full	1/2	1/4	1/8
85%	90%	95%	99%

Energy Output = Electrical energy in x Efficiency

Motor Mass = Energy Use per Turn x 3 / Efficiency

Piloting Modifier -1 per Motor

Electric Generator

Most internal combustion engines use a generator or alternator of some sort. Many vehicles require electric power to operate. This necessitates the conversion of mechanical power to electricity. A generator is essentially an electric motor in reverse is the most common method of generating electrical power. In most cases a single motor can be used as both a motor and a generator.

Efficiency

Full	1/2	1/4	1/8
85%	90%	95%	99%

Mass = Energy Required x 3 x Efficiency

Piloting Modifier -1 per Motor

Plasma Coil

Plasma coils can generate mechanical energy as well as electrical power at the same time using the magnetic field of the plasma.

Efficiency

Full	1/2	1/4	1/8
85%	90%	95%	99%

Power Output: The Power Output is selected by the designer.

Fuel Consumption Rate
FCR = Power Output / Efficiency / Power per CC

Engine Mass = FCR x 1,000

Piloting Modifier -15 per Coil

Fusion Plant

Fusion technology is rare on The Artifact. Usually any time large amounts of power are required the best way to obtain it is to get it from a plasma conduit. Conversely the size of the fusion reactor usually makes it impractical for most vehicles. Fusion plants require a large amount of energy to start (usually from a plasma main).

Fusion plants require fuel in the form of hydrogen or deuterium (heavy hydrogen) but the rate that they consume their fuel is minute and so fuel is not considered to be an issue under most conditions but is considered to have a 1 month fuel supply.
Min Mass 50,000 Kg
Power = Kg / 50 per turn
Piloting Modifier -500 per reactor

ZPE

ZPE stands for "Zero Point Energy". This is the background noise of the universe. Only the Chezbah know how to manufacture these devices, and the technology is a jealously guarded secret. Because of this any ZPE generators that the character encounters will most likely be a booster engine stolen out of a Mass Transit train car. Larger engines exact a hefty price because they are either out of a Mass Transit engine or less probably a Chezbah Cruiser.

Booster
Power = 10,000 per turn
Mass = 34,000 Kg
Piloting Modifier -10 per Generator
Cost: By negotiation only

Mass Transit Engine
Power = 170,000 per turn
Mass = 578,000 Kg
Piloting Modifier -12 per Generator
Cost: By negotiation only

Muscle Power

Sometimes muscle power is the only available option or it is preferable for some reason. Human muscle power and animal muscle power work in the same way.

For every human or animal providing muscle power add the STR attributes together and then divide by 5000 to get the EUs that muscle power puts out. To convert this energy to electricity a generator must be used.

Power = 1 per 5,000 STR

To harness the energy and put it to use, there must be a device of some kind that converts the muscle power into mechanical energy such as pedals, oars, yolks or spoked wheel. There are any number of ways this can be done but the mass must be taken into account.

Mass in Kilograms = STR / 75

Building Lasers

Lasers are rugged and relatively long ranged weapons but usually are lower yield than other weapons. While there are some notable exceptions to this on larger vehicles, the weapon is often moderately heavy. However they are simple to automate and add little complexity when added to vehicles.

Speeder 15 Laser Blaster
PB Damage 40
Energy Required: 0.32
Mass: 4.8 Kg
Range Class: B
ROF: 1

TF-2394 Laser
PB Damage 300
Energy Required: 6
Mass: 132 Kg
Range Class: D
ROF: 1

TF-2394 Heavy Laser
PB Damage 500
Energy Required: 17
Mass: 367 Kg
Range Class: D
ROF: 1

Rall 4 Laser
PB Damage 400
Energy Required: 11
Mass: 235 Kg
Range Class: D
ROF: 1

Hunter Laser
PB Damage 100
Energy Required: .5
Mass: 14 Kg
Range Class: D
ROF: 1

Demolisher Belly Laser
PB Damage 1000
Energy Required: 90
Mass: 1870 Kg
Range Class: E
ROF: 1

Kelrath Capital Ship Laser
PB Damage 1500
Energy Required: 200
Mass: 3300 Kg
Range Class: D
ROF: 1

Designing Lasers

Vehicle Piloting Modifier
Piloting Modifier -1 per Gun

Laser Base Stats
The table below shows the relationship of the desired damage to the amount of energy required to the mass of the laser. The Player chooses the PB Damage and then uses the rules that follow this table to modify the base stats of the laser.

PB Damage	Energy	Mass	Base Range Class
40	0.2	5.33 Kg	C
50	0.3	8.33 Kg	C
100	1.25	33.3 Kg	C
150	2.8	75 Kg	C
200	5	133 Kg	D
250	8	208 Kg	D
300	11	300 Kg	D
400	20	533 Kg	D
500	31	840 Kg	D
600	45	1200 Kg	D
700	61	1650 Kg	D
800	80	2150 Kg	E
900	101	2700 Kg	E
1000	125	3500 Kg	E

For values other than those given here see the Appendix: Laser Calculations

Range Class

To change the Base Range Class of a laser from the classes in the table above multiply the energy and mass by the numbers below.

Range Class	Energy	Mass
-1	X 0.8	X 0.9
+1	X 2.8	X 2.4

Energy Engineering Roll

If the Player wants to reduce the energy used by the laser, roll against the Engineer's Electrical Engineering skill. Multiply the base stat of the laser by the number of the fraction column rolled.

Fail	Full	1/2	1/4	1/8
X 1.3	X 1	X 0.9	X 0.8	X 0.7

Mass Engineering Roll

If the player wants to reduce the mass of the laser, roll against the Engineer's Mechanical Engineering skill. Multiply the base stat of the laser by the number of the fraction column rolled.

Fail	Full	1/2	1/4	1/8
X 1.1	X 1	X 0.95	X 0.9	X 0.85

Rate Of Fire

Lasers normally fire continuously throughout the turn so their rate of fire is considered to be one (1). It is inefficient to make a laser fire more than one pulse during a turn, but if so desired use the following formula to do so.

Determine the desired Rate of Fire. (ROF)

Energy x ROF x 2.2 = New Energy used

The result of the formula is the new power requirement for the laser.

Add the following to the mass of the Laser

Mass x ROF / 4 = Mass to add

Calculating Damage

The damage that a laser does at various ranges is based on it's Point Blank (PB) Damage. Take the PB Damage and multiply it by the following numbers.

Short (S) x1
Medium (Med) x 0.5
Long (L) x 0.25
Extreme (Ex) x 0.1

Building Plasma Weapons

Plasma weapons are medium range weapons and carry a good punch for their energy needs. Plasma weapons use a supply of superheated gas (between 10 thousand and 15 thousand degrees) that has a strong electrical charge. An electrical charge is passed through the air and the plasma is guided down it.

TF-2394 Plasma Blaster
PB Damage: 10
Energy Required: 3
Mass: 5.2 Kg
Range Class: B
Rate of Fire: 30
Payload: 20

TF-2394 Plasma Gun
PB Damage: 400
Energy Required: 22
Mass: 448 Kg
Range Class: C
Rate of Fire: 1
Payload: 10

TF-2394 Plasma Cannon
PB Damage: 600
Energy Required: 56
Mass: 1008 Kg
Range Class: C
Rate of Fire: 1
Payload: 30

Rall 4 Plasma Cannon
PB Damage: 200
Energy Required: 2.1
Mass: 280 Kg
Range Class: C
Rate of Fire: 1
Payload: 20

Hunter Plasma Cannon
PB Damage: 200
Energy Required: 8
Mass: 290 Kg
Range Class: C
Rate of Fire: 3
Payload: 10

Designing Plasma Weapons

Vehicle Piloting Modifier
Piloting Modifier -4 per Gun

Plasma Weapon Base Stats
The table below shows the relationship of the desired damage to the amount of energy required to the mass of the Plasma Weapon. The Player chooses the PB Damage and then uses the rules that follow this table to modify the base stats of the weapon.

PB Damage	Energy	Mass	Base Range Class
50	0.1	5 Kg	A
100	0.3	20 Kg	A
150	0.5	45 Kg	B
200	1	80 Kg	B
250	2	125 Kg	B
300	3	180 Kg	B
400	7	320 Kg	C
500	13	500 Kg	C
600	22	720 Kg	C
700	35	980 Kg	C
800	51	1280 Kg	C
900	73	1620 Kg	D
1000	100	2000 Kg	D

For values other than those given here see the Appendix: Plasma Calculations

Payload
The payload that is stored in the weapon has a small mass however the powerful magnets that hold the plasma in place are very heavy.

Determine a number of rounds that the plasma weapon should store. This is the Payload of the weapon. Add the result of the following formula to the mass of the weapon.

Payload x PB Damage / 30 = Mass to add

Range Class

To change the Base Range Class of a plasma weapon from the classes in the table above multiply the energy and mass by the numbers below.

Range Class	Energy	Mass
-1	X 0.8	X 0.9
+1	X 2.6	X 2.2

Energy Engineering Roll
If the Player wants to reduce the energy used by the Plasma Weapon, roll against the Engineer's Electrical Engineering skill. Multiply the base stat of the Plasma Weapon by the number of the fraction column rolled.

Fail	Full	1/2	1/4	1/8
X 1.3	X 1	X 0.9	X 0.8	X 0.7

Mass Engineering Roll
If the Player wants to reduce the mass of the Plasma Weapon, roll against the Engineer's Mechanical Engineering skill. Multiply the base stat of the plasma weapon by the number of the fraction column rolled.

Fail	Full	1/2	1/4	1/8
X 1.1	X 1	X 0.95	X 0.9	X 0.85

Rate Of Fire
The massive magnetic fields that build up on the plasma weapon take time to cycle. This means that most Plasma weapons have a ROF of one (1). It is inefficient to make a plasma weapon fire more than one pulse during a turn, but if so desired use the following formula to do so.

Determine the desired Rate of Fire. (ROF)

Energy x ROF x 2.1 = New Energy used
The result of the formula is the new power requirement for the plasma weapon.

Add the following to the mass of the plasma weapon
Mass x ROF / 6 = Mass to add

Calculating Damage
The damage that a plasma weapon does at various ranges is based on it's Point Blank (PB) Damage. Take the PB Damage and multiply it by the following numbers.

Short (S) x1
Medium (Med) x 0.75
Long (L) x 0.5
Extreme (Ex) x 0.13

Building Particle Beam Weapons

Particle Beam weapons generate a large quantity of particles, usually electrons, but sometimes neutrons, or in rare instances alpha particles and accelerate them at a target. These beams can melt solid matter rapidly at close ranges, but the beam disperses rapidly over distance. Because of the raw energy that the weapon handles the system usually requires time to charge and then cool, this results in a lower rate of fire than most other weapons.

TF-2394 Particle Cannon
PB Damage 4500
Energy Required: 22.5
Mass: 1898 Kg
Range Class: B
ROF: 1/2

Deliverance Particle Cannon
PB Damage 5000
Energy Required: 111
Mass: 3515 Kg
Range Class: C
ROF: 1/2

Chezbah Cruiser Particle Cannon
PB Damage 9500
Energy Required: 401
Mass: 12,691 Kg
Range Class: C
ROF: 1/2

Flying Fortress Super Particle Cannon
PB Damage 80,000
Energy Required: 455,111
Mass: 2,800,000 Kg
Range Class: E
ROF: 1/2

Designing Particle Weapons

Vehicle Piloting Modifier
Piloting Modifier -5 per Gun

Particle Weapon Base Stats
The table below shows the relationship of the desired damage to the amount of energy required to the mass of the Particle Weapon. The Player chooses the PB Damage and then uses the rules that follow this table to modify the base stats of the weapon.

PB Damage	Energy	Mass	Base Range Class
200	0.1	3 Kg	A
300	0.3	6 Kg	A
400	0.5	10 Kg	A
500	1	16 Kg	A
1000	3	63 Kg	A
1500	7.5	140 Kg	A
2000	13	250 Kg	A
2500	21	390 Kg	B
3000	30	563 Kg	B
3500	33	765 Kg	B
4000	37	1000 Kg	B
4500	42	1266 Kg	B
5000	27	1563	B

For values other than those given here see the Appendix: Particle Beam Calculations

Range Class
To change the Base Range Class of a particle beam weapon from the classes in the table above multiply the energy and mass by the numbers below.

Range Class	Energy	Mass
-1	X 0.6	X 0.8
+1	X 3	X 2.5

Energy Engineering Roll
If the Player wants to reduce the energy used by the Particle Weapon, roll against the Engineer's Electrical Engineering skill. Multiply the base stat of the Particle Weapon by the number of the fraction column rolled.

Fail	Full	1/2	1/4	1/8
X 1.3	X 1	X 0.9	X 0.8	X 0.7

Mass Engineering Roll
If the Player wants to reduce the mass of the Particle Weapon, roll against the

Engineer's Mechanical Engineering skill. Multiply the base stat of the particle weapon by the number of the fraction column rolled.

Fail	Full	1/2	1/4	1/8
X 1.1	X 1	X 0.95	X 0.9	X 0.85

Rate Of Fire

Particle Weapons require a huge amount of power to operate and dissipate heat. In most instances this means that the ROF of a particle weapon is one every other turn (1/2). It is with inefficient to make a Particle Weapon fire more than one pulse every other turn, but if so desired use the following formula to do so.

Determine the desired Rate of Fire. (ROF)

Energy x ROF x 4.6 = New Energy used

The result of the formula is the new power requirement for the Particle Weapon.

Add the following to the mass of the Particle Weapon.
Mass x ROF / 2 = Mass to add

Calculating Damage

The damage that a Particle Weapon does at various ranges is based on it's Point Blank (PB) Damage. Take the PB Damage and multiply it by the following numbers.

Short (S) x 0.88
Medium (Med) x 0.4
Long (L) x 0.08
Extreme (Ex) x 0.008

Building Meta Atom Weapons

Meta Atom weapons are long range weapons. The damage they do remains very close to their point blank damage even at the end of their range.

TF-2394 Meta Cannon
PB Damage 400
Energy Required: 17.5
Mass: 1898 Kg
Range Class: E
ROF: 1

Designing Meta Atom Weapons

Vehicle Piloting Modifier
Piloting Modifier -3 per Gun

Meta Atom Weapon Base Stats
The table below shows the relationship of the desired damage to the amount of energy required to the mass of the Meta Atom Weapon. The Player chooses the PB Damage and then uses the rules that follow this table to modify the base stats of the weapon.

PB Damage	Energy	Mass	Base Range Class
50	0.1	25 Kg	D
100	0.3	100 Kg	D
150	0.5	225 Kg	E
200	1	400 Kg	E
250	2	625 Kg	E
300	3	900 Kg	E
400	7	1600 Kg	E
500	13	2500 Kg	E
600	22	3600 Kg	E
700	35	4900 Kg	F
800	51	6400 Kg	F
900	73	8100 Kg	F
1000	100	10,000 Kg	G

For values other than those given here see the Appendix: Meta Atom Calculations

Range Class

To change the Base Range Class of a Meta Atom weapon from the classes in the table above multiply the energy and mass by the numbers below.

Range Class	Energy	Mass
-1	X 0.5	X 0.9
+1	X 2.25	X 2.1

Energy Engineering Roll

If the Player wants to reduce the energy used by the meta atom, roll against the Engineer's Electrical Engineering skill. Multiply the base stat of the meta atom weapon by the number of the fraction column rolled.

Fail	Full	1/2	1/4	1/8
X 1.3	X 1	X 0.9	X 0.8	X 0.7

Mass Engineering Roll

If the Player wants to reduce the mass of the meta atom weapon, roll against the Engineer's Mechanical Engineering skill. Multiply the base stat of the meta atom weapon by the number of the fraction column rolled.

Fail	Full	1/2	1/4	1/8
X 1.1	X 1	X 0.95	X 0.9	X 0.85

Rate Of Fire

The massive magnetic fields that build up on the Meta Atom weapon take time to cycle. This means that most Meta Atom weapons have a ROF of one (1). It is inefficient to make a Meta Atom weapon fire more than one pulse during a turn, but if so desired use the following formula to do so.

Determine the desired Rate of Fire. (ROF)

Energy x ROF x 2.2 = New Energy used

The result of the formula is the new power requirement for the meta atom weapon.

Add the following to the mass of the meta atom weapon.
Mass x ROF / 4 = Mass to add

Calculating Damage

The damage that a meta atom does at various ranges is based on it's Point Blank (PB) Damage. Take the PB Damage and multiply it by the following numbers.

Short (S) x1
Medium (Med) x 0.88
Long (L) x 0.88
Extreme (Ex) x 0.5

Building Projectile Weapons

Gas powered Weapons do not require a significant amount of energy to operate as their energy is in the ammunition. The main performance impact of a traditional projectile weapon is the mass of the weapon and its ammunition which can be considerable. However below are two variations on projectile weapons use electrical power. These are EMP guns (Electro-Magnetic Pulse) that use coils or rails to create a magnetic field that accelerate the projectile from the barrel, or to concentrate the expanding gas from a gas propelled shell.

Chemical

TF-2394 Projectile Cannon
PB Damage 500
Mass: 1,563.5 Kg
Range Class: D
Payload: 30
ROF: 1

KS-10 Main Cannon
PB Damage 500
Mass: 1564 Kg
Range Class: D
Payload: 50
ROF: 1

GRX Storm Main Cannon
PB Damage 600
Mass: 2,252 Kg
Range Class: D
Payload: 50
ROF: 1

Designing Projectile Weapons

Vehicle Piloting Modifier
Piloting Modifier -10 per Gun

The table below shows the relationship of the desired damage to the amount of energy required to the mass of the projectile weapon. The Player chooses the PB Damage and then uses the rules that follow this table to modify the base stats of the weapon.

PB Damage	Energy	Mass	Base Range Class
50	0	6.25 Kg	C
100	0	25 Kg	C
150	0	56 Kg	C
200	0	100 Kg	D
250	0	156 Kg	D
300	0	225 Kg	D
400	0	400 Kg	D
500	0	625 Kg	D
600	0	900 Kg	E
700	0	1225 Kg	E
800	0	1600 Kg	E
900	0	2025 Kg	E
1000	0	2500 Kg	E

For values other than those given here see the Appendix: Projectile Calculations

Payload

The payload of the weapon is how many Projectiles and propellant pairs the weapon carries. These can make up a significant proportion of the weapon's mass.

Determine a number of rounds that the projectile weapon should store. This is the Payload of the weapon. Add the result of the following formula to the mass of the weapon.

Payload x PB Damage x PB Damage / 15,000 = Mass to add

Range Class

To change the Base Range Class of a Meta Atom weapon from the classes in the table above multiply the energy and mass by the numbers below.

Range Class	Energy	Mass
-1		X 0.7
+1		X 2.3

Mass Engineering Roll

If the Player wants to reduce the mass of the projectile weapon, roll against the Engineer's Mechanical Engineering skill. Multiply the base stat of the projectile weapon by the number of the fraction column rolled.

Fail	Full	1/2	1/4	1/8
X 1.1	X 1	X 0.95	X 0.9	X 0.85

Rate Of Fire

Projectile weapons are reasonably efficient in being able to rapidly fire but there are material stress considerations that do make them heavier as their ROF increases.

Determine the desired Rate of Fire. (ROF)

Add the following to the mass of the projectile weapon.
Mass x ROF / 10 = Mass to add

Calculating Damage

The damage that a projectile does at various ranges is based on it's Point Blank (PB) Damage. Take the PB Damage and multiply it by the following numbers.

Short (S) x1
Medium (Med) x 0.9
Long (L) x 0.8
Extreme (Ex) x 0.5

Building Mechanical Projectile Weapons

Projectile weapons such as catapults use stored mechanical energy to launch a projectile on a ballistic trajectory. These weapons take less time to collect materials for and are simpler to construct. Often, rubble can be used as the projectiles making any local source of material usable ammunition.

Unlike chemically powered projectile weapons, mechanical powered weapons require energy, in most cases to reset them to a ready firing state. This energy can be provided by human or animal muscle power or by another source like an internal combustion engine. However these weapons are usually designed to be set to fire by using very little power that is stored up over time. For instance a catapult that does 50 points of damage can be reset over six turns by two men putting out only 0.006 EU each.

Designing Mechanical Projectile Weapons

Vehicle Piloting Modifier
Piloting Modifier -20 per weapon

The table below shows the relationship of the desired damage to the amount of energy required to the mass of the projectile weapon. The

Player chooses the PB Damage and then uses the rules that follow this table to modify the base stats of the weapon.

PB Damage	Energy	Mass	Base Range Class
50	0.07	120 Kg	A
100	0.3	650 Kg	A
150	0.6	1500 Kg	A
200	1.1	2600 Kg	A
250	1.8	4166 Kg	A
300	2.6	6000 Kg	A
400	4.6	10,650 Kg	A
500	7	16,650 Kg	A
600	10	24,000 Kg	A
700	14	32,650 Kg	A
800	18	42,650 Kg	A
900	23	54,000 Kg	A
1000	29	66,650 Kg	A

For values other than those given here see the Appendix: Mechanical Projectile Calculations

Payload

The payload of the weapon is how many Projectiles the weapon carries. These can make up a significant proportion of the weapon's mass.

Determine a number of rounds that the projectile weapon should store. This is the Payload of the weapon. Add the result of the following formula to the mass of the weapon.

Payload x PB Damage x PB Damage / 15,000 = Mass to add

Range Class

To change the Base Range Class of a Meta Atom weapon from the classes in the table above multiply the energy and mass by the numbers below.

Range Class	Energy	Mass
-1	X 0.5	X 0.7
+1	X 3	X 2.3

Mass Engineering Roll

If the Player wants to reduce the mass of the projectile weapon, roll against the Engineer's Mechanical Engineering skill. Multiply the base stat of the projectile weapon by the number of the fraction column rolled.

Fail	Full	1/2	1/4	1/8
X 1.1	X 1	X 0.95	X 0.9	X 0.85

Rate Of Fire

Projectile weapons are reasonably efficient in being able to rapidly fire but there are material stress considerations that do make them heavier as their ROF increases.

Determine the desired Rate of Fire. (ROF)

Add the following to the mass of the projectile weapon.
Mass x ROF / 10 = Mass to add

Calculating Damage

The damage that a projectile does at various ranges is based on it's Point Blank (PB) Damage. Take the PB Damage and multiply it by the following numbers.

Short (S) x1
Medium (Med) x 0.9
Long (L) x 0.8
Extreme (Ex) x 0.5

Building Electro-Thermal Chemical Weapons

ETC guns use chemical charge to accelerate a shell down a barrel like a regular chemical powered weapon, but unlike a regular gas powered gun, the ETC uses a powerful electrical field to keep the expanding gas in a column behind the shell even after it has left the barrel. This allows the shell to be pushed further and harder than a traditional gas powered weapon.

Designing Electro-Thermal Chemical Weapons

Vehicle Piloting Modifier

Piloting Modifier -10 per Gun

The table below shows the relationship of the desired damage to the amount of energy required to the mass of the projectile weapon. The Player chooses the PB Damage and then uses the rules that follow this table to modify the base stats of the weapon.

PB Damage	Energy	Mass	Base Range Class
50	0.05	7.14 Kg	D
100	0.1	28 Kg	D
150	0.2	64 Kg	D
200	0.5	114 Kg	D
250	1	178 Kg	D
300	1.5	257 Kg	E
400	3	457 Kg	E
500	6	720 Kg	E
600	11	1028 Kg	E
700	17	1400 Kg	E
800	25	1830 Kg	F
900	36	2320 Kg	F
1000	50	2860 Kg	F

For values other than those given here see the Appendix: ETC Calculations

Payload

The payload of the weapon is how many Projectiles and propellant pairs the weapon carries. These can make up a significant proportion of the weapon's mass.

Determine a number of rounds that the projectile weapon should store. This is the Payload of the weapon. Add the result of the following formula to the mass of the weapon.

Payload x PB Damage x PB Damage / 15,000 = Mass to add

Range Class

To change the Base Range Class of a Meta Atom weapon from the classes in the table above multiply the energy and mass by the numbers below.

Range Class	Energy	Mass
-1	X 0.5	X 0.7
+1	X 2.2	X 2.3

Energy Engineering Roll

If the Player wants to reduce the energy used by the ETC weapon, roll against the Engineer's Electrical Engineering skill. Multiply the base stat of the ETC weapon by the number of the fraction column rolled.

Fail	Full	1/2	1/4	1/8
X 1.3	X 1	X 0.9	X 0.8	X 0.7

Mass Engineering Roll

If the Player wants to reduce the mass of the ETC weapon, roll against the Engineer's Mechanical Engineering skill. Multiply the base stat of the ETC weapon by the number of the fraction column rolled.

Fail	Full	1/2	1/4	1/8
X 1.1	X 1	X 0.95	X 0.9	X 0.85

Rate Of Fire

The massive magnetic fields that build up on the ETC weapon takes time to cycle. This means that most ETC weapons have a ROF of one (1). It is inefficient to make a ETC weapon fire more than one pulse during a turn, but if so desired use the following formula to do so.

Determine the desired Rate of Fire. (ROF)

Energy x ROF x 2.2 = New Energy used

The result of the formula is the new power requirement for the EM weapon.

Add the following to the mass of the ETC weapon
Mass x ROF / 4 = Mass to add

Calculating Damage

The damage that a projectile does at various ranges is based on it's Point Blank (PB) Damage. Take the PB Damage and multiply it by the following numbers.

Short (S) x1
Medium (Med) x 0.9
Long (L) x 0.85
Extreme (Ex) x 0.5

Building Electro-Magnetic Weapons

Electro-Magnetic Projectile launchers can use several different principles to accelerate a projectile. These can include rail guns, coil guns, or pulse guns. Although each uses very different principles to operate but the effect is similar, a projectile is accelerated to ballistic velocities using a magnetic field.

Designing Electro-Magnetic Projectile Weapons

Vehicle Piloting Modifier
Piloting Modifier -10 per Gun

The table below shows the relationship of the desired damage to the amount of energy required to the mass of the projectile weapon. The Player chooses the PB Damage and then uses the rules that follow this table to modify the base stats of the weapon.

PB Damage	Energy	Mass	Base Range Class
50	0.1	25 Kg	D
100	1	100 Kg	D
150	3.4	225 Kg	D
200	8	400 Kg	D
250	16	625 Kg	E
300	27	900 Kg	E
400	64	1600 Kg	E
500	125	2500 Kg	E
600	216	3600 Kg	E
700	343	4900 Kg	F
800	512	6400 Kg	F
900	729	8100 Kg	F
1000	1000	10,000 Kg	F

For values other than those given here see the Appendix: Electro-Magnetic Calculations

Payload
The payload of the weapon is how many projectiles the weapon carries. These can make up a significant proportion of the weapon's mass.

Determine a number of rounds that the projectile weapon should store. This is the Payload of the weapon. Add the result of the following formula to the mass of the weapon.

Payload x PB Damage x PB Damage / 30,000 = Mass to add

Range Class
To change the Base Range Class of a Meta Atom weapon from the classes in the table above multiply the energy and mass by the numbers below.

Range Class	Energy	Mass
-1	X 0.5	X 0.7
+1	X 2.2	X 2.3

Rate Of Fire
The massive magnetic fields that build up on the EM weapon takes time to cycle. This means that most EM weapons have a ROF of one (1). It is inefficient to make a EM weapon fire more than one pulse during a turn, but if so desired use the following formula to do so.

Determine the desired Rate of Fire. (ROF)

Energy x ROF x 2.2 = New Energy used
The result of the formula is the new power requirement for the EM weapon.

Add the following to the mass of the EM weapon
Mass x ROF / 4 = Mass to add

Calculating Damage
The damage that a projectile does at various ranges is based on it's Point Blank (PB) Damage. Take the PB Damage and multiply it by the following numbers.

Short (S) x1
Medium (Med) x 0.9
Long (L) x 0.85
Extreme (Ex) x 0.5

Building-Missile Launchers

Missiles are different from most other weapon systems because the weapons mass consists primarily of ammunition. Because the missile provides the thrust with little impact on the vehicle, the bulky reinforcements that withstand the stresses of a projectile weapon firing are not needed. This makes the payload the missile can deliver much higher.

Designing Missile Launchers

Vehicle Piloting Modifier
Piloting Modifier -5 per Launcher

The table below shows the relationship of the desired damage to the amount of energy required to the mass of the missile launcher. The Player chooses the PB Damage and then uses the rules that follow this table to modify the base stats of the weapon.

PB Damage	Mass	Base Range Class	Blast Range Class
200	10 Kg	C	A
500	22.5 Kg	C	A
1000	40 Kg	C	B
2000	62.5 Kg	D	B
4000	250 Kg	D	B
6000	562 Kg	D	B
8000	1000 Kg	E	B
10,000	1562 Kg	E	B
12,000	2250 Kg	E	B

For values other than those given here see the Appendix: Missile Launcher Calculations.

Payload
The payload of the weapon is how many missiles the weapon carries. These make up a majority of the weapon's mass.

Determine a number of missiles that the launcher should store. This is the Payload of the weapon. Add the result of the following formula to the mass of the weapon.

Payload x PB Damage = Mass to add

Range Class
To change the Base Range Class of a missile launcher from the classes in the table above multiply the energy and mass by the numbers below.

Range Class	Energy	Mass
-1	X 0	X 0.8
+1	X 0	X 3

Blast Range Class
To change the Blast Range Class of a missile launcher from the classes in the table above multiply the energy and mass by the numbers below.

Range Class	Energy	Mass
-1	X 0	X 0.9
+1	X 0	X 2.6

Mass Engineering Roll
If the Player wants to reduce the mass of the missile launcher, roll against the Engineer's Mechanical Engineering skill. Multiply the base stat of the launcher by the number of the fraction column rolled.

Fail	Full	1/2	1/4	1/8
X 1.1	X 1	X 0.95	X 0.9	X 0.85

Rate Of Fire
Missile launchers usually can fire their full payload in a single round. By reducing the number of missiles that can be fired at any one time, the total mass of the launcher can be slightly reduced.

Determine the desired Rate of Fire. (ROF)

Subtract the following to the mass of the launcher if the ROF is less than the total payload.
ROF / Payload x Mass /5 - Mass to Subtract

Calculating Damage
The damage that an explosive missile does is based on it's PB Damage. The numbers given below are for the Blast Range Class.

Short (S) x1
Medium (Med) x 0.9
Long (L) x 0.85
Extreme (Ex) x 0.5

Shields

There are two types of force fields or shields that are in use on The Artifact. The most common is the ion cascade barrier in which a powerful magnetic field envelops the vehicle and a curtain of ionized gas or plasma that deflects projectiles or disperses energy. The second kind is much less common and there is only one design. The Kerdi use a field that dampens and absorbs energy. Very little is understood about this type of shield and removing them from a

Kerdi takes great skill as they are highly integrated into the Kerdi's systems.

Ion Cascade Sheilds

Ion cascade shields are the standard shields used on The Artifact. They use a powerful magnetic field to accelerate a curtain of ionized gas (usually from the air in an atmosphere) around a building or vehicle. This curtain diffuses laser light and has enough force to deflect plasma and even projectiles.

Piloting Modifier -3 per Generator

HP	Energy	Mass
100	1	13 Kg
150	2.5	28 Kg
200	4	50 Kg
300	9	113 Kg
400	16	200 Kg
500	25	312 Kg
600	36	450 Kg
700	49	612 Kg

Kerdi Sheilds

Kerdi Shields are omnidirectional shields but can only absorb energy from all fire arcs. They are ineffective against projectile weapons and cannot be combined with Ion Cascade Shields.

Kerdi Shields also give a camouflage bonus in dark conditions and from sensors.

HP	Energy	Mass
400	+1 per HP absorbed	1200 Kg

Sensors and Countermeasures

Sensors are used to enhance a person's ability to perceive the world. In this section sensors refer to a cluster of devices such as radar, sonar, infrared cameras, laser range finders and optical cameras.

Electromagnetic Countermeasures are used to foil sensors.

Sensors

The statistics below are for sensor clusters that include radar, low light, infrared, ultraviolet, spotlights, parabolic microphones and sonar.

Skill Modifier	Energy	Mass	Base Range Class
+5	0.25	25 Kg	B
+10	0.3	35 Kg	B
+15	0.5	50 Kg	C
+20	0.8	66 Kg	C
+25	1	78 Kg	D
+30	1.5	94 Kg	D
+35	2	110 Kg	E
+40	3	130 Kg	E

Range Class

To change the base range class of the sensors from the classes in the table above, multiply the energy and mass by the numbers below.

Range Class	Energy	Mass
-1	X 0.9	X 0.9
+1	X 1.3	X 1.1

Visual sensors are only pointed in one fire arc unless they are mounted on a turret like the head of an E-Suit.

Electro-Magnetic Counter Measures

Electromagnetic counter measures include flares, chaff, optics sensor blinding lasers, radio jammer and sound dampeners. ECMs are used to fool enemy sensors by making false sensor readings, make the system with the ECM disappear or make the system seem to jump around erratically. These systems are designed to prevent sensors from locking onto the system with the ECM.

Skill Modifier	Energy	Mass	Base Range Class
+5	1	25 Kg	A
+10	1.5	35 Kg	B
+15	2	50 Kg	B
+20	3	66 Kg	B
+25	4	78 Kg	C
+30	5	94 Kg	C
+35	7	110 Kg	C
+40	9	130 Kg	D

Range Class

To change the base range class of the sensors from the classes in the table above, multiply the energy and mass by the numbers below.

Range Class	Energy	Mass
-1	X 0.5	X 0.8
+1	X 2	X 1.5

Electro-Magnetic Counter Counter Measures

ECCMs consist of the following, radar boosters, software to filter through ECM interference, sidelobe comparison antenna and radar jammer location systems.

Skill Modifier	Energy	Mass	Base Range Class
+5	1	12 Kg	A
+10	1.1	23 Kg	A
+15	1.2	25 Kg	B
+20	1.5	33 Kg	B
+25	2	40 Kg	B
+30	2.5	47 Kg	C
+35	3	55 Kg	C
+40	4	65 Kg	C

Range Class

To change the base range class of the sensors from the classes in the table above, multiply the energy and mass by the numbers below.

Range Class	Energy	Mass
-1	X 0.9	X 0.9
+1	X 1.3	X 1.1

Lighting

In locations where lighting has failed either because of a lack of power or because

the lighting systems have failed, it is important to provide lighting for movement and to light living areas. This can often involve lighting large areas.

There are two considerations in lighting. The luminosity and the surface area to be lit. The brighter the luminosity the larger the surface area that can be lit, this is called luminance.

It is possible to do most activities at a luminance of between 50-100 lux (lux is a unit that measures luminance or the amount of light). However this may be insufficient for detailed work such as writing, reading or mechanical repair work. For these purposes it is better to have a lux between 350 up to 500. For growing plants it is necessary to have a lux between 6,000 and 10,000.

To determine how much lighting is required the surface area to be lit must be determined.

Surface Area = length of area in meters x width of area in meters

Next, the desired number of lux should be determined as described above. Then the total luminosity of the lighting source can be determined.

Luminosity = Surface Area x desired lux

Now that the luminosity has been determined the total power required for the lighting system can be determined. The Player should roll against the Engineer's Electrical Engineering skill to determine the lighting efficiency.

Energy Efficiency
Roll vs Electrical Engineering

Full	1/2	1/4	1/8
20	50	100	150

Power in EU = Energy Efficiency x 10,000 / Luminosity

The Power in EU is the total power required by the lighting system. Now the mass of the lighting system must be determined.

Mass = EU x 300

The Agricultural Hex has light panels that put out 9,000 lux over 86,601,632 square meters. There are six light panels that use 86,602 EU each (The power required to illuminate one panel) for a total of 519,610 EU or 520 Megawatts. With 990 billion Agricultural Hexes the total power consumption of lighting in these hexes is 515 Exawatts or 514,800,000,000,000,000,000 watts.

Other Items

The following items do not fall under other categories.

Life Support

Life support usually consists of oxygen tanks that are supplemented by a CO_2 scrubber or re-breather. In addition a supply of water equal to twice the available oxygen supply since water is more often needed for survival.

Mass = 2Kg x People Supported x Hours

Turret

A turret is an armored mount point for a weapon or sensor the turret adds protection to a weapon, but adds mass and complexity. The more firing arcs it can move through the larger the mechanism must be.

Heads on E-Suits are considered turrets.

Turrets count as a critical hit location on vehicles.

Mass for Emplacements
Mass = Equipment mass x Fire Arcs / 2

Mass for Vehicles
For vehicles the mass of the turrets armor is included in the hull mass.
Mass = Equipment mass x Fire Arcs / 4

Arms

Arms are used to manipulate objects however they require power to function. The more power that is put into them the faster and stronger they are. The design of the Arm and hand determines how dexterous it is.

Arms can be used as a mount point for weapons.

Hosent Arms
STR: 8000
Punch Damage: 200
Dexterity CDF: -13
Piloting Modifier: -23
Length: 145 m
Mass: 7,520 Kg
Energy Required: 43

TF-2394 Arms
STR: 800
Punch Damage: 80
Dexterity CDF: -3
Piloting Modifier: -13
Length: 1.72 m
Mass: 309 Kg
Energy Required: 6

Rall 4 Arms
STR: 600
Punch Damage: 60
Dexterity CDF: -5
Piloting Modifier: -15
Length: 2.279 m
Mass: 291.16 Kg
Energy Required: 5

Designing Arms

The total power put into each arm is split between making the arm faster and making the arm stronger. The engineer decides how much power to put into either purpose. A slow arm can be very strong but will be difficult to handle and not have much punch damage. A weaker arm that is fast will be more dexterous.

Speed Modifier

Lower numbers from this calculation mean the arm moves faster.
Speed = 400 / Power

STR = Power x 200

Punch Damage = Str/ Speed x 20

The design of the arm greatly impacts how easy it is to use. The player must roll against the engineer's Mechanical Engineering skill. The fraction column rolled indicates how easy it is to use. However it also effects the time it takes to manufacture the arm.

Engineering Modifier

Full	1/2	1/4	1/8
-10	-20	-40	-60

Dexterity CDF = Speed Modifier / Engineering Modifier

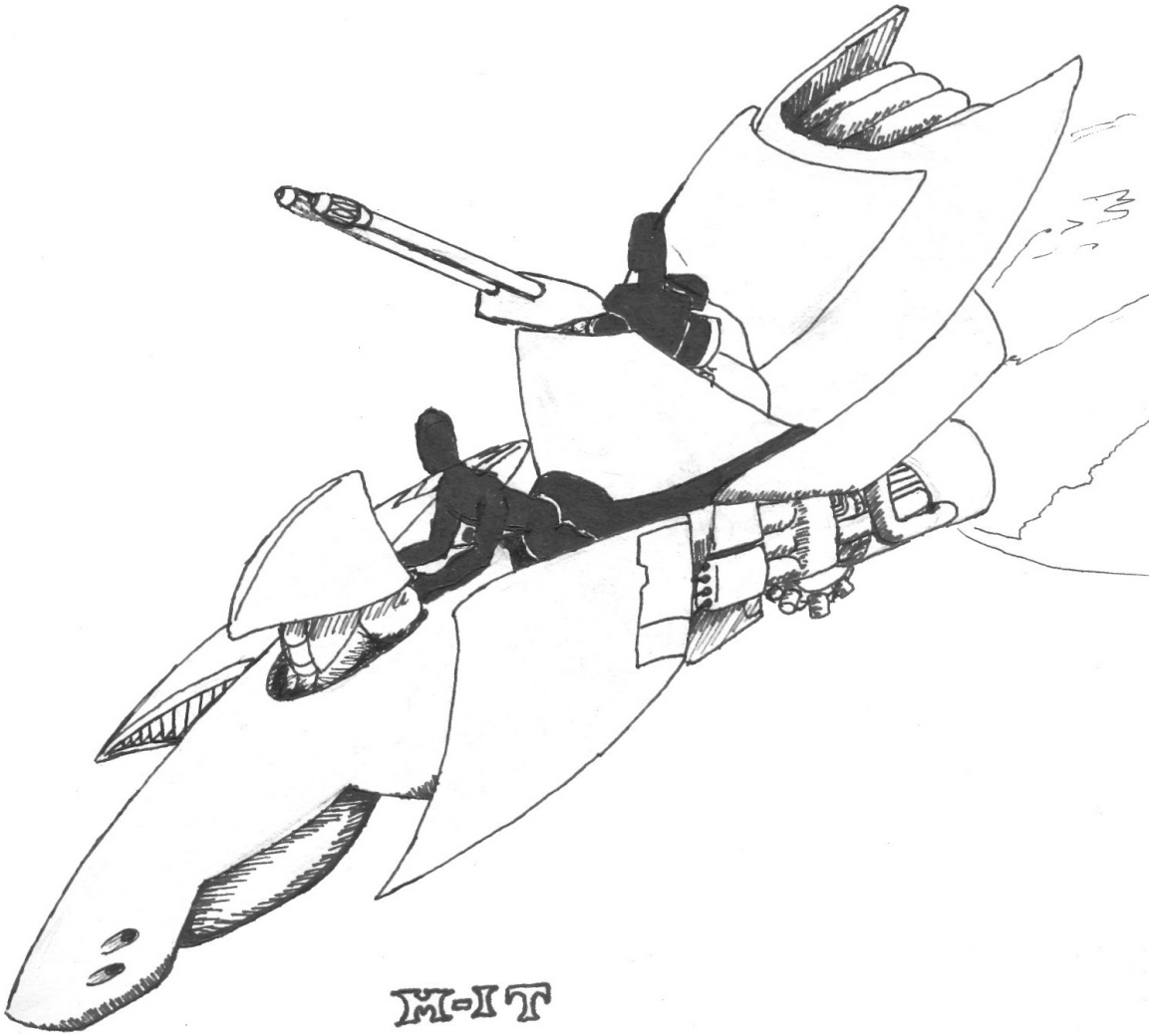
The Length of the arm determines it's reach from it's mount point. A longer arm is heavier than a shorter arm. (An E-suit arm is normally 0.43 it's total hight)
Mass = Power + Length x 40

Vehicle Piloting Modifier = 10 + Dexterity CDF each arm

Added Manufacture Time
minutes = Engineering Modifier x Mass / -300

Arms count as a critical hit location on vehicles.

Building Vehicles



Build Track

To start building a vehicle the following build track is used. This gives the proper order to follow.

1. Get all the equipment you want to build into the vehicle and add up all the mass and power requirements. See: Equipment and Building Sections
2. Choose a Fuel/Engine type.
3. Choose a drive type (wheeled, tracked, articulated, thrusters, etc.)
5. Choose the hull material and strength. Apply the hull calculations to see how much mass is left for equipment.
6. Enter the mass of the vehicle and power into the vehicle ratings and record the effects

Control Systems

Control systems are all the systems that allow a vehicle to be piloted.

Cockpit

A cockpit usually is a small 1-3 person control system that allows a vehicle to be piloted.
Piloting modifier = +20 x Crew
210 Kg x Crew

Bridge

A bridge is a room with 4 or more (sometimes much more) crew that control the vehicle.
Piloting modifier = +20 x Crew
150 Kg x Crew min 5 crew

Gyroscope

A Gyroscope can be used to maintain orientation for vehicles.

Piloting Modifier = +20
Mass: 10 Kg

Engine Room

The engine room is like a bridge that focuses on controlling power to the vehicle and systems integrity. Because of this a vehicle with an engine room is more resistant to systems being damaged.

Piloting Modifier = +20 x Crew

The engine room makes systems less likely to fail because of damage. This reduces the Critical Hit Location Percent on one hit location by 10% for every 4 crew.

Computers

Quantum Liquid Computer (QLC)

Quantum Liquid Computers use photon energy in a liquid sodium media to store and calculate information. Sodium atoms are kept under high pressure and begin to behave as a liquid in chambers called "wave guides". Electrical current applied to these wave guides alters the sodium atoms spin and thus the properties of the liquid. Dependent on the spin state, the liquid takes on different optical properties that allow the wave guides to store photons or emit photons with different spin states. Although computers using a similar processor design became more common on earth after 2040, they relied on ultra cold temperatures to operate. Quantum Liquid Computers developed on The Artifact have hundreds of times the quibits (Quantum Bits) than those built on Earth. The processors of a QLC also function as data storage instead of using a separate storage device such as a hard drive or caterpillar drive.

Personal QLC

These are the processors for the Scimrahn Comm/Comp.
Piloting Modifier = +3
Mass: 200 g
Cost: ¥2,000

Small QLC

Two of these computers manage the terrain handling and balance of the TF-2394 E-Suit.
Piloting Modifier = +8
Mass: 50 Kg
Cost: ¥6,000

Medium QLC

One of these computers handles the operation of each TF-2394.
Piloting Modifier = +18
Mass: 200 Kg
Cost: ¥8,000

Large QLC

Piloting Modifier = +39
Mass: 600 Kg
Cost: ¥12,000

Hex Mainframe QLC

Hex Mainframes are massive QLCs that maintain each hex. In truth they are overkill for what they are used for. Only one percent of the processing power is used to handle the operation of the hexes. There are several native programs on these QLCs that should be noted. The first of which is a packet sniffer that forwards all communications to the Chezbah. This process is built into the operating instructions of the computer. Removing the sniffer will cause the mainframe to fail. The QLC will continuously request that its operating instructions be reloaded from its neighboring systems. While the process that handles the sniffer can be shut down, the operating instructions on the QLC will restart it in a matter of seconds. Only by re-writing the operating instructions fully will the sniffer be permanently circumvented. Secondly, the operating instructions allow the system to be "self healing". In other words the system will restart any crashed or errored processes to bring them back into operation.
Piloting Modifier = +23
Mass: 480 Kg
Cost: ¥4,000

Hosent Brain

The QLCs used in Hosent are widely available in industry hexes and are used for a large variety of functions where the size of the processor is not an issue. The Hosent Brain is a cube measuring 120 cm on a side. Hosent Brains that are for sale are usually just covering the labor costs of removing and transporting the processor.
Piloting Modifier = +95
Mass: 2,000 Kg
Cost: ¥4,000

Kerdi Brain

The Kelrath manufacture and sell the QLC that is used in Kerdi robots. They are sold without the control instructions that the Kerdi function by.
Piloting Modifier = +66

Mass: 500 Kg

Cost: ¥10,000,000

Passengers

Open

In and open passenger compartment, the passengers are exposed on the outside of the craft. This makes for a lighter vehicle but does not protect the passengers like an enclosed crew compartment would. Passengers in an open compartment have soft cover.

Mass = Number of Passengers x 60
Critical Percentage = 70%

Enclosed

In and enclosed passenger compartment the vehicle fully protects the passengers. Passengers cannot be attacked directly.

Mass = Number of Passengers x 110
Critical Percentage = 30%

Cargo

When calculating the cargo capacity of a vehicle, the weight of the cargo is added to the full mass where the superstructure required to transport the cargo is added to the dry mass.

Open

Open cargo compartments offer a lighter vehicle mass but does not protect the cargo from weather or attack.

Added Vehicle Mass= Cargo Capacity x Cargo Capacity / 300
Critical Percentage + 30%

Enclosed

Enclosed cargo compartments protect the cargo being carried but cause the vehicle to have a lighter mass.

Added Vehicle Mass= Cargo Capacity x Cargo Capacity / 400

Drive Types

Vehicles have a preferred mode of transport but some have more than type of movement, and some such as the Scimrahn Freighter and the Chezbah Demolisher act as hybrids.

The vehicle can have one or multiple drive types. If more than one drive type is used each will have their own speed. However if the drive types are not used at the same time, the power to the drive can be switched from one to the other.

Each drive system counts as a critical hit location on vehicles.

Articulated

Articulated vehicles are not very energy efficient but are very flexible in the types of terrain they can travel over. The mass of an articulated drive is only for the drive mechanism (or legs) not for any arms that the vehicle might have. There are three main kinds of force generating systems used in articulated systems Hydraulic, Monomer and Electrostatic.

The first thing an Articulated vehicle must be able to do is to hold itself up. Some hybrids do this with AG but a majority uses the strength of legs to hold them up. Unless the vehicle is going to use another drive type to stay up the legs must be strong enough to hold the vehicle up. The leg strength of the vehicle must be at least enough to carry the mass of the vehicle. Some of the engine power must go into this and determines the maximum vehicle mass. If the total vehicle mass ends up being greater than this, then power needs to be taken away from movement and added to strength.

Piloting modifier
Roll vs. Mechanical Engineering

Full	1/2	1/4	1/8
-30	-20	-10	-0

Select a number of EU that will go into the drive system. Higher power levels will move the vehicle faster and able to hold up more mass. The amount of power selected cannot exceed the total power generation of the vehicle's powerplant minus all the power required by other systems. This is "Energy Into Drive".

The Energy Into Drive must be split into two uses. One to hold the vehicle up, this is Energy Into STR and the other to move it forward, this is Energy Into Movement.

Hydraulic

Hydraulic systems uses a pump to push liquid into a piston therefore extending it. This is the type of drive used in the TF and Rall series E-Suits. It is also used in the legs of

the Scimrahn Freighter and Chezbah Demolisher. Hydraulic systems are stable even if power is lost. This means that a Hydraulic limb can continue to hold up a vehicle even after power has been turned off because of valves that maintain pressure in the pistons when the pump is shut off.

Hydraulic drive systems use a pump to create pressure and require mechanical energy output.

Leg STR = Energy Into STR x 200
Max Vehicle Mass = STR x 2

Movement Power = 0.75 x Energy Into Movement
Drive Mass = Energy Into Drive x 45

Monomer

Monomer systems use polymer cords that shrink when electricity is passed through them. They are fast but not as strong as hydraulic and therefore used in smaller, faster vehicles such as the S-15 and the Walking Tent.

Monomer limbs are not by themselves stable when power is lost unless there is a secondary system that locks limbs in place when unpowered. This adds complexity to the design of joints.

Monomer drive types require electrical power to function.

STR = Energy Into STR x 100
Max Vehicle Mass = STR x 2

Movement Power = 0.9 x Energy Into Movement
Drive Mass = Energy Into Drive x 55

Electrostatic

Electrostatic systems use what is essentially a flat stepper motor to extend or contract. They are faster than Hydraulic and stronger than Monomer.
Electrostatic limbs are not by themselves stable when power is lost unless there is a secondary system that locks limbs in place when unpowered. This adds complexity to the design of joints.

Electrostatic drives require electrical power to function.
STR = Energy Into STR x 100
Max Vehicle Mass = STR x 2

Movement Power = 0.82 x Energy Into Movement
Drive Mass = Energy Into Drive x 38

Land

Land vehicles are wheeled, or tracked vehicles. While these are comparatively simple vehicles, they cannot easily move vertically between floors. Land vehicles have static support systems that do not require power to support the vehicle, only to move it.

Piloting modifier
Roll vs. Mechanical Engineering

Full	1/2	1/4	1/8
-10	-5	-2	-0

Wheeled

A wheeled vehicle uses wheels to both support and propel the vehicle.

Movement Power = 0.95 x Energy Into Drive
Critical Percentage + 30%
Drive Mass = Energy Into Drive x 15

The designer may increase the mass of the drive to allow for a heavier vehicle

Max Vehicle Mass = Drive Mass x 10

Tracked

Tracked vehicles use belts stretched over rows of wheels. The tracks give the vehicle the ability to move over soft terrain and can support much larger vehicles than wheels.
Movement Power = 0.85 x Energy Into Drive
Drive Mass = Energy Into Drive x 30

The designer may increase the mass of the drive to allow for a heavier vehicle

Max Vehicle Mass = Drive Mass x 15

Water

Water vehicles are buoyant and the hull is supported by water.

Piloting modifier
Roll vs. Mechanical Engineering

Full	1/2	1/4	1/8
-30	-20	-10	-5

Sail

Sail powered vehicles use the power of the wind to move the vehicle. They do not require external power to move the vehicle.

Drive Mass =
Critical Percentage + 50%
Piloting modifier -30

Powered Surface

A powered surface craft uses mechanical energy to turn a paddle, screw or propeller to move the vessel through the water.

Movement Power = 0.6 x Energy Into Drive
Drive Mass = Energy Into Drive x 5

Submersible

A submersible vehicle is designed to move underneath the water. The hulls of these vehicles must have a mix of high Armor Rating and thick hull to resist the crushing force of water. In addition the vehicle must counteract it's natural buoyancy with heavy ballast.

Movement Power = 0.3 x Energy Into Drive
Drive Mass = Equipment Mass x .5 x Energy
Critical Percentage + 30% To Crew Compartments

Flying

Flying vehicles have two types of propulsion, thrust and lift. Thrust Is used to move a vehicle. Lift is what keeps a air vehicle in the air.

The Energy Into Drive must be split into two uses. One to hold the vehicle up, this is Energy Into Lift and the other to move it forward, this is Energy Into Movement.

The Lift is divided by the Mass of a vehicle. If the resulting number is one or greater then the vehicle will float. If the vehicle does not have lift, or the lift divided by mass is less than 1 then the vehicle must use thrust to make up the difference.

The thrust of a vehicle is divided by the Mass of the vehicle and the Lift ratio (up to +1) is added.

Piloting modifier
Roll vs. Engineering

Full	1/2	1/4	1/8
-90	-60	-30	-15

Anti-Grav

Anti-Grav engines use a large crystal (or core) made of nano layers of embedded materials suspended in a magnetic field and spun up to hundreds of thousands of RPM. The core would fly out of it's housing if it were not held in place by a powerful magnetic field. The force of the core lifting is transferred by the magnetic field to the engine housing and the housing is securely mounted to the hull of the vehicle. The core lifts against gravity and once at speed creates a force that is exactly opposite of whatever gravity well it is in.

Anti-Grav engines are exacting to manufacture and require five times the normal build time for its mass. Anti-Grav engines are driven by electro-magnets and therefore require a generator if they use LCF or another liquid fuel.

Anti-Grav engines can be used for lift and thrust; however, they are much better at lifting. Each energy point put into the engine must go into either lift or thrust. The lift energy must be higher than the thrust power and the two are divided to get the lift to thrust ratio. The lift to thrust ratio cannot be lower than three (3).

LTR (Lift to Thrust Ratio) = Energy Into Lift / Energy Into Movement

Drive Mass = Energy Into Drive x 5

Lift
Maximum Vehicle Mass = Engine Mass x Energy Into Lift

Movement Power Efficiency
Roll vs Mechanical Engineering

Full	1/2	1/4	1/8
0.6	0.7	0.8	0.9

Movement Power = Movement Power Efficiency x Energy Into Movement

Piloting Modifier -20 per Motor

Thrusters

There are many different designs for thrusters, for simplicity they are put into one category. Thrusters use chemical fuel to produce lift and thrust. This includes all jets and rockets.

Because thrusters use fuel directly, they do not require a separate power generation system. However thrusters can be built to drive an electric generator but the power that goes into the generator is subtracted from the Energy Into Movement.

Drive Mass = Energy Into Drive x 3.75

Energy Efficiency
Roll vs Mechanical Engineering

Full	1/2	1/4	1/8
70%	80%	90%	95%

Lift
Max Vehicle Mass = Energy Into Lift x 40 x Energy Efficiency

Movement Power = Energy Efficiency x Energy Into Movement

Fixed Wing
Fixed wings are useful for converting thrust into lift. They operate poorly at low speed and thin atmospheres. The larger the wing the more lift it provides, but also weighs more. It should be noted that dropping below the speed that provides enough lift to get the vehicle off the ground will cause the vehicle to loose altitude. Falling or going into a dive, makes the vehicle accelerate and therefore causes a quick, but controllable decent.

Efficiency

Full	1/2	1/4	1/8
70%	80%	90%	95%

Lift
Max Vehicle Mass = Speed x Efficiency x Square meters of wing

Drive Mass = Square meters of wing x 40

Rotor Wing (Helicopter)
A rotor wing vehicle uses a wing that is spun by a shaft to create lift. In most instances the rotor or body of the vehicle is tilted to move some of the energy behind the center of gravity and thus causes it to move forward. This for game purposes is considered thrust.

Energy Efficiency
Roll vs Mechanical Engineering

Full	1/2	1/4	1/8
70%	80%	90%	95%

Lift
Max Vehicle Mass = Energy Into Lift x Efficiency x Square meters of wing

Movement Power = Energy Efficiency x Energy Into Movement

Mass = Square meters of wing x 40

The Critical Hit Location for the Rotor Wing drive has a +20% to it's Critical Hit Location Percent.

Lighter than Air
A lighter than air vehicle is one that uses a gas such as helium or less preferably hydrogen in one or many gas bags to lift the vehicle. Three kilograms of helium and its lift bags can lift one kilogram of vehicle.

Lighter than air systems can only provide minimal movement by pitching the vehicle and usually rely on atmospheric wind for movement or some other form of thrust.

Drive weight = Equipment + Power generation mass x 3

All hull Critical Hit Locations have a +30% to their Critical Hit Location Percent.

Orbital

Orbital vehicles do not need to produce lift as they are in free fall around a planet.

Piloting modifier
Roll vs. Mechanical Engineering

Full	1/2	1/4	1/8
-360	-240	-120	-60

Drive Mass = Energy Points x 3.75

Energy Efficiency
Roll vs Mechanical Engineering

Full	1/2	1/4	1/8
70%	80%	90%	95%

Movement Power = Energy Efficiency x Energy Into Movement

Hull

The hull of a vehicle is the outer skin of the vehicle and the structure that supports the mass of the vehicle.

The hull of the vehicle counts as a critical hit location on vehicles.

Hull Material

Hull material is an important factor in vehicle design. It affects the weight of the vehicle and the time that it takes to build the vehicle.

The player can pick an AR in the range of the material they have chosen but choosing the highest value may not always be the best choice since it will increase the mass of the vehicle.

CCC

By far the most common native building material on The Artifact. It is stronger than steel by weight.
AR 10-60
Hull multiplier = AR * Armor Thickness (CM) / 70

HDCCC

HDCCC is very hard and strong but is very difficult to produce and machine. The time to make parts from raw materials is five times longer than normal.
AR 100-250
Hull multiplier = AR * Armor Thickness (CM) / 50

Steel

Steel or even iron is relatively rare on The Artifact but it can be obtained and Hosent have the ability to smelt it.

The time it takes to collect materials for a steel hull is five times longer than normal, unless the engineer is using scrap that is already available. This may be the case if there are a large number of wrecked earth vehicles or equipment that can be salvaged.
AR 20-70
Hull multiplier = AR * Armor Thickness (CM) / 35

Chobam

An engineered armor that was developed in the 1960's and has gradually been improved upon. It consists of layers of materials that offer different resistances to a penetrating attack and thus diffuse the attack.

The time it takes to collect materials for a Chobam hull is fifteen times longer than normal unless the engineer is using scrap that is already available. This may be the case if there are a large number of wrecked Earth tanks that can be salvaged.

The time to make parts from raw materials is five times longer than normal.
AR 40-100
Hull multiplier = AR * Armor Thickness (CM) / 60

Reactive

Reactive armor uses shaped charge explosives to deflect an attack away from the vehicle. It is not effective against lasers, although the greater mass of the material may give some protection.

It is relatively heavy for the protection it gives.
2 Kg = 1 HP vs plasma and projectiles

Protecting Critcal Hit Locations

To reduce the critical hit chance on a hit location add 5% (0.05) to the Hull Multiplier. This will reduce the Critical Hit Location Percent on one hit location by 10%. This can be done as many times as is practical for the vehicle but will make it heavier each time.

Hull Mass

The mass of a vehicle hull equals 15% (0.15) plus the Hull Multiplier of all the equipment and drive weight that is being built into it.

Hull Mass Percent = 0.15 + Hull Multiplier

Equipment and Drive Mass = Equipment Mass + Drive Mass

Hull Mass = Hull Mass Percent x Equipment and Drive Mass

Final Mass Calculations

Determine Total Mass

Total Mass is the mass of all equipment plus the drive system of the vehicle plus the hull mass.

Total Mass = Equipment Mass + Drive Mass + Hull Mass

Vehicle Ratings

All Vehicles have a size rating. This is used to classify their performance. Given the same engine, a vehicle given a Light classification will be faster than a vehicle given a Medium classification, and faster still than a Heavy vehicle. The closer a vehicle is to the upper range of its size rating the more performance penalties it must take.

Vehicles that have a mass less than or equal to 5,000 Kilograms Full Mass are considered light vehicles.

Vehicles that have a mass more than 5,000 Kilograms Full Mass but less than or equal to 10,000 Kilograms Full Mass are considered Medium vehicles.

Vehicles that have a mass more than 10,000 Kilograms Full Mass but less than or equal to 50,000 Kilograms Full Mass are considered Heavy vehicles.

Vehicles that have a mass greater than 50,000 Kilograms Full Mass are considered Super Heavy vehicles.

Light Vehicles

Hit Points

To determine the total HP of the Vehicle, add the total mass and multiply by the Armor Rating (AR) then divide by 500

HP = Total Mass x AR / 500

Speed

After the amount of energy that will drive the vehicle is determined and the effects of efficiency and drive system power loss is taken into consideration, the amount of energy remaining is consulted on this chart. The speed listed is the speed the vehicle could travel without any Performance Penalties.

Horse Power	Energy Points	Speed in Km/h
14	1	55
28	2	77
42	3	95
56	4	110
70	5	122
84	6	134
98	7	145
112	8	155
126	9	164
140	10	173
210	15	212
280	20	245
350	25	274
420	30	300
490	35	324
560	40	346
630	45	367
700	50	387
770	55	406
840	60	424
910	65	442
980	70	458
1050	75	474
1120	80	490
1190	85	505
1260	90	520
1330	95	534
1400	100	548

For values other than those given here see the Appendix: Light Vehicle Speed Calculations.

Fire Arcs

Light vehicles have 4 fire arcs, front, right, back and left.

Critical Hits

Light vehicles have a base 40% chance of a critical hit for all their critical locations. This number is modified by the Armor Rating of the vehicle, any Performance Penalties and the modifications for the chassis itself.

Three systems must be chosen for each critical hit location to be used as critical hits. The chosen systems must make sense for the hit locations.

Performance Penalties

For every three hundred (300) Kilograms of vehicle mass, the vehicle must take one (1) performance penalty. For each performance penalty the character designing the vehicle must make a Mechanical Engineering roll. If the roll is passed, the Player may choose the penalty, otherwise a random penalty is rolled.

Penalty List

Top Speed -10%
Piloting Modifier -10
Total Fuel Capacity -10%
Build Time x1.5
Hit Points -10%
Armor Rating -10%
+10% To 1 Critical location

Penalty Table

Roll 1D100

1-10	Top Speed -10%
11-15	Top Speed -20%
16-25	Piloting Modifier -10
26-30	Piloting Modifier -20
31-40	Total Fuel Capacity -10%
41-45	Total Fuel Capacity -20%
46-55	Build Time x1.5
56-60	Build Time x2
61-70	Hit Points -10%
71-80	Armor Rating -10%
81-90	+10% To 1 Critical location
91-100	+20% To 1 Critical location

Medium Vehicles

Hit Points

To determine the total HP of the Vehicle, add the total mass and multiply by the Armor Rating (AR) then divide by 750

HP = Total Mass x AR / 750

Speed

After the amount of energy that will drive the vehicle is determined and the effects of efficiency and drive system power loss is taken into consideration, the amount of energy remaining is consulted on this chart. The speed listed is the speed the vehicle could travel without any Performance Penalties.

Horse Energy Speed

Power	Points	in Km/h
280	20	57
420	30	70
560	40	81
700	50	91
840	60	99
980	70	107
1120	80	115
1260	90	121
1400	100	128
1540	110	134
1680	120	140
1820	130	146
1960	140	152
2100	150	157
2240	160	162
2380	170	167
2520	180	172
2660	190	177
2800	200	181
3080	220	190
3220	230	194
3360	240	198
3500	250	202
3640	260	206
3780	270	210
3920	280	214
4060	290	218
4200	300	222

For values other than those given here see the Appendix: Medium Vehicle Speed Calculations.

Fire Arcs

Medium vehicles have 8 fire arcs.

Critical Hits

Medium vehicles have a base 30% chance of a critical hit for all their critical locations. This number is modified by the Armor Rating of the vehicle, any Performance Penalties and the modifications for the chassis itself.

Medium vehicles add one extra critical hit location for their hull. The hull will now have two critical hit locations and are usually designated front and back.

Three systems must be chosen for each critical hit location to be used as critical hits. The chosen systems must make sense for the hit locations.

Performance Penalties

For every five hundred (500) Kilograms of vehicle mass, the vehicle must take one (1) performance penalty. For each performance penalty the character designing the vehicle must make a Mechanical Engineering roll. If the roll is passed, the Player may choose the penalty, otherwise a random penalty is rolled.

Penalty List

Top Speed -10%
Piloting Modifier -10
Total Fuel Capacity -10%
Build Time x1.4
Hit Points -10%
Armor Rating -10%
+10% To 1 Critical location

Penalty Table

Roll 1D100	
1-10	Top Speed -10%
11-15	Top Speed -20%
16-25	Piloting Modifier -10
26-30	Piloting Modifier -20
31-40	Total Fuel Capacity -10%
41-45	Total Fuel Capacity -20%
46-55	Build Time x1.5
56-60	Build Time x2
61-70	Hit Points -10%
71-80	Armor Rating -10%
81-90	+10% To 1 Critical location
91-100	+20% To 1 Critical location

Heavy Vehicles

Hit Points

To determine the total HP of the Vehicle, add the total mass and multiply by the Armor Rating (AR) then divide by 750

HP = Total Mass x AR / 750

Speed

After the amount of energy that will drive the vehicle is determined and the effects of efficiency and drive system power loss is taken into consideration, the amount of energy remaining is consulted on this chart. The speed listed is the speed the vehicle could travel without any Performance Penalties.

Horse Power	Energy Points	Speed in Km/h
700	50	57
1,400	100	80
2,100	150	98
2,800	200	113
3,500	250	127
4,200	300	139
4,900	350	150
5,600	400	160
6,300	450	170
7,000	500	179
7,700	550	188
8,400	600	196
9,100	650	204
9,800	700	212
10,500	750	219
11,200	800	227
11,900	850	234
12,600	900	240
13,300	950	247
14,000	1000	253
15,400	1100	266
16,800	1200	278

18,200	1300	289
19,600	1400	300
21,000	1500	310
22,400	1600	320
23,800	1700	330
25,200	1800	340
26,600	1900	349
28,000	2000	358

For values other than those given here see the Appendix: Heavy Vehicle Speed Calculations.

Fire Arcs

Heavy vehicles have 8 fire arcs.

Critical Hits

Heavy vehicles have a base 30% chance of a critical hit for all their critical locations. This number is modified by the Armor Rating of the vehicle, any Performance Penalties and the modifications for the chassis itself.

Heavy vehicles add two extra critical hit location for their hull. The hull will now have three critical hit locations and are usually designated front, back and belly or deck. This is up to the designer.

Three systems must be chosen for each critical hit location to be used as critical hits. The chosen systems must make sense for the hit locations.

Performance Penalties

For every four thousand (4,000) Kilograms of vehicle mass, the vehicle must take one (1) performance penalty. For each performance penalty the character designing the vehicle must make a Mechanical Engineering roll. If the roll is passed, the Player may choose the penalty, otherwise a random penalty is rolled.

Penalty List

Top Speed -10%
Piloting Modifier -10
Total Fuel Capacity -10%
Build Time x1.2
Hit Points -10%
Armor Rating -10%
+10% To 1 Critical location

Penalty Table

Roll 1D100

1-10	Top Speed -10%
11-15	Top Speed -20%
16-25	Piloting Modifier -10
26-30	Piloting Modifier -20
31-40	Total Fuel Capacity -10%
41-45	Total Fuel Capacity -20%
46-55	Build Time x1.5
56-60	Build Time x2
61-70	Hit Points -10%
71-80	Armor Rating -10%
81-90	+10% To 1 Critical location
91-100	+20% To 1 Critical location

Super Heavy Vehicles

Hit Points

To determine the total HP of the Vehicle, add the total mass and multiply by the Armor Rating (AR) then divide by 750

HP = Total Mass x AR / 4000

Speed

After the amount of energy that will drive the vehicle is determined and the effects of efficiency and drive system power loss is taken into consideration, the amount of energy remaining is consulted on this chart. The speed listed is the speed the vehicle could travel without any Performance Penalties.

Horse Power	Energy Points	Speed in Km/h
4,200	300	55
7,000	500	71
14,000	1,000	100
21,000	1,500	122
28,000	2,000	141
35,000	2,500	158
42,000	3,000	173
49,000	3,500	187
56,000	4,000	200
63,000	4,500	212
70,000	5,000	224
77,000	5,500	235
84,000	6,000	245
91,000	6,500	255
98,000	7,000	265
105,000	7,500	274
112,000	8,000	283
119,000	8,500	292
126,000	9,000	300
133,000	9,500	308
14,000	1,000	100
28,000	2,000	141
42,000	3,000	173
56,000	4,000	200
70,000	5,000	224
84,000	6,000	245
98,000	7,000	265
112,000	8,000	283
126,000	9,000	300
140,000	10,000	316
210,000	15,000	387
280,000	20,000	447
350,000	25,000	500
420,000	30,000	548
490,000	35,000	592
560,000	40,000	632
630,000	45,000	671
700,000	50,000	707

For values other than those given here see the Appendix: Super Heavy Vehicle Speed Calculations.

Fire Arcs

Super Heavy vehicles have 8 fire arcs.

Critical Hits

Super Heavy vehicles have a base 30% chance of a critical hit for all their critical locations. This number is modified by the Armor Rating of the vehicle, any Performance Penalties and the modifications for the chassis itself.

Super Heavy vehicles add four extra critical hit location for their hull. The hull will now have five critical hit locations and are usually designated front, back and belly and deck. This is up to the designer.

Three systems must be chosen for each critical hit location to be used as critical hits. The chosen systems must make sense for the hit locations.

Performance Penalties

For every ten thousand (10,000) Kilograms of vehicle mass, the vehicle must take one (1) performance penalty. For each performance penalty the character designing the vehicle must make a Mechanical Engineering roll. If the roll is passed, the Player may choose the penalty, otherwise a random penalty is rolled.

Penalty List

Top Speed -5%
Piloting Modifier -2
Total Fuel Capacity -5%
Build Time x1.1
Hit Points -5%
Armor Rating -5%
+1% To 1 Critical location

Penalty Table

Roll 1D100

1-10	Top Speed -5%
11-15	Top Speed -10%
16-25	Piloting Modifier -4
26-30	Piloting Modifier -5
31-40	Total Fuel Capacity -5%
41-45	Total Fuel Capacity -10%
46-55	Build Time x1.1
56-60	Build Time x1.5
61-70	Hit Points -5%
71-80	Armor Rating -5%
81-90	+1% To 1 Critical location
91-100	+2% To 1 Critical location

Critical Hit Locations

Critical hit locations are definable segments of the vehicle. They are used to better determine what systems would be effected by damage before a vehicle has lost all it's hit points.

The Critical Hit Location Table

Each Critical Hit Location has a percent likelihood that it will take a critical hit. This is by default a standard number for the vehicle but can be modified by making the hull thicker in certain locations or by adding an engineering room as described previously. The percentages should be recorded with their Critical Hit Location.

The first step is generating the chart that randomly determines which critical hit location is hit in an attack. This depends on the direction that the attack is coming from and thus involves the vehicle's fire arcs. Light vehicles have only four (4) fire arcs but medium and larger vehicles have eight (8) fire arcs making the chart twice as complex.

For each fire arc, only certain Critical Hit Locations are in line of sight. For example, light vehicles have only one hull Critical Hit Location and that hull is likely visible from all fire arcs. Medium and larger vehicles have two or more Critical Hit Locations, usually these are designated front and back (although they do not have to be). In that case the front hull would not be visible from fire arc 6 and the back hull hit location would not be visible from fire arc 2.

For light vehicles, the hull hit location must be visible from all four fire arcs. All other Critical Hit Locations need to be visible from three consecutive fire arcs.

For medium vehicles and larger, each Critical Hit Location must be visible from five consecutive fire arcs.

A turret or arm that can fire into a fire arc must be visible from that fire arc.

Add up the number of hit locations visible in each fire arc and divide by ten. Then round to the nearest whole number. This number is used to determine how many digits it should take up on a 1D10 roll. For instance if the number is two (2), the first critical hit location would take up 1-2 on a 1D10 roll. The next hit location would take 3-4 on the 1D10 roll and so on.

It is likely that the number generated will not equal ten when the Critical Hit Locations are added up. If the number is less than ten, add one to one of the hull Critical Hit Locations. If the number is more than ten, subtract one from the hit location with the least amount of equipment in it.

Now that you have the chart of Critical Hit Locations you will need to determine what Critical Hit effects are in those locations.

Critical Hits

Critical Hits are used to simulate the effect of systems failure on a vehicle before it has lost all it's hit points. There are certain vehicle parts that count as Critical Hit Locations such as turrets, arms and drive systems. These also count as systems that can fail due to damage. Hull does not count as a system that can fail by a critical hit. Any device or system installed on a vehicle can be made eligible for a Critical Hit.

Three systems must be chosen for each Critical Hit Location to be used as Critical Hits. The Chosen systems must make sense for that hit location. The three systems chosen should be the three systems with the most mass, unless the GM approves a smaller system being selected. Remember to include the power generation equipment, it's fuel supply, drive equipment and arms in the list that are eligible as Critical Hits.

It is possible, even likely, that some critical hit locations will have fewer than three systems in them. If this is the case, only the systems that are logically in them should be listed. This may mean that there will not always be three Critical Hits in a hit location.

To determine the chance of hitting a Critical Hit on a Critical Hit Location, add the mass of all the chosen systems together. Then divide by ten (10) this number is the Mass Ratio.

Mass Ratio = Combined mass of chosen systems / 10

Then for each system, divide it's mass by the Mass Ratio and round to the nearest whole number or if it is too low, record a one (1). Record this number for each system. The number indicates the likelihood of a system being hit in that Critical Hit Location.

Likelihood = System mass / Mass Ratio

Round the Likelihood number to the nearest whole number and record it.

Add all three Likelihood numbers together. If they add up to ten (10) move on to the next step. If they are higher than ten (>10), subtract one (1) from the largest Likelihood number until ten (10) is reached. If they add up to less than ten (<10) add one (1) to the largest system until ten (10) is reached. Record the adjusted Likelihood numbers.

The Likelihood number recorded for each number is used to determine how many digits it should take up on a 1D10 roll. For instance if the Likelihood number is five (5) for a system it could take up 1-5 on a 1D10 roll. If the next system has a Likelihood number of 3 it could take up 6-8 on a 1D10 roll. When done the three systems should occupy all the digits of a rolled 1D10. Record these table results.

Critical Effect

To determine the effect of the critical hit, roll on the table below. Remember that unless the Critical Effect is "Catastrophic Failure" the effect is only on the system that is damaged, not the whole vehicle.

Roll 1D10	
1-2	Quarter failure
3-4	Half failure
5-8	Total failure
9-10	Catastrophic failure

Quarter Failure

Whatever the system does, it has lost one quarter of it's capacity. The GM should agree on the result of this effect.

Half Failure

The system looses one half of it's capacity to function.

Total Failure

The system has completely failed, it no longer functions.

Catastrophic Failure

The destruction of this system causes a catastrophic failure of other systems until the vehicle is completely disabled.

Equipment

Type Tracked
Model **R4 Bulldozer**

Because of the cost and difficulty of transporting large vehicles to The Artifact, the bulldozers that have been teleported are small bulldozers. However they are still highly effective.

Overall height **2.7m**
Overall width **4m**
Overall length **9m**
Dry Mass **8919 Kg**
Full Mass **9269 Kg**

Power plant type: Internal Combustion

Movement
Top Speed 20 Km/h
Total fuel capacity: 12 Hours 187 L
Fuel type: Diesel

Armor Rating: 30
Hit Points: 300
Crew: 1
Passengers: 1
Piloting Modifier:-30
Cost: $120,000

Sensors: None

Manhour Rating = 75 Earthmoving.

Fire Arcs

1	2	3
8	●	4
7	6	5

Hit locations 1d10

Arc1	Arc2	Arc3	Arc4	
1-4	1-8	1-4	-	Front
5-7	9-10	5-7	1-6	Track
8-10	-	8-10	7-10	Side
-	-	-	-	Back

Arc5	Arc6	Arc7	Arc8	
-	-	-	-	Front
1-3	1-6	1-3	1-6	Track
4-6	-	4-6	7-10	Side
7-10	7-10	7-10	-	Back

Critical Hits 1D10
Front 30% chance of critical
1-5 Engine damaged, speed and Manhour rating down 50%
6-10 Pilot Cabin, pilot takes 50% of damage to vehicle.

Track 30% chance of critical
1-10 Tread damaged. speed and Manhour rating down 50%

Side 60% chance of critical
1-3 Engine damaged, speed and Manhour rating down 50%
4-10 Pilot Cabin, pilot takes 50% of damage to vehicle.

Back 60% chance of critical
1-2 Transmission Damage, speed and Manhour rating down 50%
3-10 Pilot Cabin, pilot takes 50% of damage to vehicle.

Variant: Armored Bulldozer

This is usually a field prepared variant. Slabs of CCC or steel with concrete poured in front of it add huge amounts of hit points and greatly reduce the chances of critical hits.

Armor Rating: 40
Hit Points: 1000
Manhour Rating = 50 Earthmoving.

All critical location percentages are reduced by 25%

Skid Steer

Type Tracked
Model **Skid Steer**

Because of the cost and difficulty of transporting large vehicles to The Artifact, the bulldozers that have been teleported are small bulldozers. However they are still highly effective.

Overall height **2 m**
Overall width **1.7 m**
Overall length **3.5 m**
Dry Mass **3,525 Kg**
Full Mass **3,625 Kg**

Power plant type: Internal Combustion

Movement
Top Speed 10 Km/h
Total fuel capacity: 24 Hours 50 L
Fuel type: Gasoline

Armor Rating: 10
Hit Points: 100
Crew: 1
Passengers: 0
Piloting Modifier:-20
Cost: $25,000

Sensors: None

Manhour Rating = 20 Earthmoving, 10 Heavy Lifting.

Fire Arcs

\ 1 /

4 ● 2

/ 3 \

Hit locations 1d10

Arc1	Arc2	Arc3	Arc4	
1-4	1-8	1-4	-	Front
5-7	9-10	5-7	1-6	Track
8-10	-	8-10	7-10	Side
-	-	-	-	Back

Arc5	Arc6	Arc7	Arc8	
-	-	-	-	Front
1-3	1-6	1-3	1-6	Track
4-6	-	4-6	7-10	Side
7-10	7-10	7-10	-	Back

Critical Hits 1D10
Front 30% chance of critical
1-5 Engine damaged, speed and Manhour rating down 50%
6-10 Pilot Cabin, pilot takes 50% of damage to vehicle.

Track 30% chance of critical
1-10 Tread damaged. speed and Manhour rating down 50%

Side 60% chance of critical
1-3 Engine damaged, speed and Manhour rating down 50%
4-10 Pilot Cabin, pilot takes 50% of damage to vehicle.

Back 60% chance of critical
1-2 Transmission Damage, speed and Manhour rating down 50%
3-10 Pilot Cabin, pilot takes 50% of damage to vehicle.

Tractor Trailer

Type Wheeled
Model **Tractor Trailer**

Although poorly suited for unprepared roads, Tractor Trailers are very useful for moving large amounts of cargo. Tractor Trailers are able to haul especially very heavy loads that Scimrahn Freighters cannot carry. The stats here are for a tractor trailer with a flatbed trailer but other types of trailers are similar but likely have a smaller cargo capacity.

Overall height 4 m
Overall width 2.59 m
Overall length 6 m
Dry Mass 12,000 Kg
Full Mass 112,000 Kg

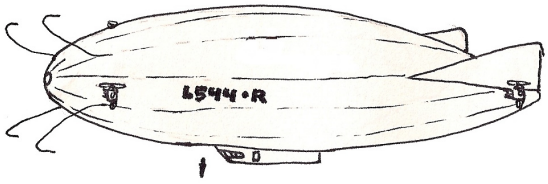
Power plant type: Internal Combustion

Movement
Top Speed 210 Km/h
Total fuel capacity: 13 Hours 1500 L
Fuel type: Diesel

Armor Rating: 10
Hit Points: 600
Crew: 1
Passengers: 1-3
Piloting Modifier:-30
Cost: ¥20,00,000

Sensors: None
Cargo Capacity: 100,000 Kg

I-CA Vehicle



Type Dirigible
Model **Catfish**

The Catfish model is a helium filled semi rigid dirigible. It has a much longer range than heavy lift helicopters and can carry far more weight. The catfish is a very large dirigible, it has steel bumpers that extend out in the front of the vehicle to prevent collisions with walls and give the Catfish it's name.

Overall height 30m
Overall width 27.2m
Overall length 232m
Dry Mass 100,100 Kg
Full Mass 180,100 Kg

Power plant type: Internal Combustion.

Movement
Flying Top Speed 120 Km/h
Total fuel capacity: 30 Hours
Fuel type: Gasoline / Alcohol

Armor Rating: 5
Hit Points: 400

Crew: 30
Passengers: 85
Piloting Modifier: -30
Cost: ¥46,000,000

Sensors: +5 to Int
Range Class: D
Cargo Capacity: 80,000 Kg

Fire Arcs

1	2	3
8	●	4
7	6	5

Hit locations 1d10

Arc1	Arc2	Arc3	Arc4	
1-4	1-6	1-4	1-2	Front
5	-	5	3-4	Back
6	-	6	5-6	Belly
7-8	7-8	7-8	7-8	Cockpit
9	9	9	9	Engine
10	10	10	10	Fin

Arc5	Arc6	Arc7	Arc8	
1	-	1	1-2	Front
2-5	1-6	2-5	3-4	Back
6	-	6	5-6	Belly
7-8	7-7	7-8	7-8	Cockpit
9	9	9	9	Engine
10	10	10	10	Fin

Critical Hits 1D10

Front 60% chance of critical
1-8 Gas bag rupture 20 Km/h decent
9-10 Sensors destroyed

Back 60% chance of critical
1-8 Gas bag rupture 20 Km/h decent
9-10 Fuel Explosion! 100 points 10m blast radius

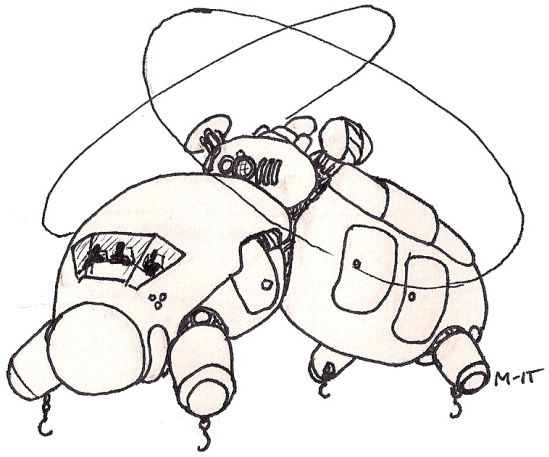
Belly 60% chance of critical
1-5 Gas bag rupture 20 Km/h decent
6-10 Cargo damaged

Cockpit 30% chance of critical
1-8 Crew Hit 1D10 crew killed.
9-10 Controls damaged -30 to pilot

Engine 30% chance of critical
1-5 Engine damage, energy cut in half, all systems at half power.
5-10 Fuel explosion! 100 points 10m blast radius

Fin 30% chance of critical
1-10 Rudder Damage -20 to pilot

ASO Vehicle



Type Helicopter

Model **J3N1 "Big Jenny"**

The J3N1 is a multifunction heavy lift helicopter. It is a twin counter rotating rotor design that uses cross thrust to stabilize heavy loads. Although the blade counter rotate they can vary their rate of rotation to generate more or less thrust. On board computers track the blades in real time and ensure that they do not collide. In addition to this the J3N1 had four modular cargo pods that allow it to modify its primary heavy lift function into hostile extractions and as a fuel transport. The Heavy Lift functionality comes from four on board cranes that extend from the four corners of the helicopter.

Overall height 8.3m
Overall width 29.4m
Overall length 36m

Dry Mass 29,000 Kg
Full Mass 41,500 Kg

Power plant type: Internal Combustion.

Movement
Flying Top Speed 300 Km/h
Total fuel capacity: 3 Hours
Fuel type: Gasoline

Armor Rating: 4
Hit Points: 110
Crew: 3 (2 Pilots 1 Crane Operator)
Passengers: 10
Piloting Modifier:-20
Cost: $25,000,000

Sensors: +5 to Int
Range Class: D

Cargo Capacity: 12,000 Kg

Fire Arcs

1	2	3
8	●	4
7	6	5

Hit locations 1d10

Arc1	Arc2	Arc3	Arc4	
1-4	1-4	1-4	1-4	Body
5-6	5-7	5-6	5	Cockpit
7-9	8-10	7-9	6-7	Rotor
10	-	10	8-10	Cargo pod

Arc5	Arc6	Arc7	Arc8	
1-2	1	1-2	1-4	Body
-	-	-	5	Cockpit
3-5	2-4	3-5	6-7	Rotor
6-10	5-10	6-10	8-10	Cargo pod

Critical hits 1d10
Body 30% chance of critical
1-2 Cargo hook destroyed
3-6 Engine damage 40 Km/h decent
7-8 Fuel explosion! 100 points 10m blast radius
9-10 Sensors destroyed

Cockpit 30% chance of critical
1-4 Controls damaged -30 to pilot
6-10 Crew killed

Rotor 50% chance of critical
1-10 Rotor destroyed

Cargo pod 30% chance of critical
1-2 Cargo in left front pod destroyed
3-4 Cargo in right front pod destroyed
5-7 Cargo in left back pod destroyed
8-10 Cargo in right back pod destroyed

25mm Machine Gun Pod
Reduces the total cargo capacity by 3000 Kg but adds a gunner station with a 25mm Machine Gun.

	PB	S	Med	L	E x
Damage:	80	80	70	65	40

Range Class: C
Payload: 300 rounds
Rate of Fire: 30

Troop Pod
Reduces the total cargo capacity by 3000 Kg but adds the capacity to carry troops and give light fire support.
Passengers = 12

Machine Gun

	PB	S	Med	L	Ex
Damage:	20	20	18	16	10

Range Class: C
Payload: 600
Rate of Fire: 60

Machine Gun Grenade Launcher

	PB	S	Med	L	Ex
Damage:	50	40	20	10	2

Range Class: C
Blast Range Class: A
Payload: 100
Rate of Fire: 8

Fuel Pod
Reduces the total cargo capacity by 3000 Kg but adds large fuel tanks that can be used to refuel other vehicles. Because the fuel may be of different types the J3N1 does not have the ability to draw fuel from these pods directly. A Repair Machinery roll and 2 manhours of work can make the J3N1 use the tank to extend it's range.
Liters of fuel:

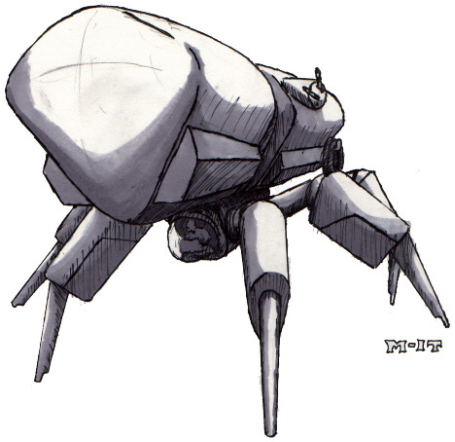
Missile Pod
Reduces the total cargo capacity by 3000 Kg but adds a powerful pilot operated missile launcher.

Missile Rack

	PB	S	Med	L	Ex
Damage	1000	500	500	250	50

Blast Range Class: B
Range Class C
Payload 50
Rate of fire 1-50
Fire Arcs 4 or 8

Scimrahn Vehicle



Type Anti-Grav
Model **Fuel Carrier**
This is a variant of the Scimrahn Freighter that has a hull designed to carry liquid instead of dry cargo. These vehicles are very dangerous to pilot because of the huge quantity of fuel they carry.

Overall height 6.3 m
Overall width 3.1 m
Overall length 12.4 m
Dry Mass 5,493 Kg
Full Mass 15,200 Kg

Power plant type: Anti-Grav

Movement
Top Speed 80 Km/h
Total fuel capacity: 2 Months 1,050.6 L
Fuel type: Liquid Carbon

Armor Rating: 10
Hit Points: 1500
Crew: 2
Passengers: 2
Piloting Modifier:-20
Cost: 7,000,000

2 Turrets of 2 Lasers

	PB	S	Med	L	Ex
Damage	20	20	10	5	1

Range Class C
Rate of fire 1 each (4 total)
Fire Arcs T1-1,2,3 T2-1,3,4

ECCM: +5 to skill
Range Class: B
Sensors: +5 to skill
Range Class: C

Cargo Capacity: 9,707 Kg

Shield Information
Shields: 1 active at 100 hp
No. of shields: 2 (Arcs 1+3)

Fire Arcs

Hit locations 1d10

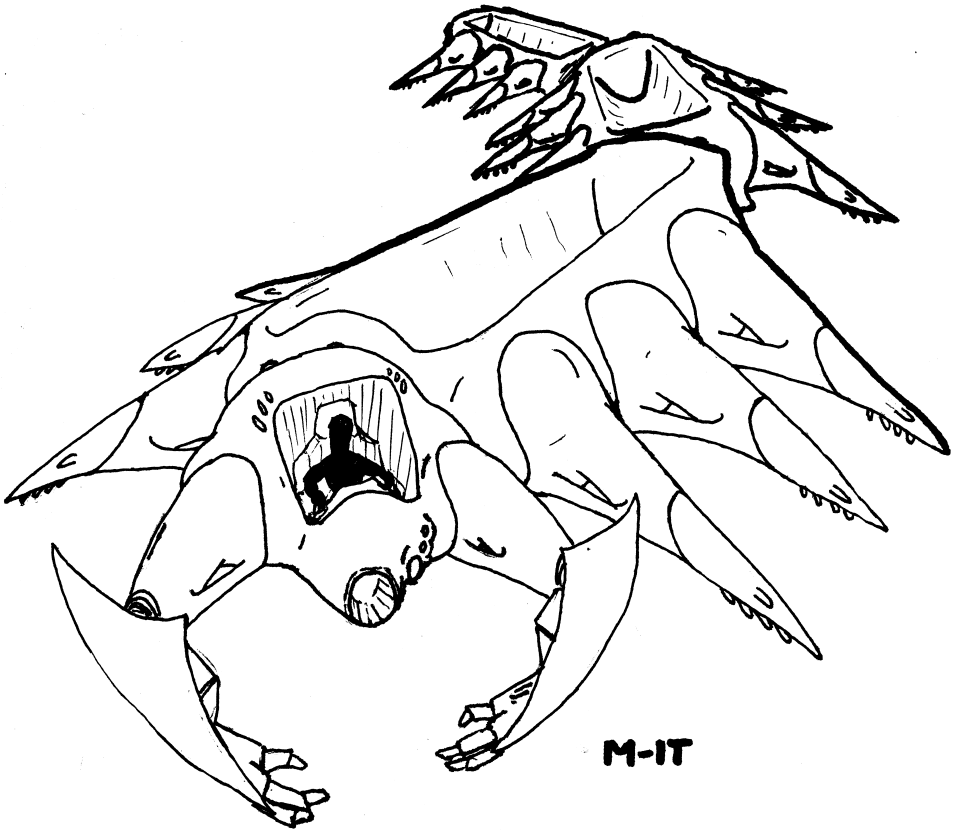
Arc 1	Arc 2	Arc 3	Arc 4	
1-6	1-5	1-3	1-5	Body
7-8	6-8	4-5	-	R Leg
9-10	-	6-7	6-8	L Leg
-	9-10	8-10	9-10	AG Engine

Critical hits 1d10
Body 20% chance of critical
1-2 Cockpit, pilot killed
3 Laser Destroyed
4-10 Cargo damaged

Engine 35% chance of critical
1-4 Fuel Explosion! 800 points 10m blast radius
5-10 Engine damage, all systems at half power.

Leg 30% chance of critical
1-10 Linkages, Leg inoperable Top speed down 1/6

C-Suit



Type C-Suit
Model **Builder 562869**

This Chezbah C-Suit is a mining and emergency rescue vehicle. It is used for mining ore a the core and is used to rescue workers that have been trapped in fallen rubble. Many Chezbah cities use these when they are being rebuilt and one or more will remain in the city afterward but often fall into disrepair.

The C-Suit walks on it's many legs to distribute it's mass on soft ground. Even when fully loaded it can travel well on loose ground and rubble without disturbing it, an important function for rescue operations.

Overall height 2.6 m
Overall width 6.2 m
Overall length 24 m

The Artifact 69

Dry Mass **8,919Kg**
Full Mass **27,269 Kg**

Power plant type: Electrical

Movement
Top Speed 40 Km/h
Total fuel capacity: 12 Hours
Fuel type: Batteries

Armor Rating: 70
Hit Points: 3000
Crew: 1
Passengers: 100 (in cargo beds)
Piloting Modifier:-40
Cost: 10,000,000

Particle Beam
Used for cutting into stone or CCC. This tool is useful for mining and rescue.

	PB	S	Med	L	Ex
Damage	10 K	9 K	2 K	1 K	100

Range Class A
Rate of fire 1
Fire Arc 1-3

Sonic Hammer
Used to shake apart tightly packed stones when mining. This tool is too unpredictable for rescue operations.

	PB	S	Med	L	Ex
Damage	500	500	200	100	50

Range Class A
Rate of fire 1
Fire Arc 1-3

Sensors: +5 to skill
Range Class: B

Cargo Capacity: 18,000 Kg

Manhour Rating
Earthmoving 120

Shield Information
Shields: 1 active at 200 hp
No. of shields: 1 (Arc 1 only)

Fire Arcs

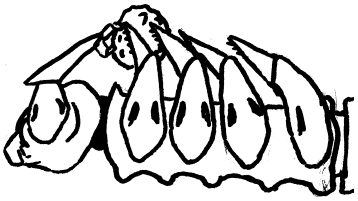
1	2	3
8	●	4
7	6	5

Hit locations 1d10

Arc1	Arc2	Arc3	Arc4	
1-4	1-6	1-4	1-2	Head
5	7-8	5	3	Arms
6-8	9	6-8	4-7	Legs
9-10	10	9-10	8-10	Bin

Arc5	Arc6	Arc7	Arc8	
-	-	-	1-2	Head
1	1	1	3	Arms
2-7	2-6	2-7	4-7	Legs
8-10	7-10	8-10	8-10	Bin

Critical hits 1d10



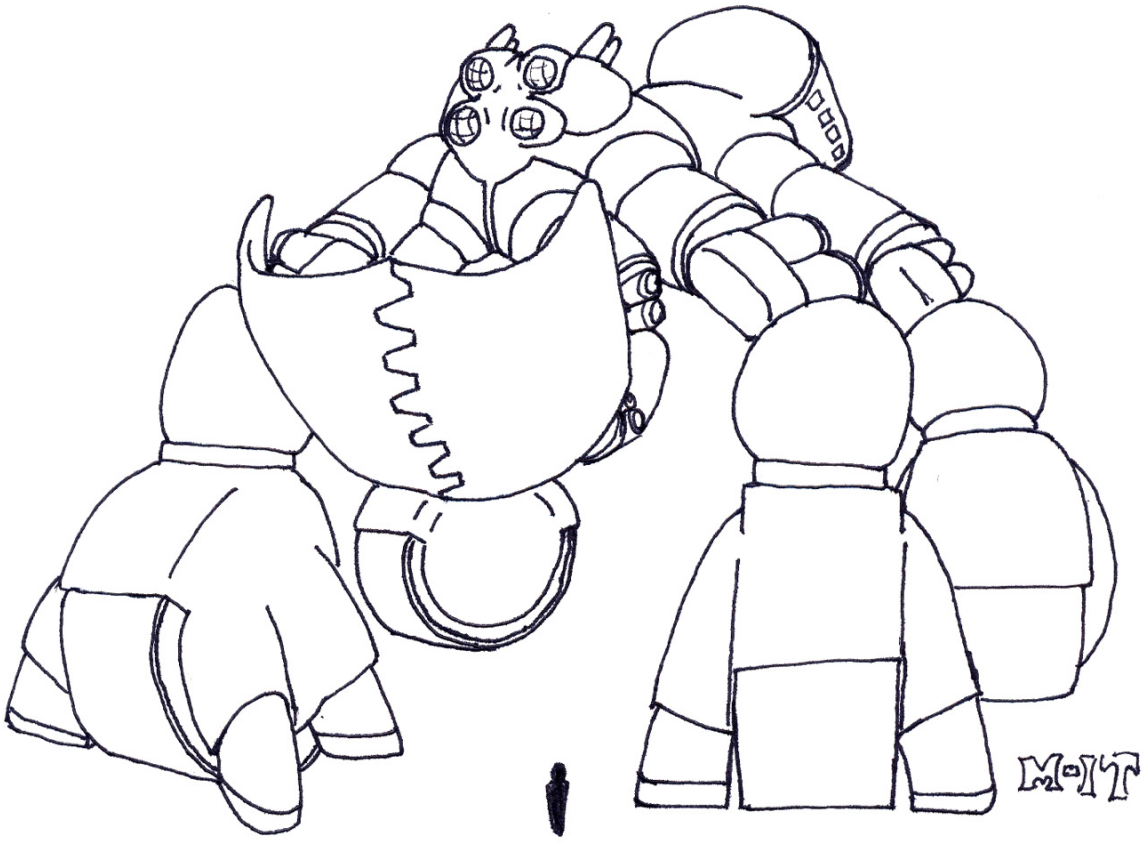
Head chance of critical 40%
1-3 Cockpit, pilot killed vehicle disabled.
4-7 Particle Beam destroyed.
8-10 Sonic Hammer destroyed.

Arms chance of critical 40%
1-10 Linkages damaged, arm inoperable.

Legs chance of critical 40%
1-4 Linkages damaged speed down 10%
5-10 Batteries destroyed speed down 10%

Bin chance of critical 20%
1-8 Cargo damaged, cargo takes 50% of damage to vehicle.
9 Batteries damaged, sensors and equipment at 50% power, does not effect movement.
10 Bin Coupler destroyed, one of the bins is disconnected, cargo capacity down 6000 Kg

C-Suit



Type C-Suit
Model **Kennis Thuphe**

The Kennis Thuphe is the largest C-Suit in production. There are several other heavy construction vehicles that the Kelrath produce but they are not considered C-Suits. Because it's size and power it is highly prized by the Scimrahn when building rubble pile style safe houses.

The name of the C-Suit means "Big Kennis", Kennis being the oracle called "the master builder". This enormous E-Suit is used for heavy lifting and earthmoving. Most large Kelrath cities have at least one and mining communities will often have several.

A small number of these have become available to Earth forces.

The Kennis Thuphe uses a hybrid drive system. When moving any distances, the C-Suit uses its wheels to move. When moving over heavily broken ground it walks by moving one leg at a time. When digging or lifting it's eight toes stabilize the front two legs.

Overall height	**20.3 m**
Overall width	**28.9 m**
Overall length	**35.3 m**
Dry Mass	**390,900 Kg**
Full Mass	**681,056 Kg**

Power plant type: Internal Combustion

Movement
Driving Top Speed 10 Km/h
Walking Top Speed: 2 Km/h
Total fuel capacity: 12 Hours 6883 L
Fuel type: Liquid Carbon

Armor Rating: 90
Hit Points: 17,000
Crew: 4
Passengers: 2
Piloting Modifier:-50
Cost: 3,200,000,000

Sensors: Ground penetrating radar in toes
Range Class: B

Manhour Rating
Earthmoving 400
Heavy Lifting 1500

Lifting Capacity: 280,000 Kg

Fire Arcs

1	2	3
8	●	4
7	6	5

Hit locations 1d10

Arc1	Arc2	Arc3	Arc4	
1-3	1-4	1-3	1-2	Shovel
4-5	5-6	4-5	3-4	Wheels
6-7	7-8	6-7	5-7	Legs
8-9	9-10	8-9	8-9	Body
10	-	10	10	Cockpit

Arc5	Arc6	Arc7	Arc8	
1	-	1	1-2	Shovel
2-3	1-2	2-3	3-4	Wheels
4-5	3-4	4-5	5-7	Legs
6-8	5-7	6-8	8-9	Body
9-10	8-10	9-10	10	Cockpit

Critical hits 1d10

Shovel chance of critical 20%
1-10 Linkages

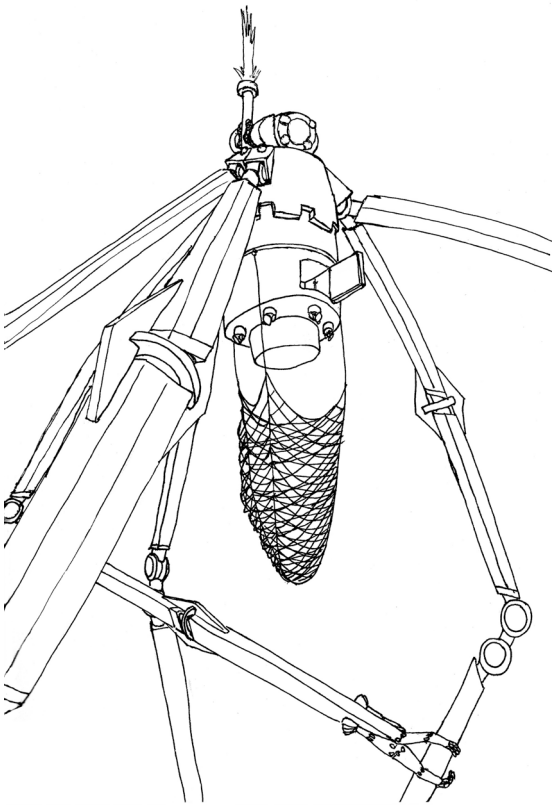
Wheels chance of critical 20%
1-4 Engine Damage, all systems at half power.
5-10 Fuel Explosion! 800 points 10m blast radius

Legs chance of critical 30%
1-7 Linkages, leg inoperable speed down 1/2
8-10 Stabilizing toes damaged, vehicle unable to lock in place for lifting

Body chance of critical 30%
1-6 Fuel Explosion! 800 points 10m blast radius
7-8 Floodlight destroyed
9-10 Computer damaged -40 to pilot

Cockpit chance of critical 30%
1-8 Crew killed
9-10 Gyroscope damaged -30 to pilot

C-Suit



Type C-Suit
Model **Hosent Walking Robot**

These C-Suits are made from a Hosent robot removed from it's housing and powered electrically by harvesting ultracapacitors from the power management systems in the Power Hex nearby.

The Hosent robot is reprogrammed and controls are attached to it's computer. Then it extends it's arms down to the ground and it's connection to the housing is cut. As this severs the electrical connection to the robot, an extension cord must be made to reconnect it to power. This cord is often harvested from another hex and is up to ten kilometers long. Once powered, the robot then lowers itself to the ground and one of the walls of the Hosent's housing is disassembled allowing the robot to exit. Next the Hosent robot's arms must be reconfigured and reenforced to hold up the mass of it's body. Once this is done, it is a Hosent Walking Robot but it is only powered by it's extension cord. In some industry tribes it is left this way as it does not leave a specified area. However if the Walking Robot is to be used as a vehicle, it is now piloted to the Power Hex and a battery of utracapacitors is removed and attached to the power input of the robot. Now the vehicle is able to travel short distances.

The Hosent Walking Robot is one of the oldest C-Suits in the history of The Artifact. When they started to be built is not entirely clear but it was the Scimrahn that make use of them most often today. In fact only a few centuries ago the Scimrahn used them as general purpose vehicles. It is said that the Hunter E-Suit was specifically designed to hunt down and destroy Hosent Walking Robots.

These vehicles are durable but their legs are not well suited to lifting the mass of the body. Because of this, the loss of a single leg can either topple or immobilize the vehicle.

Overall height **141.2 m**
Overall width **35.4 m**
Overall length **35.4 m**
Dry Mass **150,230 Kg**
Full Mass **152,466 Kg**

Power plant type: Electrical

Movement
Walking Top Speed: 25 Km/h

Total fuel capacity: 1.5 Hours
Fuel type: Electrical

Armor Rating: 40
Hit Points: 3,500
Crew: 1
Passengers: 12
Piloting Modifier:-60
Cost: 500,000

Sensors: Sonar
Range Class: B

Manhour Rating
Earthmoving 40
Heavy Lifting 20

Lifting Capacity: Kg

Fire Arcs

1	2	3
8	●	4
7	6	5

Hit locations 1d10

Arc1	Arc2	Arc3	Arc4	
1-5	1-5	1-5	1-5	Leg
6-8	6-8	6-8	6-8	Body
9	9	9	-	Cockpit
10	10	10	9-10	Power Supply

Arc5	Arc6	Arc7	Arc8	
1-5	1-5	1-5	1-5	Leg
6-8	6-8	6-8	6-8	Body
-	-	-	-	Cockpit
9-10	9-10	9-10	9-10	Power Supply

Critical hits 1d10
Body chance of critical 20%
Power Supply damaged
Hydraulic system damaged
Brain destroyed

Arc Furnace/Cockpit chance of critical 20%
Controls destroyed
Cockpit hit pilots killed

Legs chance of critical 50%
1-6 Linkages vehicle immobilized
7-10 Bracing damaged vehicle collapse

Power Supply chance of critical 40%
1-10 Power Supply damaged 1/4th of all power lost

Equipment

Bomb Sniffer

A bomb sniffer is a chemical detector that draws in samples of air and tests for chemicals in explosives. The bomb sniffer is calibrated to explosives that are manufactured on Earth but have been modified to detect LCF
Mass: 402 g
Cost: ¥30,000

Cutting Explosives

See page 24

	PB	S	Med	L	Ex
Damage:	25	1	0	0	0

Blast Range Class: A +1 Range Class for more than 500 grams
Mass: 5 G
Black Market Cost: ¥800 for 5 grams

E-Suit Entrenchment Tool (BHS Big Hydraulic Shovel)

A cross between a shovel, and a jackhammer, the BHS as it is often referred to connects to the E-Suits Hydraulic systems to generate a jackhammer action for cutting though soil or breaking rocks and CCC.
Mass: 315 Kg
Cost: ¥110,000

Electrical Cable

This is electrical cable that is used to carry power through hexes but is often wrapped in cloth or an insulator to make a kind of extension cord. The cable is scavenged and then whatever insulator that is available is wound around it.

Gauss Meter

A Gauss Meter is a measuring device for detecting the strength of magnetic fields. It has many uses, one of which is to tell if electrical cables are electrified and with a successful Mathematics skill roll the amount of power going through can be determined. The location of magnetic mines can be pinpointed with this device.
Mass: 1 Kg
Cost 34,000

Ground Penetrating Radar/Sonar

These devices can detect the presence of hard materials buried underground. They can also be used to find hidden passages in floors, walls or soil.
Mass: 40 Kg

Cost: 28,000,000

Particle Cutter

This is a Scimrahn tool used to cut out the outline of a CCC Slab and then the slab is sheared off with an electrothermal device, or explosives

	PB	S	Med	L	Ex
Damage	200	30	5	1	1

Range Class: A
Payload: Draws from Hex Power
Mass: 18 Kg
Cost: ¥110,000

PHE Rapid 40mm gun

The PHEG (pronounced 'peg' by some but most normally 'feg') stands for Penetrating High Explosive Gun and is use for drilling tunnels. The PHEG fires a 40mm caseless round that penetrates into its target and then detonates. This process is used in bunker demolition on earth against heavy concrete structures. It is effective against low to medium grade CCC but not HDCCC as the round does not penetrate.

In rock the PHEG will blast a 1m by 1m hole 50cm deep per round, but CCC breaks differently and the size of the tunnel is dependent on the direction of the grain. When firing into the grain, the hole is often 3m tall and 30cm wide and 30cm deep, firing against the grain causes more dramatic fracturing and will open a 1.5m by 1.5m and 30cm deep hole.

	PB	S	Med	L	Ex
Damage:	250	250	220	190	120

Range Class: B
Payload: 25 per belt
Rate of Fire: 20
Mass: 402 Kg
Cost: ¥1,800,000

Plasma Wand

A Plasma Wand is a small plasma torch that is used to clean off white spoor, chemical, biological and nanotech weapon residues. The amount of plasma that is used is very small and will not harm most materials if handled properly. If the plasma wand is left in one place it can ignite combustible materials.
Mass: 740 g
Cost: ¥1,200

Wheelbarrow

Wheelbarrows cut the time that it takes to move soil.

One person with a wheelbarrow can move four times the amount of soil in the same amount of time.
Mass: 8 Kg
Cost: ¥1,800

Appendix

Laser Calculations
Base Energy Usage
PB Damage x PB Damage / 8,000

Base Mass
PB Damage x PB Damage / 300

Plasma Calculations
Base Energy Usage
PB Damage x PB Damage / 40,000

Base Mass
PB Damage x PB Damage / 500

Particle Beam Calculations
Base Energy Usage
PB Damage x PB Damage / 300,000

Base Mass
PB Damage x PB Damage / 1,600

Meta Atom Calculations
Base Energy Usage
PB Damage x PB Damage / 40,000

Base Mass
PB Damage x PB Damage / 100

Chemical Projectile Calculations
Base Mass
PB Damage x PB Damage / 400

Mechanical Projectile Calculations
Base Energy Usage
PB Damage x PB Damage / 35,000

Base Mass
PB Damage x PB Damage / 15

ETC Projectile Calculations
Base Energy Usage
PB Damage x PB Damage / 20,000

Base Mass
PB Damage x PB Damage / 350

Electromagnetic Projectile Calculations
Base Energy Usage
PB Damage x PB Damage x PB Damage / 1,000,000
*note PB Damage is multiplied three times instead of two

Base Mass
PB Damage x PB Damage / 100

Light Vehicle Speed Calculations
√ Energy to Movement x 3000

Medium Vehicle Speed Calculations
√ Energy to Movement x 165

Heavy Vehicle Speed Calculations
√ Energy to Movement x 64

Super Heavy Vehicle Speed Calculations
√ Energy to Movement x 10

Vehicle Type:
Model:

Overall height:
Overall Width:
Overall Length:
Dry Mass:
Full Mass:
Vehicle Rating:

Power plant type:
Power plant energy:
Power plant mass:
Fuel Type:
Fuel capacity:
Fuel mass:

Material Collection Time:
Materials To Parts:
Assembly Time:

Hull Data
Hull Material:
Hull Thickness:
Armor Rating:
Hull Multiplier:
Hit Points:

Hull Mass:

Piloting Modifier
Equipment Piloting Modifier:

Control Systems

Control Piloting Modifier:

Piloting Modifier:

Weapons

	PB	S	Med	L	Ex
Damage:					
Energy:					
Mass:					
Range Class:					
ROF:					
Payload:					

	PB	S	Med	L	Ex
Damage:					
Energy:					
Mass:					
Range Class:					
ROF:					
Payload:					

	PB	S	Med	L	Ex
Damage:					
Energy:					
Mass:					
Range Class:					
ROF:					
Payload:					

Total Energy:
Total Mass:

Shields
No. of Shields:
HP:
Energy:
Mass:
Total Piloting Modifier:

Fire Arcs Covered

\ /
●
/ \

Drive system type:
Drive system mass:
Energy to Movement:
Max Vehicle Mass:
Top Speed:

Drive system type:
Drive system mass:
Energy to Movement:
Max Vehicle Mass:
Top Speed:

Arms
of Arms:
Str:
Punch Damage:
Dex CDF:
Length:
Mass:
Energy:

Turrets
Item:
Fire Arcs:
Item Mass:
Turret Mass:

Item:
Fire Arcs:
Item Mass:
Turret Mass:

Sensors
Skill Modifier:
Range Class:
Energy:
Mass:

ECM
Skill Modifier:
Range Class:
Energy:
Mass:

ECCM
Skill Modifier:
Range Class:
Energy:
Mass:

Total Energy:
Total Mass:

Design

Equipment

Item	Mass	Energy

Total Mass:
Total Energy:

Performance Penalties
Number of Penalties:

Critical Hits

Arc 1	Arc 2	Arc 3	Arc 4	Critical Hit Location

Critical Hit Locations

Location		Crit

Notes

Vehicle Type:
Model:

Overall height:
Overall Width:
Overall Length:
Dry Mass:
Full Mass:
Vehicle Rating:

Power plant type:
Power plant energy:
Power plant mass:
Fuel Type:
Fuel capacity:
Fuel mass:

Material Collection Time:
Materials To Parts:
Assembly Time:

Hull Data
Hull Material:
Hull Thickness:
Armor Rating:
Hull Multiplier:
Hit Points:

Hull Mass:

Piloting Modifier
Equipment Piloting Modifier:

Control Systems

Control Piloting Modifier:

Piloting Modifier:

Weapons

	PB	S	Med	L	Ex
Damage:					

Energy:
Mass:
Range Class:
ROF:
Payload:

	PB	S	Med	L	Ex
Damage:					

Energy:
Mass:
Range Class:
ROF:
Payload:

	PB	S	Med	L	Ex
Damage:					

Energy:
Mass:
Range Class:
ROF:
Payload:

Total Energy:
Total Mass:

Shields
No. of Shields:
HP:
Energy:
Mass:
Total Piloting Modifier:

Fire Arcs Covered

Drive system type:
Drive system mass:
Energy to Movement:
Max Vehicle Mass:
Top Speed:

Drive system type:
Drive system mass:
Energy to Movement:
Max Vehicle Mass:
Top Speed:

Arms
of Arms:
Str:
Punch Damage:
Dex CDF:
Length:
Mass:
Energy:

Turrets
Item:
Fire Arcs:
Item Mass:
Turret Mass:

Item:
Fire Arcs:
Item Mass:
Turret Mass:

Sensors
Skill Modifier:
Range Class:
Energy:
Mass:

ECM
Skill Modifier:
Range Class:
Energy:
Mass:

ECCM
Skill Modifier:
Range Class:
Energy:
Mass:

Total Energy:
Total Mass:

Design

Equipment

Item	Mass	Energy

Total Mass:
Total Energy:

Performance Penalties
Number of Penalties:

Critical Hits

Arc 1	Arc 2	Arc 3	Arc 4	Critical Hit Location

Arc 5	Arc 6	Arc 7	Arc 8	Critical Hit Location

Critical Hit Locations

Location		Crit

Notes