Intro

This is the updated 3rd edition of **Guns!, Guns!, Guns!**, otherwise known as **3G^3**. It is a set of design rules and guidelines to let you construct a realistic set of melee and ranged weapons for virtually any role-playing system. They can be kept in the detailed **3G^3** format, or transferred to the system you currently play, or even to systems of your own design. You have the advantage that any weapon designed with **3G^3** will follow the same rules as any other weapon designed with the system, giving you a level of cross-system consistency no other weapon supplement can match. Read on!

Designer's Notes

3G^3 has progressed from a simple black and white booklet (1988), through two printings of the 2nd edition (1989), to the third edition (1991) to what it is now (1996). Originally a hidden design tool for the 2nd edition **TimeLords** rpg, it was published in the hope that a few others would like to take advantage of its capabilities. Despite being the densest, driest, most textbook-like game supplement ever made, acceptance of **3G** was surprisingly high, and there are now enough copies in circulation to prove that it works, and people *did* want what it could give them. But it still had a few bugs. You can never get rid of them all, but you have to try. So, lessons learned have been incorporated into each new edition.

If this is the first time you have seen **3G^3**, here's what it is: A system that lets you create or recreate just about any weapon that has ever existed/might exist, in a form that you can convert into the role-playing system you use. For instance, while you might not be able to *exactly* duplicate an Uzi using the design rules, you can get accurate figures for a weapon with the characteristics of a 9mm submachine gun built with 1960's technology, having a medium length barrel and a 30 round clip. You'll know how long and heavy the weapon is, how much it costs, the range characteristics, and so on. While this is no big deal, since you can just look up the real world figures, the system would also let you design a submachine gun that might be built using technology from the year 2100, or what a submachine gun might be like if built in 1800!

While these rules are mainly for hand-held weapons, the equations used can be stretched all the way out to naval guns and starship weapons with surprisingly little loss of accuracy, provided you pay sufficient attention to detail.

These rules require a bit of thought to use, and no doubt you will run into design dead-ends and compromises. Your hand-held tank cannon will end up weighing more than you do, and the recoil would knock you into next week, anyway. For computer buffs, all the **3G^3** rules are based on formulas (condensed into tables for convenience), and you can design spreadsheets to virtually automate the weapon design process.

Regretfully, results are not guaranteed. Very few people can accurately predict the future, and I don't claim to be one of them. A lot of research and computer time went into these rules, but science marches to a strange drummer, and unexpected breakthroughs can make futuristic designs obsolete at any time. On the bright side, predictions can't be proven wrong until things actually happen otherwise, so any changes you make to the rules are right until science catches up with your imagination and proves you wrong (at which point we'll revise the rules). Have fun!

Last but not least, if you use **3G^3** to design a weapon for any sort of *published* game, game scenario, magazine article, etc., give credit where credit is due. It lets me know that you're out there using it. Thanks!

Basics

3G^3 makes the assumption that you are willing to do some work for your game to get realistic and consistent guns. This willingness may not necessarily be matched by a practical knowledge of ballistics, material science, terminology or a number of other pertinent factors. This section should help alleviate that problem. If you are already familiar with these terms, skip to the next section.

The terms on the following pages are used throughout the rules. If you have *any* questions while trying to design a weapon, are confused about what a term means, or are not sure where to look, please check either here or in the **index** (p.123). One of the two should provide some assistance.

Destroy this book!

If you are going to use **3G^3** on a regular basis, probably the best thing you can do is get a 3-ring binder. Then take **3G^3** down to your local print shop, and tell them to cut off the binding (carefully!) and drill it for the ring binder. Then you can put index tabs in it, keep all your designs in one place, and even loan out sections in case friends want to design something from one section while you want to design from another. It would be *much* better though if they were to buy their own copy. It is also *not* nice to photocopy the entire rules for other people. BTRC tries to produce games at a price where you'd rather have an original for just slightly more than a photocopy. Be nice to us; buy our games.

Weapon Design 101

Guns are generally designed for the purpose of killing living creatures, usually humans. The motives may be legal, illegal, moral or immoral, but dead is still dead. Guns are inherently dangerous and should be treated with great respect.

Weapons generally do damage by disruption of the target. This is usually by the application of energy. Conventional guns apply the kinetic energy of a moving projectile, and energy weapons cause the target to absorb some form of electromagnetic energy, such as a laser beam. Energy alone is not enough, however. The ability to penetrate armor is a matter of the area this energy is applied over. While you may not have realized this, it happens all the time in everyday life. While you can't stick your finger through a piece of wood, the same force concentrated into the point of a thumbtack lets you push it in up to the head. The same applies to the difference between a punch and a knife thrust. One is force applied over the area of a fist, and the other is concentrated into the tip of the blade.

As you will see later, the diameter of an attack makes a large difference in the damage that weapon does. The same energy will have a higher damage if placed behind a small bullet than a large one. An energy beam with double the diameter of a small one will have four times the area to distribute its energy over, so its ability to penetrate armor is lower than that of the small beam.

Basic Terminology

Tech Level

All weapons will have a Tech Level, or TL. Advanced designs may have more than one TL, but for most purposes all components on a weapon will be of the same TL.

TL is the single most important factor in any weapon design. TL's are based solely on physical, not cultural constraints, so make sure you have the background of this weapon firmly in mind before you start the design process.

Repeating cartridge firearms could have been made by the Romans in 100AD. The materials were sufficient, but the science was lacking. They had the *material science* technology to make gunpowder, mercury fulminate primers, lead bullets, bronze cartridge cases and bronze barrels. They did not have the *scientific knowledge* to create these materials and combine the various technologies in order to make them work, and they did not have any lucky accidental discoveries that would let them work these things out by chance. That had to wait another several centuries. Neon signs started appearing in 1905. Anyone who can make a neon sign can, with a little effort, make a helium-neon laser...or a CO_2 cutting laser. Again, the technology was there, but the knowledge of what a few simple modifications would do was not. Keep this in mind when you look at the rules and find you can make gunpowder weapons for the ancient Egyptians, or design lasers for WWI. They are possible, but not very efficient, and not very likely. The **3G^3** Tech Levels are based on the following scale.

TL	Approx. date	Technology
1	Pre-history	Wood
2	10,000BC	Stone
3	3,000BC	Bronze
4	0AD	Iron, rockets
5	1400AD	Matchlock firearms
6	1700AD	Flintlock firearms
7	1800AD	Percussion firearms, airguns, steam power
8	1900AD	Cartridge firearms, HMG's, aircraft
9	1930AD	Submachine guns, atomic power, LMG's
10	1960AD	Light assault rifles, laser invented
11	1980AD	Autoburst weapons, microchips
12	2000AD	Caseless ammo, first railguns, fusion?
13	2100AD	Portable railguns, laser weapons, p-beams
14	2200AD	Advanced versions of above
15	2300AD	Peak of above technology
16+	?	Too advanced to predict

Example - You design a cartridge firearm at TL5 on *this* scale. If the system you play has 1400AD as TL3, this weapon would be TL3 in *that* system, but would still follow all **3G^3** TL5 design rules.

The scale is not particularly regular, since it corresponds to the vagaries of Earth's history and technological progress. Other game worlds may vary. Note that TL's from 13 and up have dates which may not apply to a particular game universe. Specifically, the long intervals listed here apply to a particular timeline in which a catastrophe retarded all scientific progress for decades, beginning shortly after the start of TL12, with lingering effects caused by population decline and socioeconomic factors. Adjust the dates for any an all TL's to match the chronology of any other game system you convert your designs to.

Damage Value

Or DV for short. This is a measure of the *penetrating* ability of a given attack. For attacks which may vary on an individual basis, each 10 points of DV represents 1d10 of damage. For attacks which are consistent (like firearms), the DV does average damage, or 5.5 points per 10 points of DV. For consistency's sake, all firearms will have the DV listed, but you should realize that the number of points of damage will be roughly half this number.

Armor Value

Or AV for short. This is a measure of how well a material can stop attacks or resist being punctured, cut or broken. An item will stop damage up to its AV in points, the remainder going through and possibly damaging the item. As a measure of the AV scale, 10mm of the following substances will have the listed AV's:

Material	AV for 10mm	Density (water=1.0)
TL10 armor quality steel	40	7.7
TL10 mild steel	27	7.7
TL10 aluminum alloy armor	20	2.5
TL10 bulletproof glass	18	3.5
TL3 bronze	15	7.5
Cement or stone	3	2.2
Plexiglass	2	1.0
Oak or other heavy wood	2	.7

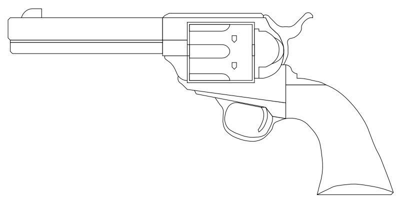
For rough comparison, historical TL10 rounds will penetrate the following amounts of these materials using **3G^3** rules:

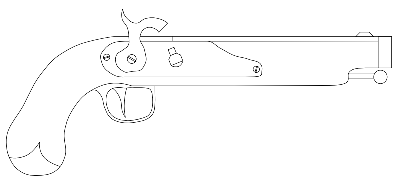
TL10 caliber	Armor steel (TL10)	Cement	Oak
.22LR	2mm	27mm	41mm
.32ACP	2mm	24mm	36mm
.380ACP	2mm	26mm	39mm
.38 Special	2mm	29mm	44mm
.45ACP	2mm	31mm	47mm
9mm	3mm	39mm	58mm
.357 Magnum	3mm	44mm	66mm
.41 Magnum	4mm	50mm	74mm
.44 Magnum	4mm	53mm	80mm
.30 Carbine	5mm	64mm	96mm
5.56mm	6mm	90mm	135mm
7.62mm	7mm	99mm	149mm
.460 Magnum	11mm	147mm	220mm
.50 cal	13mm	178mm	267mm
14.5mm	16mm	219mm	327mm
20mm	20mm	273mm	410mm

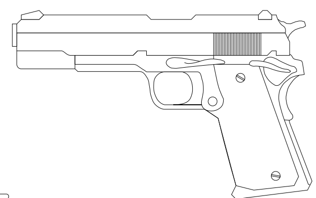
Special ammunition types may differ in penetration, and numbers for small calibers may vary due to the angle the target is struck with, tumbling or disintegration of the bullet within the material, and other situational modifiers. For instance, organic materials like wood get much of their "AV" due to resiliency, which applies much more to a low velocity attack than to a high velocity one. In most cases, supersonic projectiles (>330 meters per second) will be counted as armor-piercing vs. organic armors, and the penetration distances would therefore be double the listed amounts. Likewise, armor-piercing rounds would go through double or more the listed thickness of armor steel unless the steels were of a TL higher than the armor-piercing round.

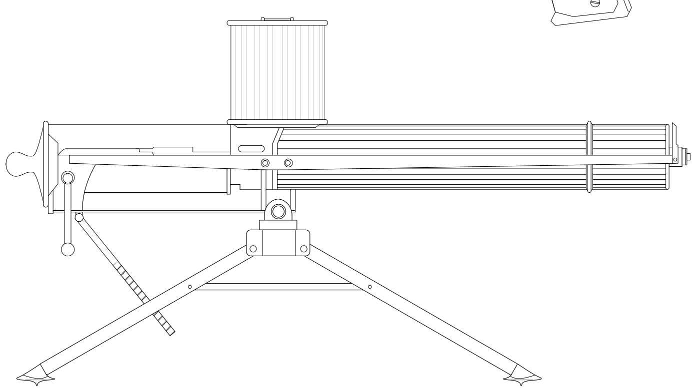
Action

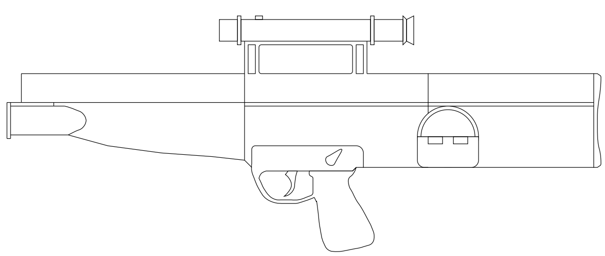
The method by which the weapon feeds ammunition from a storage area to the part of the weapon is it fired from. These are described below, along with the abbreviation used in the rules and tables.

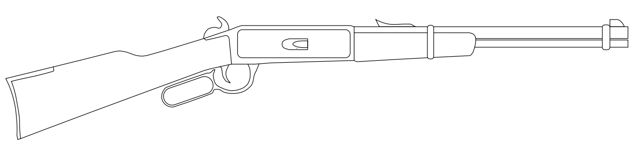


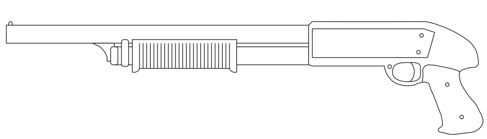


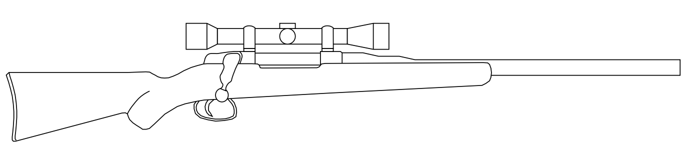












Revolver (RV/n)

Rounds are contained in a cylindrical housing which serves as both a storage area, and firing chamber. Before firing, this cylinder is rotated to align with the barrel. Mass inefficiencies make this impractical for weapons with large ammunition capacity. The "/n" shows how many rounds the action holds, i.e. "RV/6" would mean a 6-shot revolver. Modern revolvers typically range from RV/9 for .22LR, to RV/5 or RV/6 for the .44 Magnum.

Single shot (SS/n)

The weapon can only fire one shot for each barrel it has. Rounds must be manually inserted and removed after each shot is fired. The "/n" shows how many barrels the action has, i.e. "SS/2" means a double-barreled weapon.

Semi-auto (SA/t)

The weapon has a magazine of some type, and each time the trigger is pulled, a single shot is fed from the magazine into the weapon and fired, or the round in the weapon is fired, and the empty chamber replenished from the magazine. The same concept applies to energy weapons, the main factor being one shot per pull of the trigger. The "/t" shows the type of magazine the weapon uses. These types apply to *all* weapons with magazines.

/C Clip fed. A detachable container which holds the ammunition or energy supply for the weapon. When empty, it can be removed and replaced.

/I Internal magazine. A supply for ammunition or energy that is an integral part of the weapon, and must be manually reloaded when empty.

/E External magazine. A supply for ammunition or energy which is wholly external to the weapon. When empty, it may be disconnected and replaced.

Full-auto(AT/t)

The weapon has a magazine of some type, and when the trigger is pulled, rounds are cycled from the magazine to be fired as fast as the weapon is capable of moving them. These weapons may usually also act as semi-automatic weapons. The "/t" shows the type of magazine the weapon has.

Auto-burst (AB/t)

The weapon has a magazine of some type, and when the trigger is pulled, rounds are cycled from the magazine to be fired as fast as the weapon is capable or moving them, up to a fixed total, usually 3 or 6, so each pull of the trigger fires a fixed number of rounds. These weapons may also act as semi-auto or full auto weapons. The "/t" shows the type of magazine the weapon has.

Lever action (LA/t)

The weapon cycles rounds from a magazine of some type by means of manual cycling mechanism which does not require removing a hand from the weapon. This could be a lever that is operated by the firing hand (lever action), or a slide that is operated by the other hand (pump action). These weapons are almost always designed for two-handed use. The "/t" shows the type of magazine the weapon has.

Bolt action (B/t)

The weapon cycles rounds from a magazine of some type by means of a manual cycling mechanism which requires the firing hand be removed from the trigger, such as a manually operated bolt (bolt action). The "/t" shows the type of magazine the weapon has.

Basic Terminology

These actions can also have different ignition types, or means of igniting a powder charge on a conventional firearm. Unless otherwise specified, a conventional firearm is assumed to have an impact primer, where a sharp blow to the primer sets off a small charge of a sensitive propellant or explosive, and this in turn ignites the full powder charge.

-M Matchlock. This is the historical ignition system for TL5 weapons. A slow burning fuse (or “match”) is thrust into a touchhole when the weapon is fired. This ignites a small powder charge, which ignites the main propellant charge. The matchlock worked poorly in damp conditions, and extremely poorly in rain or snow. In addition, the match had to be lit before the weapon could be used, making constant readiness impossible.

-F Flintlock. This is the historical ignition system for TL6 weapons. A spring-driven flint would strike sparks from a steel cover, and deflect them into a small powder charge that was opened when the cover was driven back by the force of the hammer. This small powder charge would ignite the main propellant charge. Flintlocks were more reliable than matchlocks, but a given flint would need to be replaced or adjusted after around 20 shots. They worked less well in damp or wet conditions, but could be kept ready longer.

-P Percussion. This is the historical ignition system for TL7 weapons. Ignition was much the same as for modern weapons, except the impact sensitive primer had to be attached to the weapon separately, rather than as a combined unit, like modern rounds. Reliability was high, and if properly treated, they worked well in all weather conditions. Usually only found on revolver and single shot weapons.

-E Electric. This ignition system may be used historically at TL10 and above. Rounds are like conventional weapon rounds, but the priming charge is ignited by electrical resistance rather than impact.

These are suffixes that are added after any other weapon formatting information. Some samples are below.

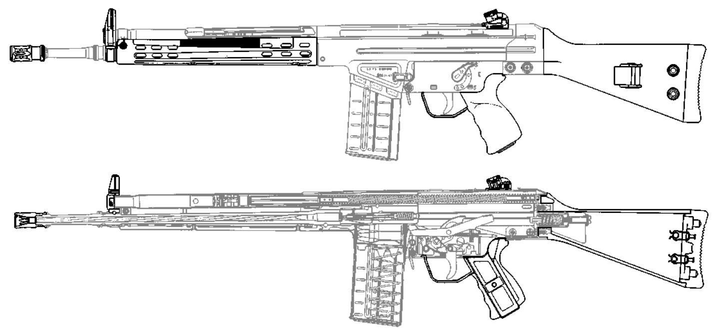
Notation	Description
SS/1-M	Single shot matchlock
SS/2-F	Double-barrel flintlock
RV/5-P	Five-shot percussion revolver
AT/E-E	Externally fed autoweapon, electric ignition

Other Terms

Aside from the previous game terms, there are some scientific and/or technical terms that are used throughout **3G^3**. If you come across an unfamiliar term, refer back to this section to see what it means.

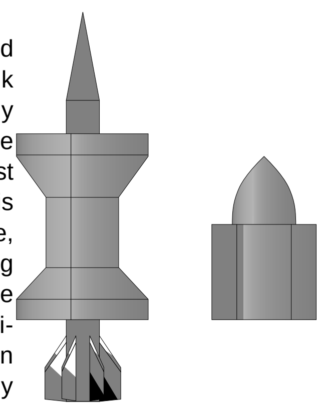
Accessories

These are items that are added to a weapon to make it easier to operate, but are not *strictly* required in order for the weapon to function. Accessories include sights, grips, handguards, stock, or attachment points for sighting aids like a telescopic sight, or auxiliary weapons like a bayonet or grenade launcher.



APFSDS

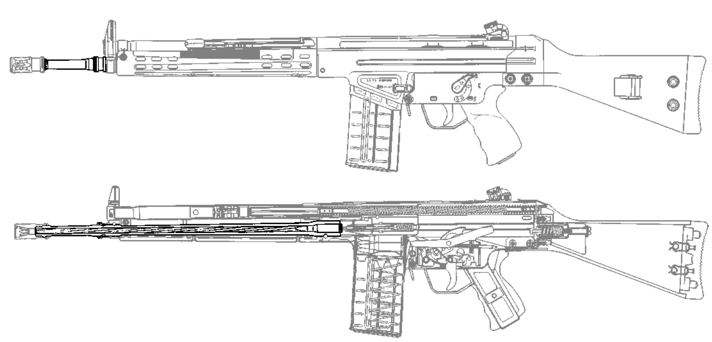
Armor **P**iercing **F**in **S**tabilized **D**iscarding **S**abot. The tank equivalent of a flechette, very accurate out to long ranges. The term APFSDS incorporates most of the abbreviations used for this class of projectile. For instance, APDS means **A**rmor **P**iercing **D**iscarding **S**abot. In game terms, armor piercing ammunition will reduce the protection afforded by armor, either by increasing the effective damage of the projectile, or decreasing the effective value of the armor.



APFSDS APDS

Barrel

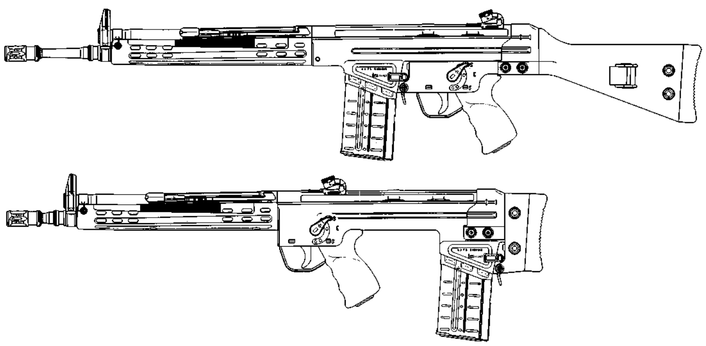
The part of a conventional firearm that guides the bullet and contains the expanding combustion gases from the propellant. The term in general applies to laser tubes, particle accelerators or magnetic launch rails as well.



Battery
Any storage device (usually chemical) that can provide constant amounts of relatively low-power electrical current, usually too small to meet the high pulse demands of an energy weapon. Most electrical generators will have similar characteristics. In **3G^3** terms, a battery can also represent any other means of storing energy so that it can be continually released, like coiled up springs.

Bore
The inside diameter of the barrel of a projectile weapon. May also be used to signify beam diameter in an energy weapon.

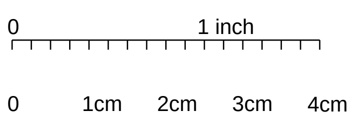
Bullpup
A name for a style of longarm where much of the machinery is placed within the usually solid parts of the stock next to the shoulder. This saves substantially on weapon length. While possible for almost any weapon, it only recently began to see use (TL11+). In general, a bullpup design is not recommended for any weapon which can have a critical malfunction in the parts right next to the firer's head.



Capacitor
A medium-tech (TL8-12) device for storing electrical power for delivery as short, intense pulses. In game terms, it may also represent other technologies with similar discharge characteristics, such as homopolar generators.

Casing
Any item which is used to provide a convenient means of simultaneously handling propellant and projectile. Ammunition which is encased in solidified propellant, or which has a thin, combustible casing will generally be referred to as caseless.

Centimeter
Or cm. A metric unit of length, used throughout **3G^3**. An inch is 2.54cm, a foot is 30.5cm, and 100cm equals 1 meter or 39.37 inches.

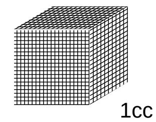


CLGP
Cannon **L**aunched **G**uided **P**rojectile. A projectile fired from a gun or cannon, which after firing is guided to the target either by a homing warhead or guidance from the firing vehicle.This gives extra versatility to existing weapons.

Coil gun
A means of magnetically accelerating an iron or other ferrous projectile, by alternately pushing and pulling it with electromagnetic coils surrounding the barrel of the weapon.

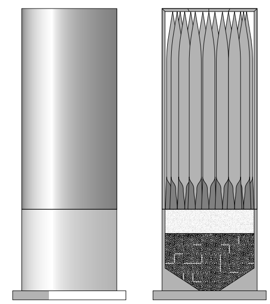
Conventional weapon
Refers to the current level of firearms technology (i.e. gunpowder or chemically propelled projectiles).

Cubic Centimeter
Or cc. A volume of 1cm x 1cm x 1cm. One cc of water (sg1) has a mass of 1 gram (about 1/28th of an ounce).



DU
Depleted **U**ranium. Uranium is an extremely dense element, and can be made into armor-piercing projectiles. These are made of uranium whose radioactive potential has been tapped, such as from spent reactor cores. The DU term is usually tacked onto the end of some other abbreviation. For instance, an APDU would be an **A**rmor **P**iercing **D**epleted **U**ranium projectile.

Flechette
A long, narrow finned projectile, usually described as a high-tech substitute for lead or steel shot for shotguns, since it causes wounds just as bad, and retains its damage producing ability out to a greater range. The disadvantage is that it is significantly more expensive to manufacture.



Fragmentation
A type of explosive shell designed to produce large numbers of high-velocity fragments, generally as an anti-personnel weapon. It will also have regular explosive effect.

Gram
Or g. A metric unit of mass used in **3G^3**. An ounce is about 28.5 grams, and a normal sheet of paper has a mass of about 5 grams. One kilogram is 1,000 grams, or about 2.2 pounds.

HE
High **E**xplosive. A shell with the primary purpose of delivering explosive to a target.

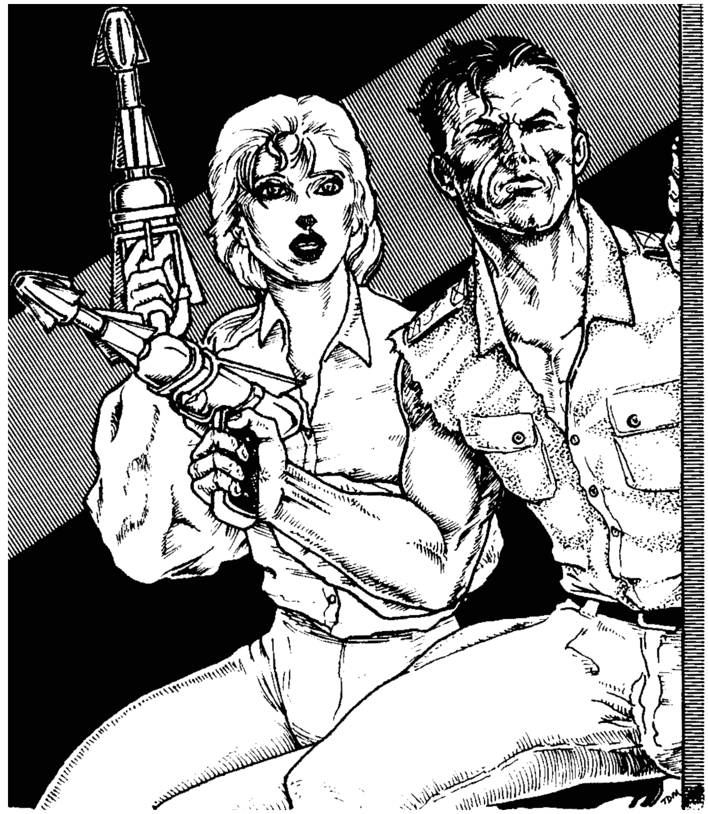
HEAT
High **E**xplosive **A**nti-**T**ank**.** A general term for any shaped charge warhead or shell. May also be known as **H**igh **E**xplosive **A**rmor **P**iercing (HEAP).

HEDP
High **E**xplosive **D**ual **P**urpose. Rounds that are a compromise between a full high explosive payload and a dedicated fragmentation payload.

Inherent Accuracy
Or IA. This game stat represents how well the weapon “points”, and how repeatably accurate it is capable of being at a given range. The larger the IA, the better.

Initiative
This game stat represents how unwieldy the weapon is. Weapons with a positive Initiative are easier to bring into play, can change targets faster and maneuver in tight places better than those with a negative Initiative.

Basic Terminology



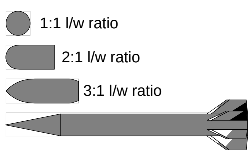
Joule
Or J. A unit of energy used in **3G³**, equal to 1 watt/second. Projectiles and energy weapon beams will have an energy in Joules, which is used to find the DV.

Kilogram
Or kg. One thousand grams (1,000g), or about 2.2 pounds. A gallon of water has a mass of about 3.6 kilograms.

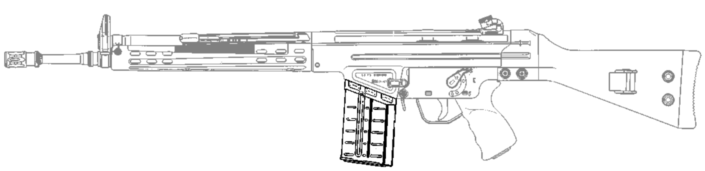
Laser
Light **A**mplification by **S**timulated **E**mission of **R**adiation. A coherent beam of light, which at high power levels can burn through virtually any material. Historically invented in late TL9/early TL10. Lasers can be tuned to emit over a large portion of the electromagnetic spectrum, from infrared, visible light, through ultraviolet and even x-rays. Most lasers in **3G³** will be a specific frequency in the infrared-visible-ultraviolet range.

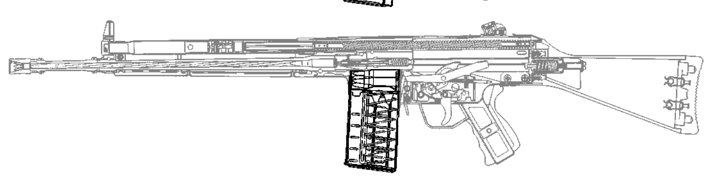
Longarm
A weapon designed to be fired with both hands, like a rifle or shotgun. Virtually any weapon which is not a pistol will be classified as a longarm.

l/w
Short for length/width ratio, a measure of how long a projectile is compared to its diameter. A bullet 5mm in diameter with a 3:1 l/w would be 15mm long.



Magazine
One of several terms for where ammunition for a weapon is stored. Magazines can be clips (see below), feed belts, hoppers, the cylinder of a revolver or the under-barrel tubes commonly used on pump and lever-action weapons.





Maser
Microwave **A**mplification by **S**timulated **E**mission of **R**adiation. A coherent beam of microwave radiation, used in some game systems as a weapon, mainly against organic materials. Historically invented in late TL9/early TL10.

Meter
One hundred centimeters (100cm), or about 39.37 inches. This book is .22m wide by .27m tall.

Muzzle energy
The energy a projectile has after any mechanical losses the propellant takes from the inefficiency of the weapon design. A weapon may be considered to have a base energy, which is how much the power source of the weapon generates, but muzzle energy is how much a projectile or beam has the instant it leaves the muzzle of the weapon, hence the term.

Particle beam
A weapon which accelerates subatomic particles to relativistic velocities. Extremely energy intensive, but has the benefit of being able to disrupt electronics and produce secondary radiation effects. Rules for particle beams may also be used to model “blasters” or “plasma guns”.

Projectile
The item fired out of a weapon by the propellant, magnetic energy or other propulsive force.

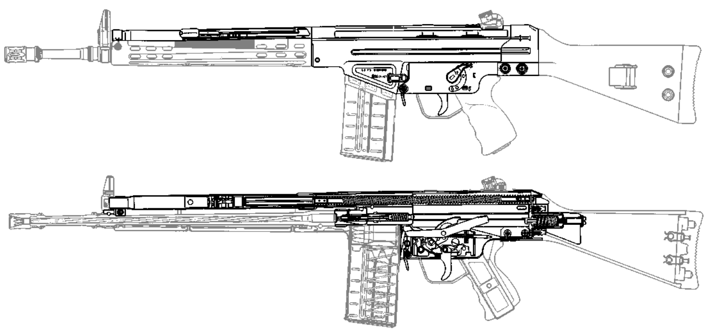
Propellant
A chemical compound which provides gas pressure to expel the projectile from the weapon. May also apply to compressed air for air-powered weapons. For conventional weapons of TL8 or lower, the propellant is usually black powder, a mixture of potassium nitrate, sulfur and charcoal. From late TL8 through TL12, propellant will probably be based on nitrocellulose compounds or other derivatives of high explosive compounds.

Railgun
A means of magnetically accelerating an iron or other ferrous projectile, by using an extremely high current pulse to generate a magnetic field in an ionized region directly behind the projectile. The projectile is pushed by this field as it travels the length of the weapon.

RAKE
Rocket **A**ssisted **K**inetic **E**nergy. A type of round developed in late TL11. In current, experimental form, it is an APDS or APFS-DS round with a rocket booster on the back as a separate unit. The advantages are a higher terminal velocity and DV, and a flatter trajectory.

Range Class
Or RC. A number that condenses the aiming or ballistic characteristics of a weapon into a row on a table for easy reference. In general, the higher the RC, the more accurate the weapon.

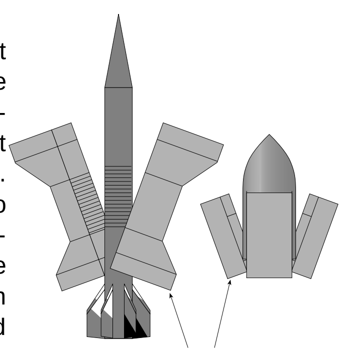
Receiver
The part of a weapon which feeds in new ammunition and ejects spent casings. It also includes any needed mechanical linkages, power conditioning circuits or similar apparatus on energy weapons.



ROF
Rate **o**f **F**ire. How many times a weapon can fire in a given time increment. In game terms this is usually in rounds per combat turn, and in technical literature, usually in rounds per minute.

Round
A complete unit of ammunition for a conventional firearm, consisting of propellant, projectile and casing.

Sabot
The outer part of a multiple-part projectile, designed so that the outer part separates after leaving the barrel, and the inner part continues towards the target. The main purpose of this is to provide an easy means of propelling a projectile which alone would be very difficult to design a weapon for, such as a finned dart.



SAM
Surface to **A**ir **M**issile. A ground launched missile that engages airborne targets.

Shaped charge
An explosive charge designed expressly for penetrating armor. Also see HEAT. Historically, shaped charges are a TL9 development, but can be developed at any TL with high explosives (late TL7 or better). Low explosives like black powder do not generate the shaped charge effect.

Shell
The propellant container on a conventional weapon, usually designed for convenient handling and easy loading. On archaic (less than TL9) weapons, the term is more commonly used to designate exploding projectiles (shot are solid projectiles, while shell are exploding projectiles).

SLAP
Saboted **L**ight **A**rmor **P**enetrator. Usually refers to an APDS round for a shoulder-fired weapon or light machine gun, which uses a small armor piercing projectile to get more energy over a smaller area.

SMG
Sub**m**achine **g**un. Usually a weapon firing a bullet originally designed for pistols, but which can fire them autofire, and which is usually capable of being fired from the shoulder. An SMG will usually have slightly better damage and long range accuracy than a pistol firing the same ammunition.

Storage bank
Any storage device (usually electrical), which can provide high power pulses of short duration, usually to power an energy weapon. Storage banks are usually charged by batteries. Also see Capacitor.

(u),(d),(n)
Round up, round down, and round nearest. All numbers in **3G^3** are rounded to the three highest digits, so 1.239kg would be treated as 1.24kg, but 11.239kg would be 11.2kg.

y^x
The number y, raised to the x power. An x of 2 means the number squared, while an x of .5 means the square root of y. Usually accessed by the y^x key on most scientific calculators.

Conventional Weapons

Pushing the limits

A weapon may be designed at the next highest TL under certain conditions, like making prototype TL12 weapons during TL11, for instance. The first condition is that you are at least halfway through the current TL. Once you are at this point, the technological advances of the next TL are in an experimental stage. If produced in a reasonable quantity, the weapon will also have a x4.0 cost multiple, after everything else is taken into account. If produced as only a few prototypes, the research and labor involved for the weapons will make the cost phenomenal, at least 100 times the normal rate, not counting the research equipment and facilities used in the process.

Some GM's may have a single technological advance in their worlds, but not others. In such a case, the weapon is of normal cost, but one part of the weapon may use the advances of a higher TL. For instance, a structural material of higher TL than powder technology, or more advanced electronics and less advanced powder, or more advanced rockets and less advanced guns. These must be handled on a case-by-case basis, but would be more likely when characters cross between cultures with a great separation between them that hinders the flow of knowledge, or where natural resources tend to favor one weapon type over another.

Chemically Propelled Projectile Weapons

Or as they are usually known, guns. This category covers almost every firearm, rocket or other powered weapon made up to the year 2000, and as such is the longest and most detailed section of the rules. Like all the design sections, it begins with a Tech Level reference for that weapon type.

TL1-2 (circa 10,000BC)

Technical notes $3G^3$ is a formula-based system, and while it is possible to design weapons at TL1-2, they aren't worth the effort.

Historical notes Not historically possible at this TL.

TL3 (circa 3,000BC)

Technical notes The first remotely practical firearms can be made at this TL. In order to get a high velocity from projectiles, it is suggested you use wood (sg1) as the projectile material. This is allowed only for subsonic projectiles.

Historical notes Not historically possible at this TL.

TL4 (circa 0AD)

Technical notes Bulky, heavy, but quite deadly repeating firearms can be made with the technology at TL4. This is "Roman Empire" technology, and is the first point where guns can be designed that successfully challenge projectile throwers like slings, bows and crossbows. For a DV of 20, the lightest way to get a 1 shot weapon is a 8mm SS/1, and for multiple shots, it is a 10mm LA/I.

Historical notes Not historically possible at this TL.

TL5 (circa 1400AD)

Technical notes The level of craftsmanship in parts of the world at this time is sufficient to make any variety of conventional firearms, although they will be bulky and heavy compared to modern counterparts. For DV20, the lightest way to get a 1 shot weapon is a 7mm SS/1, and for multiple shots, it is a 9mm LA/I.

Historical notes Give or take a few decades, this is where the first historical firearms appear. The only firearms possible at TL5 are single shot or multiple barrel firearms, using a matchlock ignition system (SS/n-M actions). Rifled barrels are not used, and all projectiles must have a 1:1 l/w ratio.

TL6 (circa 1700AD)

Technical notes Cased ammunition reaches half of what can be packed into a loose powder weapon, but loose powder, single shot weapons are still the best for getting maximum hitting power and range. For DV20, the lightest way to get a 1 shot weapon is a 6mm SS/1, and for multiple shots, it is a 8mm LA/I.

Historical notes Flintlock and wheellock ignition systems are TL6 inventions, as are revolver actions. The possible new actions are SS/n-M, SS/n-F, RV/n-M and RV/n-F. Rifled barrels are still not available, and projectiles must still use a 1:1 l/w ratio. Explosive rounds are available, but are only allowed time delay fuses.

TL7 (circa 1800AD)

Technical notes By spending *lots* of money compared to other period weapons, you could have something made which would be nearly equal to a normal TL11 weapon. For DV20, the lightest way to get a 1 shot weapon is a 6mm SS/1, and for multiple shots, it is a 8mm LA/I.

Historical notes Percussion caps become available at TL7, as do rifled barrels and 2:1 and 3:1 l/w ratio projectiles. Compressed air weapons are developed at TL7, and experimental cartridge weapons are available in the latter half of TL7. Semi-auto (SA), automatic (AT), pump (LA), lever (LA) and bolt (B) action weapons are all introduced by the end of TL7, and may be in production before TL8. Magazine-fed multiple barrel weapons (i.e. Gatling guns) show up in the latter half of TL7. Explosive and hollow-point rounds are available.

TL8 (circa 1900AD)

Technical notes Gatling weapons at this TL may be electrically powered, where before they would have had to require some mechanical means of operation, like a hand crank or spring-wound mechanism.

Historical notes All actions except autoburst (AB) are allowed, and in limited use at the start of TL8. Automatic actions (AT) are still limited to rifle-sized weapons and/or calibers. All new weapons use self-contained cartridges. Many calibers will become standards, and used up through TL12 with some modification, mainly an increase in DV. Black powder is replaced by more advanced nitrocellulose-based propellants. Rifling is standard on all new weapons except shotguns. Projectile l/w ratio is still limited to 3:1. Incendiary and tracer rounds are available in limited quantities, for autofire weapons.

TL9 (circa 1930AD)

Technical notes Most weapons developed between WWI and WWII are TL9. Lightweight weapons may have aluminum instead of steel in lightly stressed areas.

Historical notes Submachine guns and machine pistols become historically available, as do subcaliber rounds and shaped charge warheads. TL9 is the first TL in which armor-piercing tungsten (sg11) projectiles may be used, all previous armor-piercing projectiles being of steel (sg7).

TL10 (circa 1960AD)

Technical notes This is the first TL in which semi-automatic (SA), automatic (AT) and auto-burst (AB) weapons have the same action efficiency as bolt (B), lever (LA) and single shot (SS) weapons. So, the types of weapons that can take full advantage of the propellant energy are doubled.

Historical notes Aluminum alloy sees use as a structural material for guns, although steel is still used for barrels. The first caseless ammo is produced at TL10. Projectiles with a l/w ratio of 10:1 are first used in tank cannon (APFSDS rounds). "Bullpup" style weapons are first designed at TL10. Weapons that use electrical pulses to ignite the propellant charge appear at TL10.

TL11 (circa 1980AD)

Technical notes Most modern weapons are TL11, though more and more push the TL12 boundary. Computer aided design and manufacturing means that custom designs can be produced in smaller lots, giving specialty manufacturers the ability to reach a wider market than with earlier, hand-tooled designs.

Historical notes The first autoburst weapons are produced at TL11, as are laser sights. Caseless ammunition improves to the point of being feasible by the end of this period (H&K 4.9mm). Plastic begins to see use as a structural material, and by the end of TL11, has replaced all but the mostly highly stressed parts on many weapons. The first discarding sabot rounds for civilian rifles appear on the market (.308 Winchester "Accelerators"), and discarding sabot rounds for military use are made in 5.56mm, 7.62mm and 12.7mm. Civilian rounds have lead cores for hunting purposes, while military versions have tungsten or depleted uranium (sg11) for armor-piercing effect.

TL12 (circa 2000AD)

Technical notes Caseless ammunition becomes eminently practical, weight and space savings allowing a soldier or weapon to carry a larger load.

Historical notes The first caseless civilian rifles will probably appear in early TL12. Many hunters prefer custom loading their bullets, and cased technology will continue to be popular, both in lower-tech nations, and in civilian calibers.

TL13 (circa 2100AD)

Technical notes This is the TL in which revolver (RV) actions reach 100% efficiency converting propellant energy into projectile energy (at least for design purposes).

Historical notes Caseless ammunition technology will become more prevalent in civilian designs, in areas which still allow possession of such weapons by those outside the police or military. In repressive areas, they may be especially prevalent, as the difficulty of manufacturing ammunition is greater, reducing the usefulness of any stolen weapons.

TL14 (circa 2200AD)

Technical notes Weapons have more or less reached the peak of this type of technology, and will simply continue to get lighter and more powerful as the limits of chemistry and material science technology are pushed back. The main limit is now the recoil force the soldier can endure when firing a weapon.

Historical notes Military rifles can now pack the punch of TL11 heavy machine guns, and exotic ammunition is routinely used to counter new armor technologies. Conventional weapons begin to fall out of favor as the benefits of railguns and lasers begin to outweigh their disadvantages. In interstellar societies, large numbers of TL13 designs will be sold to less advanced worlds as surplus, thus profiting from stockpiles that would otherwise be scrapped.

TL15 (circa 2300AD)

Technical notes Weapons have more or less reached the peak of this type of technology, and will simply continue to get lighter and more powerful as the limits of chemistry and material science technology are pushed back.

Historical notes While there are still uses for conventional weapons, these are growing fewer and fewer, and most applications of the technology are in the fields of security or law enforcement, or hunting weapons. The material and costs of programming a robot to make a precise mechanical action for a gun may actually be greater than that for a railgun or equivalent energy weapon.

Compatibility issues

Just because two weapons share a common caliber and energy does not mean they use the same ammunition. Unless expressly designed that way, assume that all weapon ammunition is *incompatible* with that for any other weapon. Naturally, most of the time families of weapons are designed to use the same ammunition, to increase the potential market for the weapon, hence common calibers like 5.56mm NATO, 7.62mm NATO, 9mm Para, .45ACP, .22 rimfire and countless others. This is as much a political issue as a technical one.

Rifled vs. smoothbore

Most handheld weapons use rifling, or shallow spiraling grooves down the barrel to impart spin on the projectile. This improves the accuracy of the weapon. For various reasons however, weapons may have smooth instead of rifled bores. The main reason is historical. Historical weapons before TL7 rarely had rifling, for the simple reason that no one had any idea what it was or why it was useful. The modern reason is that projectiles with a l/w ratio of 10:1 or more tend to be less stable at the high rotational velocities imparted by rifling, and are more stable if they are simply stabilized by fins.

As a rough guide, the maximum aiming RC of any *handheld* weapon will be the TL, divided by 2. This rounds up for rifled weapons, and rounds down for smoothbore weapons. For instance, a TL7 rifle could theoretically reach a maximum aiming RC of 4, while a smoothbore could only reach an aiming RC of 3. Pre-TL8 mounted weapons have a maximum aiming RC of their TL.

For use as an emerging technology, rifled weapons will have a x2.0 cost multiple when first introduced.

Minimum bore

A suggested optional rule is to say that loose powder rounds have a minimum bore of (12-TL)mm, cased rounds have a minimum bore of (14-TL)mm, and caseless rounds have a minimum bore of (16-TL)mm. Weapons below this increase one level in unreliability per TL the weapon fails this minimum by.

This represents problems like powder fouling and the lesser mechanical precision available at lower TL's.

Conventional Weapons

Basics

The very first thing you need to do is get a sheet of paper, a pencil, and a scientific calculator with x^2, $\sqrt{x}$, and y^x keys. You can actually design a number of weapons without the calculator, but you will only be able to look things up on the provided tables rather than tweaking designs to your heart's content.

The next thing you need to do is figure out the Damage Value of your weapon. To do this, you need the TL, propellant energy, action type and diameter of the projectile. It is *extremely* important to remember the difference between *propellant* energy and *muzzle* energy. One is the raw energy of the propellant, and the other is the amount actually imparted to the projectile. The difference can be significant, so when the term energy is used, note which kind is mentioned. You can calculate Damage Value by using the following formula:

$$DV = (\text{Muzzle energy} \times .735/\text{Projectile diam. in cm})^{.5}\ (n)$$

Or use the table below to cross-reference your bullet size and desired DV to get the muzzle energy required.

Example - You want a 6mm weapon with a DV of 25. This will require a *muzzle energy* of 510J.

The propellant energy is based on the TL and quantity of propellant. The "base" gunpowder energy is 4,500 Joules per gram, which is multiplied by the efficiency of the powder's TL.

Base "gunpowder energy" = 4,500J per gram

Save the base propellant energy. Multiply the propellant energy by the efficiency of the action used to get the base muzzle energy of the projectile (Hint: propellant energy is TL x 135J).

Base muzzle energy = Prop. energy at that TL x action efficiency

Note that a round with a given propellant energy may have different DV's when fired from different weapons. The *base* energy may be the same, but *muzzle* energy may vary between weapons, and damage is based on muzzle energy.

TL	Propellant efficiency	Joules	B/SS/LA*	Action efficiency SA/AT/AB	RV*
1	.03	135J	.12	-	.08
2	.06	270J	.24	-	.16
3	.09	405J	.36	-	.24
4	.12	540J	.48	.40	.32
5	.15	675J	.60	.50	.40
6	.18	810J	.72	.60	.48
7	.21	945J	.84	.70	.56
8	.24	1080J	.96	.80	.64
9	.27	1215J	1.00	.90	.72
10	.30	1350J	1.00	1.00	.80
11	.33	1485J	1.00	1.00	.88
12	.36	1620J	1.00	1.00	.96
13	.39	1755J	1.00	1.00	1.00
14	.42	1890J	1.00	1.00	1.00
15	.45	2025J	1.00	1.00	1.00

*Only single shot or revolver actions are allowed below TL4

Example - A 1cm TL9 round with a propellant energy of 1,000J will have a muzzle energy of 1,000J when fired from a single-shot weapon (SS), for a DV of 27. If fired from a semi-auto weapon with an efficiency of .9, the muzzle energy is 900J, for a DV of 26. The base propellant energy is 1,000J in *either* case.

Note - You can use the two tables on this page to get the muzzle energy *and* base energy for a variety of weapons. Divide the energy from the table below by the action efficiency on the table above to get the base energy required from the propellant.

Example - If you want a TL6 10mm revolver to have a DV of 15, it will need a muzzle energy of 306J. To get this muzzle energy requires a base energy of 306J/.48 = 638J.

	Caliber													
DV	4mm	5mm	5.5mm	6mm	7mm	8mm	9mm	10mm	12.5mm	14.5mm	20mm	23mm	25mm	30mm
8	35J	44J	48J	52J	61J	70J	78J	87J	109J	126J	174J	200J	218J	261J
10	54J	68J	75J	82J	95J	109J	122J	136J	170J	197J	272J	313J	340J	408J
12 (lt.pistol)	78J	98J	108J	118J	137J	157J	176J	196J	245J	284J	392J	451J	490J	588J
15	122J	153J	168J	184J	214J	245J	276J	306J	383J	444J	612J	704J	765J	918J
20 (med.pistol)	218J	272J	299J	327J	381J	435J	490J	544J	680J	789J	1090J	1250J	1360J	1630J
25	340J	425J	468J	510J	595J	680J	765J	850J	1060J	1230J	1700J	1960J	2130J	2550J
30 (hvy.pistol)	490J	612J	673J	735J	857J	980J	1100J	1220J	1530J	1780J	2450J	2820J	3060J	3670J
35	667J	833J	917J	1000J	1170J	1330J	1500J	1670J	2080J	2420J	3330J	3830J	4170J	5000J
40 (lt.rifle)	871J	1090J	1200J	1310J	1520J	1740J	1960J	2180J	2720J	3160J	4350J	5010J	5440J	6530J
45	1100J	1380J	1520J	1650J	1930J	2200J	2480J	2760J	3440J	4000J	5510J	6340J	6890J	8270J
50 (med.rifle)	1360J	1700J	1870J	2040J	2380J	2720J	3060J	3400J	4250J	4930J	6800J	7820J	8500J	10.2kJ
60	1960J	2450J	2690J	2940J	3430J	3920J	4410J	4900J	6120J	7100J	9800J	11.3kJ	12.2kJ	14.7kJ
70 (hvy.rifle)	2670J	3330J	3670J	4000J	4670J	5330J	6000J	6670J	8330J	9670J	13.3kJ	15.3kJ	16.7kJ	20.0kJ
80	3480J	4350J	4790J	5220J	6100J	6970J	7840J	8710J	10.9kJ	12.6kJ	17.4kJ	20.0kJ	21.8kJ	26.1kJ
90	4410J	5510J	6060J	6610J	7710J	8820J	9920J	11.0kJ	13.8kJ	16.0kJ	22.0kJ	25.3kJ	27.6kJ	33.0kJ
100 (.50 cal)	5440J	6800J	7480J	8160J	9520J	10.9kJ	12.2kJ	13.6kJ	17.0kJ	19.7kJ	27.2kJ	31.3kJ	34.0kJ	40.8kJ
120	7840J	9800J	10.8kJ	11.8kJ	13.7kJ	15.7kJ	17.6kJ	19.6kJ	24.5kJ	28.4kJ	39.2kJ	45.1kJ	49.0kJ	58.8kJ
140	10.7kJ	13.3kJ	14.7kJ	16.0kJ	18.7kJ	21.3kJ	24.0kJ	26.7kJ	33.3kJ	38.7kJ	53.3kJ	61.3kJ	66.7kJ	80.0kJ
160 (20mm)	13.9kJ	17.4kJ	19.2kJ	20.9kJ	24.4kJ	27.9kJ	31.3kJ	34.8kJ	43.5kJ	50.5kJ	69.7kJ	80.0kJ	87.1kJ	104kJ
180	17633J	22.0kJ	24.2kJ	26.4kJ	30.9kJ	35.3kJ	39.7kJ	44.1kJ	55.1kJ	63.9kJ	88.2kJ	101kJ	110kJ	132kJ
200	21.8kJ	27.2kJ	29.9kJ	32.7kJ	38.1kJ	43.5kJ	49.0kJ	54.4kJ	68.0kJ	78.9kJ	109kJ	125kJ	136kJ	163kJ
250	34.0kJ	42.5kJ	46.8kJ	51.0kJ	59.5kJ	68.0kJ	76.5kJ	85.0kJ	106kJ	123kJ	170kJ	196kJ	213kJ	255kJ
300	49.0kJ	61.2kJ	67.3kJ	73.5kJ	85.7kJ	98.0kJ	110kJ	122kJ	153kJ	178kJ	245kJ	282kJ	306kJ	367kJ