Airguns are mechanical devices that turn the stored potential energy of a coiled spring or compressed gas into kinetic (moving) energy, and transmit it to a projectile. However, the kinetic energy (or "power") of a gun is not measured directly. Rather, it is the energy imparted to the projectile (a pellet) that is measured. This pellet energy is the product of "velocity" and "weight" (actually "mass"), both of which are measured separately.

TARGET AIRGUNS:

Precision airguns that are used exclusively for target shooting (such as the Beeman/FWB 603 air rifle or the Beeman/FWB P34 air pistol) require only enough energy (3 to 5 ft. lbs.) to speed a .177 caliber pellet through 10 meters of air. The speed component can be low, but the accuracy of a pellet must be exceedingly high--on the order of 0.04" center-to-center (c-t-c).

With target airguns, repeatability of the power plant is a major aspect of high-quality. So are such accuracy-related aspects of precision shooting as the character of trigger let-off (and its repeatability), adjustability of trigger pull and let-off and the adjustable fit of the airgun to the hand and body. The ergonomics of reloading the airgun is also important to target shooters. This function should be as smooth and unstressful as possible to keep concentration at a world-class level. Pellet insertion should be easy. CO2 and pre-charged airguns eliminate one physically distracting aspect of target shooting--recocking--and contribute thereby to a smoother shooting process.

HUNTING AIR RIFLES:

In addition to reasonable accuracy, (two inches at 50 yards) hunting or field air rifles must transfer three to five times as much energy to the pellet as target airguns. The energy of a hunting rifle pellet should be at least as high at the target distance (pest birds, for example), as target airguns are at the muzzle (4 ft. lbs.).

PELLET CALIBER & WEIGHT:

A. Caliber. By far the largest number of airguns are sold in .177 caliber, and this is the pellet size of choice for nearly all target shooting, plinking and some small pest hunting. .177 caliber offers the highest velocity for a given amount of airgun energy, and results in the flattest trajectory. However, the speed of sound--1080 fps at sea level at 32°F--sets a practical upper limit on the energy with which a pellet can be propelled. Breaking the sound barrier results in a loud crack--just like a firearm--and generally sends the pellet tumbling wildly. It would take 16.8 ft. lbs. to propel Beeman's Laser pellets to 1080 fps, and 21 ft. lbs. for Beeman/H&N Match pellets in .177 caliber.

.20 caliber (5mm) is a perfect example of obtaining large ballistic gains in performance with small, optimal changes compared to .177 caliber. The 5mm trajectory remains nearly as flat, but its heavier weight lets it carry about 40% more energy for the same velocity. This is the best general purpose caliber.

The .22 caliber has a large gain in pellet weight and size is only useable in the highest-powered hunting rifles. The range of the .22 caliber is less than the .20 caliber, and the downrange energy less than the larger .25 caliber pellet. .22 might be the choice if you owned a single hunting rifle.

.25 caliber is unbeatable in carrying the most knock-down force to the target because of its maximal pellet weight and resulting incredible shock value. It is the perfect round for the tough tree squirrel and the right caliber in high-powered air rifles for any of the larger furbearers such as woodchuck, opossum and even raccoon.

B. Pellet Type. The single most important factor in choosing a pellet is to obtain one that is accurate in your airgun! Only personal experimentation will let you discover the most effective pellet for your airgun/target combination. Each airgun varies slightly in the way it handles different pellet types. Since the accuracy of pellets themselves will vary slightly from batch-to-batch, it is wiser to buy a year's supply of pellets at one time than to buy in smaller quantities.
Using the same powerplant, a light pellet will accelerate rapidly and leave the gun barrel at high speed. Its time in the barrel is the shortest, thus reducing the effects of an unsteady hold. The light pellet's time-to-target is also shortest so gravity can pull on it for only a split second. An accurate, very flat trajectory is the result. Yet in some high-powered rifles, light pellets are ejected so rapidly they do not dwell long enough to get the full energy transfer of the decompressing charge of air. While the same rifle can propel an 9.2-grain .20 Laser pellet to 850 fps and a 13.32-grain Kodiak pellet to 700 fps, these figures show the Laser only acquired 14 ft. lbs. of energy while the Kodiak obtained 15.5 ft. lbs.

The speed of a heavier pellet is lower in the same airgun versus a lighter pellet. And, because of its slower speed, a heavy pellet takes a longer time to get to the target; this gives gravity a longer time to pull it down. Note that the drop of any pellet has nothing to do with its mass or weight--all pellets are pulled down by gravity at the same rate. The only thing that counts is how much time gravity has to do the pulling. It is only because heavy pellets take longer to get to the target that their trajectory is more bowed. A lightweight pellet traveling as slowly as a heavy weight would have an equally bowed trajectory.

AIR RESISTANCE:

Once clear of the barrel, another "energy thief" begins its work: air resistance. Air resistance increases with the cube of a pellet's speed: double the speed, and air resistance increases eight times! This means fast pellets lose energy more rapidly than slower pellets. Energy equals mass times velocity squared. Since the energy imparted to a pellet is about the same and a pellet doesn't lose mass, it can only make up for the different weight by changing velocity.

In fact, fast, light pellets lose energy so rapidly, after 35 yards or so they can be traveling slower than heavy pellets. This is inconsequential in 10 meter target shooting, but it becomes a major disadvantage in hunting and field use.

WHAT PELLET SHOULD I USE?

Flat-nosed wadcutters punch perfect holes in paper targets to aid in scoring, and are required in competition. The slight effects of higher air resistance on accuracy due to the flat head are unmeasurable at 10-meter range, but do become noticeable at 35 meters and beyond.

Medium weight roundnose pellets like the Ram Jet offer the best combination of weight and flat trajectory for medium-powered hunting rifles (12 to 15 ft. lbs.). The closer you can normally get to your prey, the heavier the pellet you should use because heavy pellets (e.g., Kodiak, Crow Magnum, Silver Arrow) will penetrate much deeper and be less susceptible to wind deflection. With the most powerful air rifles (R1/R1 Laser, RX-1, Kodiak, Crow Magnum III) consider only heavyweight pellets.

The Crow Magnum hollowhead pellet is in a class by itself--it really expands! This is an ideal pellet for .177 and .20 hunting of all game because of the terrific shock imparted as the pellet doubles in size as it enters the target. Say good bye to small-caliber "overpenetration." In .22 and especially .25 caliber, the Crow Magnum pellet is absolutely deadly with larger game--rabbits, woodchuck, etc. at ranges out to 50 yards with the most powerful air rifles.

ACCURACY:

Assuming an airgun always exerts the same force on a pellet, the accuracy of a pellet's path--its trajectory--is effected by three major (and some minor) factors:

1) CROWN: During its rush up the barrel, a pellet is constrained from going anywhere but straight forward. At the instant the pellet leaves the barrel, it is desirable that the barrel lip (or "crown") always presents exactly the same surface to the spinning tail of the pellet. Ideally, the barrel loses contact with the entire circumference of the tail of the pellet at the same instant, so that the pellet is not tipped one way or the other. Tipping the pellet imparts a wobble, increasing the cross-sectional area through the air. The wobbling pellet effectively increases its caliber causing more air resistance! This increased area will slow the pellet down more quickly than if it pierced the air perfectly head-on. Many Beeman airguns
are "button choked" at the crown of the barrel to assure a perfectly uniform grip on the pellet circumference the instant it leaves the barrel. Others are exquisitely detailed to assure a perfect pellet release. Be sure not to damage the crown of any airgun barrel.

2) UNIFORMITY: Spinning is what keeps a pellet from tumbling, and keeps it facing directly forward as it bores through the air. Robert Beeman has pointed out that if a pellet is the slightest bit unbalanced as it spins the centrifugal wobble will lurch the pellet off course the instant it leaves the barrel. The direction of that lurch will vary with every shot depending on which direction the excessive mass of the pellet is pointing at the instant it is released from the "hold" of the barrel. This little-appreciated factor is one reason Beeman pays such attention to pellet quality control.

3) Wind: Supersonic bullets are more deflected by wind the slower they go. Surprisingly, sub-sonic airgun pellets are less deflected by wind the slower they go, but this seeming anomaly is due to the higher weight of the slower pellet, assuming in this comparison that both are shot out of the same airgun. For any airgun, a pellet with a higher "ballistic coefficient" will be less deflected by wind. Generally, heavy pellets have a higher ballistic coefficient than lighter ones. (The ballistic coefficient, or "C-1" of a .20 Laser pellet is 0.0096; of a .20 Kodiak, 0.0167.) In one test at 60 yards, a .20 Crow Magnum II rifle was able to print a 1.25" group with Kodiak pellets, but only a one-foot group with Laser pellets. The muzzle velocity of the Laser pellet was supersonic, dropping to subsonic 4 yards out of the barrel, the shock of which caused a violent tumbling.

AIRGUN SHOT REPEATABILITY:

An airgun does not exert the same force from shot to shot. Without such high repeatability, even excellent pellets will not be able to do their job.

Average pellets may safely exhibit a weight differential of up to a few percent in any one tin. When both pellets and air rifle vary randomly, you will find yourself hitting the target perfectly (on some shots) and missing it completely on others.

Every airgun user should obtain a tin of ultra-precise pellets to determine just what the airgun is capable of (bench rest), and what the shooter is capable of (hand held). You can use mid-grade pellets for practice. But always use the most accurate pellets you can find for competition and actual hunting. After tramping in the woods for a hour and a half, and stalking a rabbit for 20 minutes, no one will believe it is cost-effective to have finally scared it off with a single missed shot caused by the non-uniformity of a cheap pellet.

AIR RIFLE HUNTING:

To a varmint hunter, an air rifle is a tool for the job of bagging game. Just as different jobs require different tools (you wouldn't use a tack hammer to drive 3-penny nails) so do different hunting situations require different air rifles. The paramount aspect of hunting air rifles is acceptable downrange accuracy. If you can't hit your target, no amount of super pellet energy or "penetration" is going to do you any good. Next most important is downrange energy.

Pigeons and other pest birds require one-inch accuracy at 20 to 30 yards; Grey (Tree) squirrels require similar accuracy, but at least 8 ft. lbs. of energy at that distance.

Crows require two-inch accuracy at 40 to 60 yards, the same as "wild" woodchucks, but the chucks require 10 to 15 ft. lbs. of energy at that range, the crows only half that. "Suburban" woodchucks can be approached to within 30 to 40 yards, so a less powerful rifle will do.

Airgun shooters should use this guide to help select the three or four different pellet types that seem closest to answering their own shooting needs. Then shoot these pellets for accuracy to get an idea of how well each type behaves in your own airguns. Shoot into bars of soap at field ranges to learn how well different pellets penetrate and expand for hunting. There is no substitute for this personal testing which will quickly lead to the selection of the most effective pellet type for your own particular use--and boost your accuracy and shooting satisfaction to new highs.