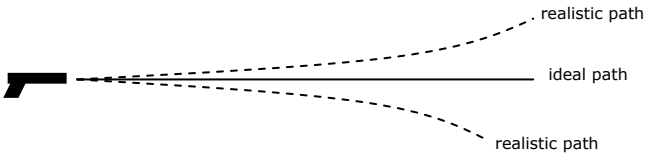
- THE SCIENCE OF SHOOTING (PART 8) -

WHY RIFLES ARE RIFLED

FACT: bullets do not fly in straight lines.

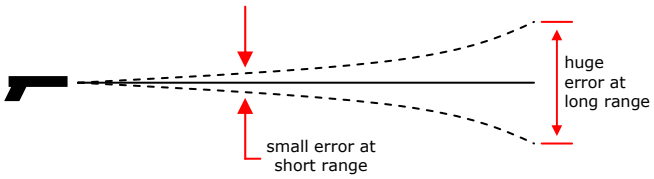
Now I'm not talking about the bullet curving towards the earth in a parabolic path due to gravity (Science of Shooting - Part 1). This type of curvature is supposed to happen. I'm talking about bullets wobbling or veering off path due to aerodynamic and / or inertial (imbalance) effects.



This is because bullets are never formed perfectly. NEVER.

One side might be a little rougher or heavier than the other for example, leading to a bias of aerodynamic drag on one side of the and thus pulling it to one side. This occurs much in the same way as if you were moving along in a rowing boat and stuck one oar in the water – the boat turns towards the side with greater drag.

Now over a short distance, this won't have a great effect. Take an old smooth-bored (ie. not rifled) pistol for example. They're short range weapons, so if the target isn't within (say) 20m or so there's a good chance you'll miss it anyway. Interestingly, this is the origin of the saying "... to see the whites of their eyes" which refers to old hunters having to delay the shooting of their game (ie. lions, etc.) until they could see the white of the animal's eyes due to their inaccurate firearms. Over such a short distances, minor aerodynamic effects don't have enough time to severely affect the bullet's path.



Now use this gun to take aim at a target which is 100m or more away. Over this distance, any slight variation in the early path of the bullet will lead to a massive error by the time the bullet reaches the distance to your target.

Luckily, there is a way to get around this inaccuracy hitch – take the bullet and *spin it*.

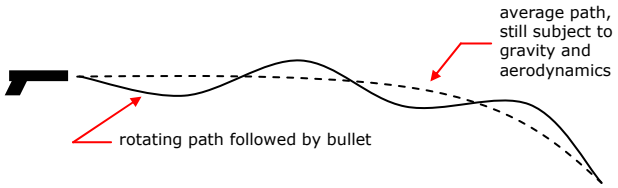
But how does this work? Well, let's say for example that the **top** of a bullet has a small imperfection. This will have the effect of **increasing the aerodynamic drag on that side** of the bullet, pulling it towards the imperfection (ie. upwards).

But if we spin the bullet, then yes, the bullet will still initially follow an upwards path. However (use your hands when trying to understand this bit as it'll make it much, much easier) after ¼ of a rotation anticlockwise (say) the bullet will now be pulled to the left.

One quarter (¼) of a rotation more, it will be pulled downwards which will cancel the initial pull upwards.

After another ¼ of a turn, the bullet is pulled right, canceling out the pull to the left. Now if you can imagine the impressive speeds at which bullets travel, then their rates of spin must be equally as impressive (the speed actually *causes* the spin).

This process repeats itself again and again, resulting in the ***average path*** of the bullet behaving more predictably. The bullet is (of course) still subject to the effects of normal aerodynamics and gravity however.



Now because the bullet is traveling so fast (and thus rotating so fast) there isn't much time for the bullet to bend towards one side before it is pulled in the opposite direction after completing ½ of a rotation.

As a result of this, the difference in distance between the spiral path of the rifle bullet and the average path of the bullet (as per the diagram above) will be *very, very small*.

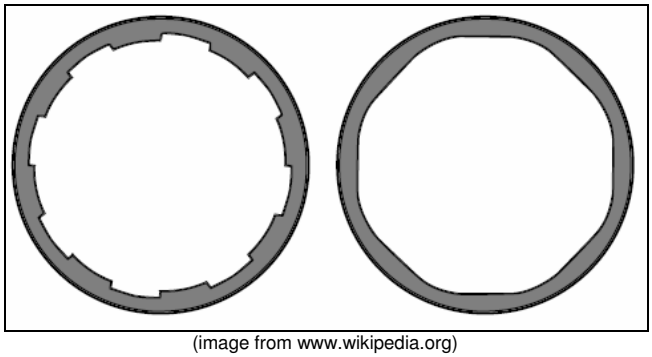
This whole rifling business also necessitates that a practical (ie. engineering) consideration be made here too. That is, why not make bullets from a much harder materials?

Think of it this way – how does a rifle manage to spin a bullet? Inside a gun barrel, rifling sits proud. As the bullet passes the rifling within the barrel, the rifling cuts grooves into the side of the bullet, inducing a rotation in the process.

Now if the bullet were made from a significantly harder material, ie. tungsten carbide for an extreme example, then instead of the rifling in the gun barrel cutting into the bullet and making it spin, the bullet would cut into the gun barrel rifling and smooth out the barrel in only a few shots.

This would be expensive.

Now there are a few types of rifling too. The picture below shows the more traditional type of rifling on the left. It's cheaper and easier to produce, so it's more common. On the right is shown what's called polygonal rifling. Whilst some claim this type of rifling gives several other benefits, it's much harder (and therefore more expensive) to produce.



(image from www.wikipedia.org)

Indeed, not only rifles are rifled. Some old canons and many handguns are rifled. Many army tanks have rifled barrels. Some shotguns have rifling too. In contrast to solid projectile firearms though, rifled shotguns are rifled for a different reason – the shooter wants a greater spread of shot. Now this is useless to us clay target shooters as by the time the shot got to the target the holes in the pattern would be gaping, but for shooters of smaller game or for those who shoot slug shot, it can be advantageous.