

## **A Short Discourse on Blade Damage and Steel Quality in Blades used for SCA Rapier and Sidesword Combat** *By Warder Kevin O'Shaughnessy*

Much discussion has been happening recently about the new sword blades available and made legal for SCA Rapier combat and the SCA Sidesword Experiment. The two varieties of combat mentioned, Rapier and Sidesword, create different levels of damage to the sword blades (and sword users). I want to discuss a little of that here.

First, I do not know the exact types of steels and heat treatment schedules used in the various commercially available blades that are now SCA legal. If I did, I could perform something akin to real engineering analysis of the materials, with calculations, graphs and charts ad nauseum. Since that information is not available, being effectively trade secrets of the blade makers, I can only make general comments.

The blades approved by the SCA for Period Fencing fall into 3 categories: 1) Modern Sport Fencing Blades: Foils & Epees 2) Oval and Diamond Practice Schlager Blades 3) Blunted Reproduction Rapier Blades (Del Tin, Scottie, Zamarano, Starfire)

In the Middle Kingdom we don't use Foils and only use Epees for practice for Out-of-Kingdom usage, so I won't be including them in my discussion. Generally speaking, their mechanical performance is regulated (sort of) by various modern fencing governing bodies. Their manufacturing processes are usually controlled to meet those regulations. In other words, charts & graphs probably are available.

Let us discuss Oval & Diamond practice schlager blades. Why do I call them practice blades? Well, the non-practice versions are sharpened and used for activities like Mensur, where persons try to leave scars on each other's heads. The ones we use started out as the blades used to practice for those sports, and grew into being rapier simulators for various Western Martial Arts and theatrical groups. It is a boom time for the manufacturers of those blades.

Oval schlager blades have much wider edges than diamond schlager blades, the edge near the hilt sometimes being almost equal to the thickness of the blade. This wide edge actually makes for "corners" where the oval sides meet the flat edge. Experience has shown us that these corners take the brunt of the damage from the normal impacts created during normal SCA rapier combat.

Diamond schlager blades and all the Blunted Rapier Reproduction blades have something much closer to a defined "edge". Obviously, this edge, varying in width from less than a 16th of an inch to more than 1/8th of an inch (on different blades) takes and shows the damage from impacts.

All the blades used in SCA rapier combat are "heat treated". This means that the steel (which is a mixture of iron, carbon and various alloying elements) has been heated to a precise temperature in order to create a chemical change in its structure and then allowed to cool in a controlled manner in order to "set" that change into its crystalline structure. Heat treatment for blades is normally a two-step process: hardening and tempering. Hardening allows the metal to resist denting or bending. Tempering makes it a little less hard and allows it to flex and spring back without breaking. Steel that is hardened without tempering is more prone to breaking (or shattering). That would be a bad thing in a sword blade.

I would expect that all styles of blade used in SCA combat are homogeneously tempered. That is, they are hardened and then tempered throughout their entire length and volume. The classic concept of the Japanese Katana is what we call "differentially tempered" (I think), such that the edge is left harder than the spine. That is a highly complex and expensive process that I'm pretty sure is not done for our Rapier blades or schlagers. I also don't think our blades are "case-hardened". Case hardening involves heat treating an object in order to make its surface, down to a certain thickness (usually not more than 1/8th inch or so) harder than the rest of it. Modern axe heads are case hardened. This makes a hard edge backed up by springy, softer iron below and behind it that helps distribute and absorb the force of impact so that the edge doesn't shatter. In a long skinny object like a blade case hardening would make the steel more prone to breakage, and probably less flexible as well.

Why then do our swords pick up nicks, chips and dents? Well those damage points are places where the blade has impacted another material nearly as hard or even harder than it is. The energy of the impact deforms (dent), tears (nick) or even breaks (nick or worse) the steel in the impact zone. Mild percussive impacts normally associated with SCA Rapier combat normally do little damage to blades. Heavy percussive impacts, like those used in Sidesword combat, do much more damage to the steel. Impacts between materials of greatly differing hardness will obviously do more damage to the softer material.

Most impacts will deform or tear the material. Completely breaking off a piece of the material is not as common. Breaking a blade "appears" to be very rare. A tear in the steel is where we get those ugly metal slivers from. I've observed a Sidesword demonstration where a red spark popped off when the blades clashed. It looked really impressive. As I stated earlier, different blade manufacturers have different formulas for the type of steel they use and how they heat-treat them. So some "Brand X" blades will be different from the "Brand Y" blades. Minor variations in how the different lots of the same manufacturer's blades are heat-treated will result in slightly different performance in what are supposed to be the "same" blade. That is a quality issue that will always exist.

If you also factor in the different physical designs of all the blades you have tremendous variety of things to consider when talking about what blade will give or receive more damage. What do I mean by differences? Well, the Zamarano blade I have dealt with has no "distal" taper. A distal taper is the narrowing in thickness of the blade as it approaches the tip. Therefore the Zamarano blade has a thicker cross-section right by the tip. Since it is a diamond cross-section the thicker tip should theoretically be stronger and less prone to be damaged. Reality is a little different, however. The steel of the Zamarano blade appears to be substantially softer than any blade it has opposed, therefore it receives more damage than it dishes out. This statement is based on observing the Zamarano blade in question get mightily chewed up by Del Tin Bated Rapier blades and Scottie Arms 42" Practice Rapiers (functionally equivalent to a Del Tin Practice Rapier blade).

Another blade that has been questioned is the Starfire Rapier Blade. The Starfire Rapier is an oval (or racetrack) cross-sectioned blade with no discernable distal taper. I have been told that the manufacturer claims that, in cases of blade breakage, the Starfire blade should be expected to break any other non-Starfire blade. If verified, it is a good statement of blade quality. It is an indication of what one might expect in thinking about the hardness and temper of the blade when compared to other blades. I will personally note that having handled the Starfire Rapier under discussion and compared its handling to other blunted reproduction rapiers I was not overly impressed. The lack of a distal taper negatively affects the handling and balance of the sword. The rounded edges and racetrack cross-section do make it more resistant to damage than a diamond cross-sectioned blade, regardless of its hardness. As for it breaking other blades, well, it has faced several blades in Sidesword combat and did, in some peoples judgement, appear to be more damaging to those blades than those blades were to it. No blades were broken by it yet. And it has been observed to receive enough damage to require more than just a light sanding job, so it doesn't appear to be an immovable object or an unstoppable force.

Blade breakage in normal SCA rapier combat is, as best as I can find out, an exceedingly rare event. Most of the cases I have heard involved what must have been pre-existing flaws in the blades (schlager blades, at least one was brand new). I have been informed that there have been no broken blades so far in Sidesword combat (as of January 9, 2002) even though the stress on the blades is orders of magnitude greater than what occurs in Rapier combat. I take this as a good sign, understanding of course that there are far fewer practitioners of Sidesword than there are of Rapier.

Properly dressed nicks, chips and dents will not substantially weaken a blade. Any sharp cornered nick in a blade will be more prone to generate what is called a "stress-riser", which you can think of as a place where failure (cracking or breaking of the

blade) is more likely. These nicks need to be carefully dressed and rounded, especially for use in Sidesword combat.

Steel bends. Steel breaks. Steel rusts. It even tears. All blades used for Rapier or Sidesword combat in the SCA (except for fiberglass) are steel and thus are subject to everything that can happen to steel. If any particular blade or type of blade proves to be excessively damaging to other blades, that is it dents, chips or nicks other blades in a manner beyond that which should be expected during normal use, then the use of that damage-causing blade should be reviewed. But our swords, especially those which see lots of use, won't last a lifetime. There may have been many generation-spanning blades in period, but I bet none of them were used as often or as hard as we use our blades.