

Molybdenum on point in fencing

A *flèche* or a *lunge* are just two of the many attacking moves in fencing that test the cold steel of foils, epees and sabers, subjecting them to brutal bending stresses. These weapons require flexibility and high toughness to ensure the safety of the fencers. The international standard for competition blades is a molybdenum-containing high-strength stainless steel that meets the challenge.

After more than one hundred years of know-how in hot forging of agricultural tools and steel fly-fishing rods, Blaise Frères, a small company from the Loire region of France, has earned highest standing in the fencing world. At the 2012 Summer Olympic Games in London, 95% of the fencers competed with their blades. Molybdenum made a decisive, if not official, contribution to this dominance.

An alloy approved by the International Fencing Federation

In the 1980s, competition injuries arising from failure of carbon steel blades led the International Fencing Federation (FIE) to seek an improved blade material. The primary objective was to guarantee faultless safety. However, it was also important to preserve the characteristic click-clack sound of crossing blades during attacks. This was a criterion of historic importance in this noble sport that harks back to the courts of the Renaissance, and it eliminated composite blades from consideration.

Fencing uses three different blade designs – foil, epee, and sabre. Foils and epees attack solely with the tip, which subjects the blades to substantial bending stresses during thrusts and impact loads during parries. Sabers strike primarily on the edge, the flat or the back of the blade, imposing sudden and repeated shocks.

A maraging steel, Z02 NKDT 18 09 05, was chosen and officially approved by the FIE. Maraging steels develop great

strength and flexibility through the metallurgical reactions of martensite formation and age hardening. The steel is a low-carbon iron alloyed with 18% nickel, 9% cobalt and about 5% molybdenum. The steel's unique properties optimally balance flexibility and strength so that blades do not twist when bent, which maintains the accuracy of 'hits'. Molybdenum plays a crucial role in blade performance, providing the metallurgical properties required to withstand short and intensive, lightning-like attacks.

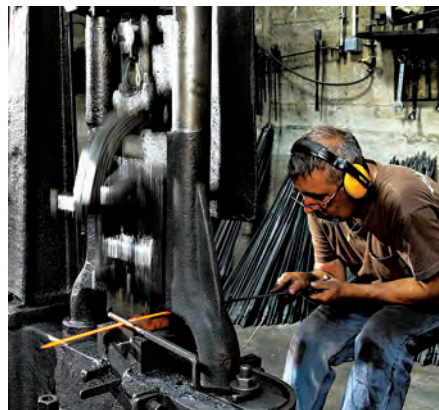
A completely traditional manufacturing process

Blades begin their life with automatic hot forging of a conical 'mock-up' from a 200–260 mm long bar. The next step is 'free' forging, hot manual shaping of the blade's final profile using a tilt hammer. By the time the blades are forged to their maximum length (870 mm at most),

they will have their typical profiles – square or rectangular for foils, V-profile for epees, and Y or V-profile for sabers.

Only the extremities of the blade are machined after forging. The base is threaded to secure the guard to the handle, and the 'tang' (the tip of the blade) is machined to house a micro-switch that registers hits. The switch's signal is transmitted through a 0.6 mm wire running in a groove along the blade. Grinding, polishing, heat treatment and marking give the blades their final appearance and mechanical properties.

During final inspection, tests to verify flexibility and resilience and, sometimes, fatigue and other destructive tests are carried out on equipment calibrated and approved by the FIE. The forging shop ships 70,000 blades around the world each year. High-level fencers, who use some 10 to 15 blades per year, particularly favor its competition models. ➤



Hot forging (left) and cold hammering (right) are performed with the naked eye by experienced craftsmen. © Blaise Frères

A seal of excellence for the manufacturer... and molybdenum

This leader of the high-end blade market depends on the workmanship of its operators, who are capable of checking up to 90% of a blade's precision of shape with the naked eye. The professional skills of its journeymen, the result of a long apprenticeship and experience, earned the company the highly-coveted EPV (Entreprise du Patrimoine Vivant – Living Heritage Enterprise). This seal distinguishes French companies with excellent craftsmanship skills and industrial expertise. Now, molybdenum has become part of this tradition. (Thierry Piérard)



A fleche (attack) at the final of the épée world cup tournament in Paris in 2012. Fencing weapons have to be extremely flexible without breaking. © Marie-Lan Nguyen