

# Following the Footsteps of Steel-toed Boots

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Every person in the military, every construction worker you see working either on roads or on developing buildings, scrap metal workers, warehouse employees, and workers at the Guam shipyard must keep their feet especially safe from harm in case something heavy slips and lands on their feet. All these people rely on steel-toed boots, and everyone in society is linked to relying on these people.

When it comes to purchasing steel-toed boots, they can be found online or at several shoe stores on-island, such as Famous Footwear and the Naval Exchange. Working backwards from the retailers to the raw materials, people can see just how complicated it is to produce and obtain something as basic as a shoe. Starting at the retailers where steel-toe boots can be found, we find that different stores on Guam each have their own best-selling brand. By investigating two specific brands, one brand popular among civilians and one brand popular among the military, we can infer how all other shoe companies then accomplish this as well.

One of the top-selling brands for safety boots among civilians on Guam is Timberland Pro; in the military, Belleville. Famous Footwear in the Guam Premier Outlet is the main retailer for Timberland's Pro Series, which specifically produces steel-toe working boots. Mark Fvasco, a Famous Footwear employee at GPO, stated that this preferred boot brand is distributed directly through the Famous Footwear Company in the United States. Buyers in Madison, Wisconsin, where Famous Footwear headquarters are located, decide which shoes and the quantity of each to be sent to the Guam branch. The Timberland company is the wholesaler of their boots and sends them to Famous Footwear's warehouses. Due to the abundance of Timberland factories, tanneries, distributors, and suppliers throughout the world, along with several "Asia Headquarters", it is nearly impossible to narrow down the exact location of each manufacturer from which Guam receives these boots. Contrarily, Arthurlevi Agulto, an HSC-25 store keeper

on Anderson Air Force Base, stated that Belleville's Safety Toe Boots are specialized only for the U.S. military. They can either be ordered online or by phone, or found in retail stores on military bases. To ensure quality, they are manufactured only within the U.S. and distributed from the mainland U.S. out here to Guam. The Belleville Shoe Manufacturing Company manufactures the boots, which are kept in warehouses until they are distributed to single parties who place orders, or wholesaled to military retail stores.

Both of these brands have different distributors that send the finished products to Guam, but the materials used and the manufacturing processes are essentially the same. The parts that compromise a steel-toe boot include: the upper, collar, sock lining, tongue, insole, midsole, outsole, threading, and steel-toe cap. As seen in Figure 1, the upper, collar, tongue, midsole, outsole, and threading are located on the exterior of the boot. The interior consists of the sock-lining, insole, and steel-toe cap. The upper is the material which covers the instep and top of the toes, the collar is the material that surrounds the heel and ankle, the tongue is the flap of material under the shoe laces, and the threading can be seen connecting the leather to other layers of leather and helps seal the leather to the insole. The sock-lining is material lining the interior of the boot and tongue, the insole is the rubber layer that the bottom of the foot touches inside the shoe, and the steel-toe cap is the steel that covers the toe area, hidden between the inside and outside layers of the boot. Each of these parts has to be constructed out of their own raw materials as well, manufactured individually, and then compiled into complete pairs of boots in a factory line.

Unlike Belleville which manufactures and produces its materials only within the United States, there are at least 217 branches of Timberland's factories and facilities world-wide, according to Timberland's Factory Disclosure update for May 2007. Since China is one of the

countries closest to Guam out of those which Timberland uses, it would appear obvious to have steel-toe boots produced there and then shipped out to Guam. However, just by looking into the inside tag of all the Timberland Pro series boots at Famous Footwear, it can be seen that the majority these boots have genuine leather uppers, man-made outsoles and sock-linings produced in the Dominican Republic. Only three models out of the Pro series have their outsole, sock-lining and genuine leather upper produced in China.

Now that we know where parts of the boots for each brand are manufactured, next we will determine where the raw materials for these parts come from and how they are processed. Both Timberland and Belleville steel-toe boots use authentic leather for the fabric on the outside of the boot, carbon steel for the cap of the toe, and polyurethane for at least the midsole. Belleville's 2008 Boot Catalogue states that "[they] only use the finest quality full-grain cattlehide leather in all of [their] boots". Timberland's boots simply state that they are made of "genuine leather". Either way, this means that both companies use leather made from animal-skin, normally that of cattle. In order to obtain cattle hide, skin from the head and/or back of cattle is cut from a cow's carcass after it has been butchered for meat. Then the skin is processed in a tannery where it is dyed, preserved, and made water-proof if needed. This is possible through either aldehyde-tanning or chromium-tanning because other means of tanning will shrink, discolor, or water-damage the leather. This leather is used for the collar, tongue, and upper of a boot. These pieces are cut into the shapes needed for each specific model. Next, the thread lining helps seal the upper to any part of the sole. Neither Timberland nor Belleville specifies the thread used in their boots but most threads used to seal footwear are synthetic, made of Teflon for example. A drilling and tapping machine punch the thread through the leather and attach it to the sole. For the steel-toe cap, Belleville uses carbon-steel but Timberland does not

specify the type of steel in their Pro Series. However, most steel in steel-toed boots is carbon steel. Unlike most metals, steel is actually a metal consisting of two elements. Carbon steel is comprised only of carbon, hence the name, and iron ore-instead of steels with manganese, tungsten, or chromium. Carbon steel is processed by heating iron ore in what is called a blast furnace, where the temperature can be up to 1200 degrees Celsius, and adding coke. Iron ore comes from iron mines. Coke is a form of coal containing carbon, and adding coal into the furnace increases the temperature. However, coal cannot remain in the iron to produce quality steel. Therefore the steel, while still in liquid form, is poured into casting machines which roll out flat sheets of metal and are cooled down usually by being blasted with oxygen. This solidifies the sheets while additionally combining oxygen atoms with carbon atoms to form carbon dioxide, releasing the left-over irregularities in the steel sheet into the air as carbon dioxide gas. Carbon steel for steel-toe caps can then be cut out of the sheet of steel and sent to a footwear manufacturing factory to put the entire boot together.

The most intricately produced parts of a steel-toe boot are probably the soles. For the midsole of both brands, a rubber-like polymer called polyurethane (PU) is used, although Timberland also has fabric for their sock-liners made out of this material. Insoles and outsoles however can be made of polyurethane as well, just in different thicknesses. By researching through websites such as Trade Mall and Trade Key, websites containing manufacturer information offer insights into what machines allow substances like polyurethane to be processed. To create the parts of the sole for any shoe, a cast for each of these soles is needed before the molten compound can be poured into the casts and then pressurized to reduce air bubbles. Specifically using chemistry terminology, "Polyurethanes are formed by reacting a polyol (an alcohol with more than two reactive hydroxyl groups per molecule) with a

diisocyanate or a polymeric isocyanate in the presence of suitable catalysts and additives” according to Center for the Polyurethanes Industry website. More simply put, polyurethane is a polymer with links of the urethane, an organic compound which contains the elements nitrogen, carbon, hydrogen, and oxygen. Such elements can be obtained through industrial gas suppliers. Polyurethane can be produced in “rigid” or “flexible” form by mixing these fluid chemicals at high speeds in different compartments within a PU foam machine. The machine keeps each chemical at a certain temperature, filters it, and then expels the fluids through different tubes that meet in the nozzle of the machine’s hose-like structure. The fluids mix as they are spewed out of the hose and into their casting mold. They are compressed into the cast by being pressurized to squeeze out any remaining air bubbles. To make sock-linings on the other hand, thin sheets of polyurethane are stretched after compression, but compression is not as important because the air holes allow the material to have ventilation. Polyurethane is not only used for the midsole, but is actually an excellent sealer when attached to the steel for the toe protector and other parts of the sole, similar to the steps show in Figure 2. Although polyurethane is not the only component that can be used to produce boot soles, discovering how one type of rubber-like polymer is made suggests how most other substances are similarly made.

Altogether, creating a pair of safety boots is more complicated than most people would consider. Who would have thought that natural elements in liquid form would be needed just for the bottom of their shoe? Even when interviewing members of shoe distributors, a single person does not know all the information about raw materials or manufacturing of their own shoe company. Realizing how intricate boot production is and learning how all the raw materials come together for the small components needed results in our appreciation for these simple material objects, along with appreciation for employees who we rely on whom use these boots.

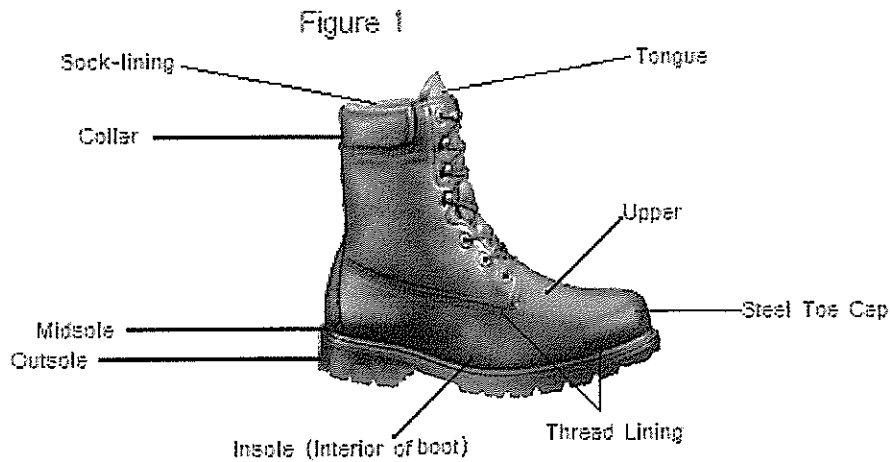


Figure 2 (Example of Layering and Sealing of Soles)

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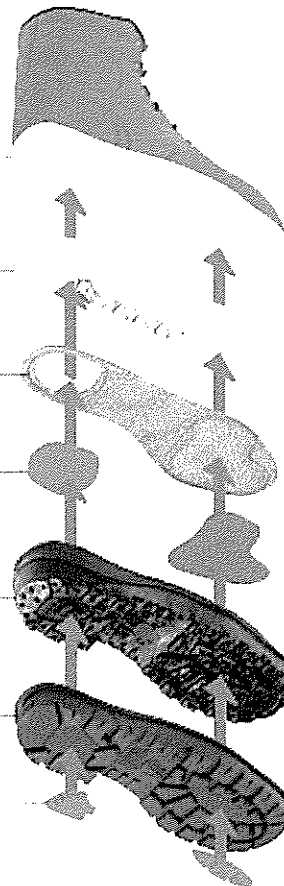
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## Pictures

Figure 1 from:

26 April 2008. <<http://www.uniformbootstore.com/images/1521.jpg>>

Figure 2 from:

26 April 2008. “TCT Antistatic Soling System”.

<<http://www.steelblue.com.au/getfile.aspx?Type=image&ID=1307&ObjectType=3&ObjectID=1289>>