The Origin of Specifications
(& Government Inspectors)

What did American industry look like before the Industrial Revolution? The manufacturing process depended solely on hand craftsmen. Every part had to be adjusted by hand to fit with every other part of an assembly. The net result of this system was that everything manufactured by hand was unique and, as a consequence, expensive.

**The Industrial Alternative**

A product with interchangeable parts was an idea Eli Whitney had around 1793. Let’s set the scene. An important factor in this story was the federal government’s limited ability to raise tax money, as well as its overall weakness in its dealings with the states. In addition, the world was a dangerous place for a fledgling country.

“The turmoil in the world would work to Whitney’s benefit. A war with France seemed more and more eminent, and the U.S. had a critical shortage of firearms. With wars in Europe eminent, it would be difficult to get arms from the other side of the ocean. The federal arsenals could not begin to meet the need for the thousands of stands of arms needed to carry on a war. A stand of arms included the musket, the ramrod, the bayonet, the wiper and the screwdriver. To give an idea of the problem, the federal arsenals in three years had barely managed to turn out a thousand stands of arms. The government was in such a quandary that it would need to call on private contractors. Whitney presented his plan to build arms with machines instead of the hand-made weapons being made at that time. His idea was to use machines to generate identical and replaceable parts. This was a brand new concept at that time, and many were skeptical of his ideas. Some machines were in use at that time, but none to do the precision work needed to make the weapons. The idea of interchangeable parts was also a brand new concept. If his idea was to succeed, Whitney would begin an industrial revolution in America.”

Whitney needed this idea to work because his first great invention, the cotton gin, had him deeply in debt. He found it nearly impossible—and costly—to defend his U.S. patent against the “King Cotton” states (weak federal government vs. strong states). This experience affected the written contract he requested in order to produce the muskets. He did not want to leave the possible acceptance or rejection of the muskets up to the individual states, so he made a provision in the contract that the federal government would be responsible for the inspection of the stands of arms. The federal inspector, therefore, was born out of the need for fair treatment by individual states with vested interests.

**The Development of Specifications**

The interchangeability of parts was revolutionary, but it depended on dimensional reproducibility. To this day, no two manufactured parts are identical. “Therefore, manufacturers had to be content with making them similar. If the parts were similar enough, they would fit (most of the time) and the product would work (more or less). Since the economic benefits of this approach were so great for both the producer and the consumer, it became a way of life in the industrialized world. Specifications were developed to define how similar the parts had to be in order to fit, and all variation was classified as either permissible (within the specifications) or excessive (outside the specifications).”

Specifications were a natural outgrowth of the Industrial Revolution. They formed a measured approach for determining the variations that distinguished a good part from a bad part. Manufacturing settled into a comfortable routine of
making, inspecting, reworking and shipping far less product than the customer needs. The pressures to ship more parts to the specification had reached the breaking point. Frank Lee Gutless, a purchasing agent, was the first to “blink” and is famous for requesting the very first deviation from a specification. The result of this action is the incessant argument over just how good parts have to be.

From Chariots to Railroads

Any discussion concerning the origin of specifications must include the following story, which may be familiar to many of you. Railroad gauge, or the distance between the rails in the U.S., is an odd-ball size and can be traced back to the first English trains imported to the U.S. The same craftsmen that made wagons manufactured the first English trains, and their manufacturing machines were set up at the wagon-axle distance. Ruts in the road caused the wheels to break if the wheels weren’t in the grooves. The vehicle that made the ruts in the first roads, of course, was the Roman chariot that was powered by two horses. To conserve resources, the chariots were built to a specification no wider than the backsides of the two horses. The fact that the earliest specifications involved a horse’s butt just reinforces the belief that not much has changed over the years as far as specification writing is concerned.

References

3. Not his real name; no actual purchasing agents were defamed during the writing of this column.