Comprehensive History of Fasteners

Opening Segment:

- **Michael (Host):** Welcome to *Wurth Knowing*! Today, we're exploring a topic that has held civilization together—fasteners!
- **Aaron (SME):** That's right, Michael. From wooden pegs to high-tech aerospace bolts, fasteners have been crucial in engineering, manufacturing, and everyday life throughout history.
- **Michael:** Let's start at the very beginning—how were the first fasteners invented?

Segment 1: Early Civilizations & the Bronze Age (Before 3000 BCE-1000 BCE)

- **Aaron:** Early humans relied on natural materials for fastening—wooden pegs, vines, sinew, and plant fibers.
- **Michael:** I wouldn't have considered those things to be fasteners!
- **Aaron:** *Give brief definition of fasteners, similar to OG episode 1 (a little repetition never hurts)*
- **Aaron:** Around 3000 BCE, metal rivets appeared, used by Egyptians and Mesopotamians for boats and armor. Over time, fasteners spread across the West through trade and cultural exchange and were developed independently in East Asia.
- The first rivets are likely to have been short metal rods that metalworkers hammered into a hole and deformed one end to hold it in place.

Segment 2: Classical Antiquity (1000 BCE – 500 CE)

- **Michael:** The Iron Age must have brought new innovations in fastening.
- **Aaron:** Absolutely! Iron nails became common by 500 BCE and were widely used by the ancient Greeks and Romans for shipbuilding and construction. Back in those days each nail was wrought by hand by blacksmiths.
- The Pantheon and aqueducts used metal clamps, and the Vikings later built their ships using iron rivets and nails, often with washers called "roves."
- **Michael:** That sounds like a lot of work! When did screws appear?
- **Aaron:** The ancient Greeks created threaded screws in wooden presses for wine and olive oil production around the 5th or 4th century BCE. Separately, in the 2nd century BCE, Chinese engineers also developed screws, using them in astronomical devices and hydraulic machinery. However, metal screws and other threaded fasteners were not commonly used the way we do until much later—they were difficult to make by hand and still a bit rudimentary.

Segment 3: Medieval to Early Modern Period (500 – 1700 CE)

- **Michael:** With the fall of Rome, did fastener development slow?
- **Aaron:** It did in the former Roman Empire, but blacksmiths continued making hand-forged nails for ships and buildings and wooden pegs were still used in cathedral and castle construction. Development also continued in East Asia, where engineers and builders refined fastener functionality and aesthetics.
- **Michael:** When did threaded fasteners become more common worldwide?
- **Aaron:** In the 14th and 15th centuries, blast furnaces were invented that could make higher-quality iron, and steel production increased allowing for more durable materials.
- Equipment for battle also became more sophisticated with the development of gunpowder. Screws were used to build cannons and assemble armor.
- Around this time, in the Middle East, metalworkers became highly advanced, using threaded fasteners in clocks and other mechanical devices. Fasteners developed during this time would have been influenced by all these factors and many more as trade and cultural exchange between the West and the East increased.
- **Michael:** Wait, didn't Leonardo Da Vinci design a lot of mechanical inventions during that time? Did those include threaded fasteners?
- **Aaron:** You're right! His designs and principles laid the foundation for mass production and the industrial revolution.

Segment 4: Industrial Revolution (1700 – 1900 CE)

- **Michael:** The Industrial Revolution must have transformed fastener production.
- **Aaron:** It did! In late 16th century UK, brothers Job and William Wyatt pioneered an early version of a screw machine, while in the same time and country Jesse Ramsden invented the first screw-cutting lathe which enabled uniform screw production.
- **Michael:** I'll bet standardization was important as the industrial revolution developed—how could you make standard machines in a factory without standardized parts?
- **Aaron:** Exactly. In 1841, Joseph Whitworth introduced standardized screw threads. Before that, screws had all different thread angles, pitches, diameters, and more, so parts were not interchangeable between different machines or manufacturers.
- **Michael:** That sounds expensive to keep track of. So, the standardization paved the way for mass production and faster, cheaper fasteners?
- **Aaron:** Exactly! Cut nails became the standard in construction, and rivets were essential for steam locomotives, bridges, and even the Eiffel Tower.

Segment 5: 20th Century – The Era of Advanced Fasteners

- **Michael:** With industrial growth, fasteners had to evolve further.

- **Aaron:** Yes! As precision machining developed, it got easier for manufacturers to produce threaded fasteners, which create clamping force for joints that are often stronger than nails or rivets.
- **Michael:** And you can't really remove and replace a rivet, can you?
- **Aaron:** That's right—but you can remove and replace a nut and bolt, which was important as these standardized machines started to need repairs. So, by the early 1900s, hexagonal nuts and bolts became industry standards. The 1930s saw Phillips head screws and self-tapping screws revolutionizing assembly lines.
- **Michael:** What about aerospace applications?
- **Aaron:** Aircraft rivets became crucial in the 1940s since aircraft manufacturing advanced so much during WWII.
- Titanium fasteners are strong as steel but up to 45% lighter, and more resistant to extreme temperatures and corrosion. This makes them ideal for space flight, so they had a lot of development in the 60's.
- Later, plastic fasteners grew in popularity for electronics.
- **Michael:** Is that because they're non-conductive of electricity?
- **Aaron:** Correct, plus they're lightweight, non-magnetic, and corrosion resistant, all of which is necessary for electronics applications.
- **Michael:** And corrosion resistance became more important?
- **Aaron:** Absolutely! As manufacturing evolved to create new machines and become more efficient, the 1980s and 90s introduced thread-locking adhesives and new coating systems to optimize fasteners for different applications.

Segment 6: 21st Century – Smart & High-Tech Fasteners

- **Michael:** What are the latest innovations in fasteners?
- **Aaron:** Smart fasteners now have sensors or indicators to monitor stress and tension. Composite and 3D-printed fasteners offer lightweight, customizable solutions. You can get a nut that forms its own threads in a rod or a coated bolt. We've covered many of the latest fastener innovations in our first generation of the show, so if you're interested in learning more about that topic, I recommend you check it out!
- **Michael:** Sustainability is also a focus, right?
- **Aaron:** Yes! Recyclable and biodegradable fasteners, along with eco-friendly manufacturing, are reducing the environmental impact of manufacturing.

Conclusion:

- **Michael:** Fasteners have played such an essential role in human progress. It's so interesting to look back and analyze the cause and effect that allowed fasteners to develop throughout history.

- **Aaron:** And as technology keeps advancing, they'll only become more efficient and sustainable. It's exciting to think about the future of industry and fasteners and what new technology will improve our world!
- **Michael:** Thanks, Aaron, for walking us through this fascinating history.
- **Aaron:** Of course, that was fun. Understanding the reasons why fasteners developed is Würth Knowing to me!

End of Episode.