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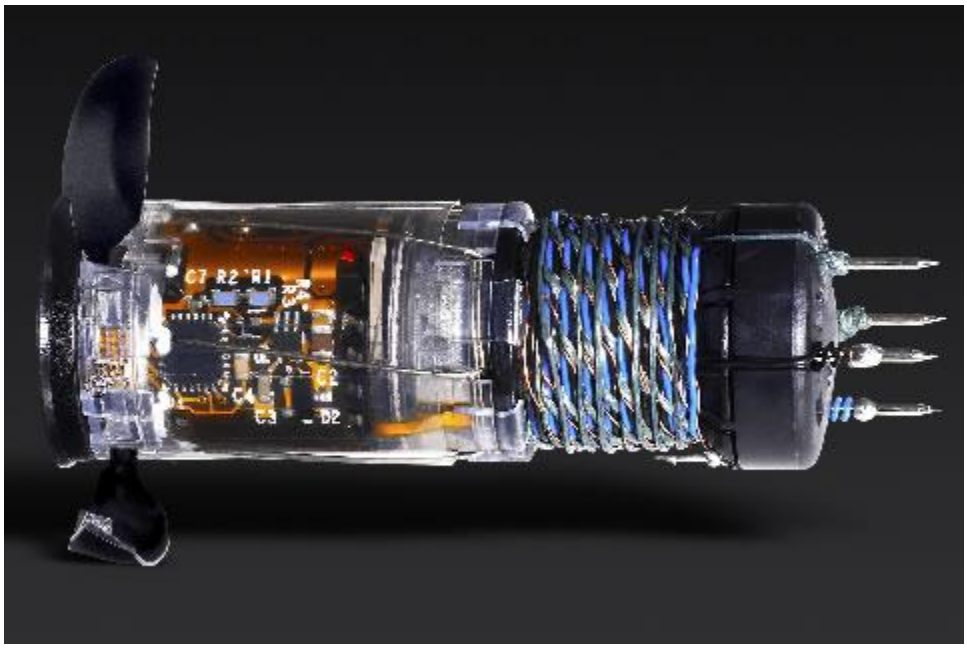
Editor's Note: The following case study was submitted by Icon Injection Molding Inc., Phoenix.

Icon Injection Molding Inc. recently provided extensive product development assistance to Taser International of Scottsdale for its latest law enforcement device—the XREP Cartridge.



The XREP Cartridge contains 23 injection-molded parts and numerous electronic components. Each part must have extremely tight tolerances to fit within the cartridge.

Icon Injection Molding, which provides contract manufacturing services to a variety of industries such as law enforcement, safety and security, has been a long-term supplier and partner to Taser International. Taser is best known for its Electronic Control Devices (ECDs) for law enforcement and corrections personnel, professional security personnel, the military and consumers for personal protection.

When Taser came to Icon with its newest project, the Taser XREP® (Extended Range Electronic Projectile) Cartridge, Icon's engineering team began looking at ways to design and manufacture this unique and challenging device.

The device is a cartridge the size of a regular shotgun shell, loaded with the Taser components that shoot a wireless charge. "It packs twice as much power and has four times the range as the standard Taser guns," said Danny Kleitsch, president and co-owner of Icon.

The Taser XREP Cartridge is a self-contained wireless electronic control device (ECD) that deploys from a standard 12-gage pump-action shotgun. It is the most technologically advanced projectile ever deployed in this manner, and delivers a Neuro Muscular Incapacitation (NMI) bio-effect similar to Taser's other well-known devices, such as the hand-held Taser X26™ ECD.

The Taser XREP Cartridge, however, can be delivered to a maximum effective range of 100' (30.48 meters). The battery supply is fully integrated into the chassis and provides the power to drive the XREP projectile engine.

In both the XREP series cartridges, the nose assembly of the projectile contains forward-facing barbed

electrodes. On impact, the forward-facing barbed electrodes attach to the body of the target. The energy from the impact breaks a series of fracture pins that release the main chassis of the XREP projectile, which remains connected to the nose by a non-conductive tether.

The XREP projectile autonomously generates NMI for 20 seconds. As the chassis falls away, six "Cholla" electrodes automatically deploy to deliver the NMI effect of a greater body mass.

As the size of the XREP Cartridge and the components it contains—23 injection-molded parts packed closely together—are extremely small with very tight tolerances, Icon had to design and build extremely precise molds with tight tolerances. The XREP Flight Stabilizer Fins had to have a wall thickness of only 0.011".

One of the molds Icon built for the XREP project was a six-cavity mold that required the company to purchase a high-speed Nissei injection molding press, an NEX15 with upgrades including a 19.7"/s injection velocity capacity with no accumulator. The press was fitted with automation for part removal so that the mold could achieve fast cycle times for high productivity.

Mark Hanchett, mechanical engineer with Taser's R&D department said that the thin walls of the parts presented a challenge in material selection. "We had to deal with materials that normally don't flow well through these thin walls, and deal with those issues in order to get the material to flow, such as heating the material to higher temperatures," Hanchett explained.

Icon and Taser worked closely with Icon's material suppliers, and chose a Sabic Lexan EXL, an experimental grade of polycarbonate with very high impact modifier content for many of the parts. A custom LNP Teflon-filled polycarbonate was chosen for the XREP's Flight Stabilizer Fins, with a material shot size of a mere 0.0276g each. The Shell base is a multi-component part that includes EXL-polycarbonate molded over a metal injection-molded (MIM) ring for improved mechanical properties when fired and ejected.

The fact that many of the 56 total mechanical components that comprise the XREP are technically micromolded parts, the intricate detail of the parts presented the biggest challenges.

"There is one molded component that mates with 15 other components, but that component is the size of a dime," said Hanchett. "And all of these components must be contained in a product that is the size of a standard 12-gage shotgun shell."

Icon developed the tool designs to make the various molds, and then performed R&D on the pre-production molds to ensure the molds would run consistently, Hanchett noted. "Icon researched the materials and performed Moldflow™ analysis on part designs and hot runner manifolds to ensure consistent quality."

In all, Icon designed and manufactured 20 tools for the manufacture of the Taser XREP Cartridge, all of which make the extremely complex parts that comprise the XREP Cartridge. Taser's management, which has partnered with Icon since 1997, is extremely happy with Icon's capabilities as a supplier.

"Taser International's design and development team have partnered with Icon Injection Molding on most of our most critical and ground-breaking projects since 1997," said Taser Mechanical Engineering Manager Milan Cerovic. "We recognized that Icon shares the same core values as Taser International does, along with innovation, technical expertise, competence and above all, quality and reliability. Their work ethics and leadership in their field are reassuring and motivating for us to work together in the future as we have in the past."