Digital eBook
A Design World Reference

Case Studies

with Proto Labs

Design World TechTiPS proto labs® Real Parts. Really Fast.™

Transforming the Circuit Breaker with Rapid Injection Molding:

Energy startup uses molded prototypes and production parts to revolutionize circuit breaker industry

A THREE-YEAR-OLD energy startup is transforming circuit breakers, with on-demand manufacturing help from Proto Labs. Charlotte, N.C.-based Atom Power is creating the first commercially viable, solid-state circuit breakers for large business and industrial building markets and is currently in the process of seeking approval from Underwriters Laboratories (UL).

"Our aim, with a solid-state circuit breaker, is to create a safer and faster means of breaking a circuit," said Taylor Santore, a mechanical engineer and project lead for Atom Power. Traditional circuit breakers stop the flow of current in an electric circuit as a safety measure, through a mechanical, automatically operated electrical switch. Atom Power's circuit breaker moves the process from mechanical to digital. "This new, solid-state breaker will mean greater customer safety, reliability, and more longevity in the part," Santore added.

Atom Power's new, solid-state circuit breaker, for large-scale business and industrial buildings, holds the promise of being a safer and faster means of breaking a circuit.

Transforming the Circuit Breaker with Rapid Injection Molding - continued

Energy startup uses molded prototypes and production parts to revolutionize circuit breaker industry

Just how groundbreaking is this technology? Energy giant Siemens has taken notice. Siemens has invested in Atom Power, forming a partnership through next47, Siemens' investment arm.

"Atom Power is on the leading edge of a fundamental change in the traditional circuit breaker and shows great promise toward enhanced energy awareness and faster reaction times in an increasingly complex energy landscape," said Terry Royer of Siemens in a recent Charlotte Business Journal article. Royer is vice president of operations and product development for Siemens' low-voltage and products business.

Development Challenge: From 3DP to IM for UL—ASAP

Santore said Atom Power started out with 3D-printed (3DP) parts from his company's in-house 3D printer, which he said worked well during the early design days of the project. "We were able to test out every part, figure out sizes, tolerances, go through everything we needed to consider, and saved a lot of money from having to use injection molding (IM) for our parts over and over again."

Eventually, however, after producing 3D-printed alpha and beta versions of the prototypes, issues such as absence of draft and other molding design considerations emerged, items that prompted Santore and his team to seek out Proto Labs to produce molded parts for prototypes, he explained.

Accordingly, a third version, an injection-molded version, was done by Proto Labs, and then, following a few more tweaks, a fourth iteration was done, though, as Santore mused, because it had just a few changes, it was more like version "three and a half."

Along the way, through all versions, Santore said that Proto Labs' design analysis, part of the automated quoting system, was valuable. Additionally, a lot of "back and forth" questions and discussions with Proto Labs' applications engineers in customer service was especially helpful, Santore said.

And, of course, all of this was done swiftly to meet timelines that are a part of Atom Power's pursuit of UL approval as the company works through various required UL testing and reviews. "Deadlines for startups like ours are insane," Santore said. "We pushed the envelope in getting these parts done and that's what is so appealing about Proto Labs, you can turn things around in a hurry."

Transforming the Circuit Breaker with Rapid Injection Molding - continued

Energy startup uses molded prototypes and production parts to revolutionize circuit breaker industry

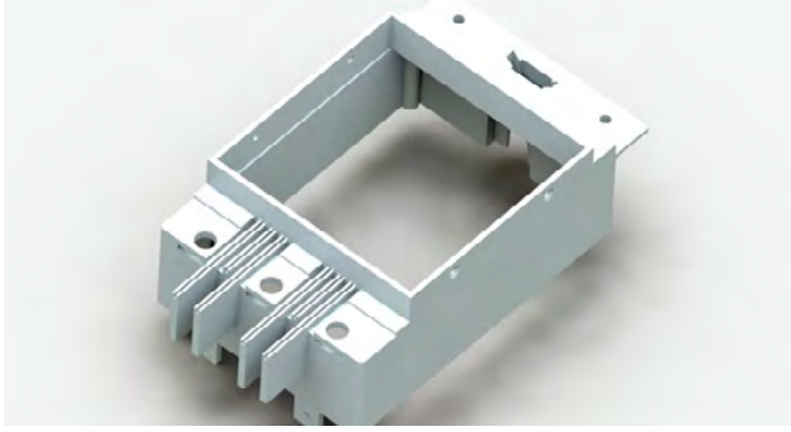
Manufacturing Solution: On-Demand, Low-Volume Production

That speed, combined with Proto Labs' on-demand, quick-turn, low-volume production capabilities, solved Atom Power's unusual manufacturing dilemma. Why unusual? The UL approval.

The company couldn't really start producing hundreds of thousands of parts for its circuit breaker products before getting UL certification, or, as Santore said, "Until we can have the UL sticker on it." So the idea, he said, was to be "completely production ready."

That meant ordering parts, but in lower quantities, "because we didn't want to have thousands of parts just sitting around in case Underwriters Laboratory wanted us to change something in the design," Santore explained.

"That's a big benefit of on-demand manufacturing," Santore added. "You enabled us to get parts fast, to see what they would look like, and see the feel, the strength, how the parts would work, without having to order large production runs."



Proto Labs manufactured several prototype and end-use production parts for Atom Power's new circuit breaker, including this enclosure.

Proto Labs produced a variety of injection-molded parts for Atom Power, including internal parts for the "disconnecting" piece of the breaker, enclosures for the breakers, and elements of the control panel. An ETPU (Engineered Thermoplastic Polyurethane) was used for the enclosure, and several different materials, including another ETPU, Isoplast 202EZ, were used for the disconnect parts.

Beyond the game-changing function of Atom Power's new circuit breakers, the company also wanted the products

Transforming the Circuit Breaker with Rapid Injection Molding - continued

Energy startup uses molded prototypes and production parts to revolutionize circuit breaker industry

to look better. "Right now, breakers are an afterthought," Santore said. "You put them in a metal cabinet and close them away." These breakers have a screen on the buttons that light up green and red, indicating on and off, the enclosure displays these as well, and the white control panel enhances the overall appearance.

Product Outcome: Functional Testing a Success

The quality of the finished parts Proto Labs made for Atom Power, and the fast delivery of those parts, are two prime reasons Santore calls Proto Labs "our go-to manufacturer."

Parts have performed as required, Santore said, including in simulations, stress analyses, "real-life" tests, and, in a requirement from UL, a 10,000-mechanical-cycles test. "We did that here in our building and we had no problems. It was really critical for us to do that...We were pleased to see how well everything held up. No fatigue cracks, no stress marks, no nothing. It was fantastic."

Plus, the delivery speed "was a huge thing," Santore said. "Being able to call Proto Labs, and in 15 days have what we need, that was awesome."

UL testing continues, as does the development of additional product lines. Atom Power already has 100 amp AC and DC products, which Proto Labs worked on, and is now developing 200 amp, 800 amp, and other models.

Mind Over Machine

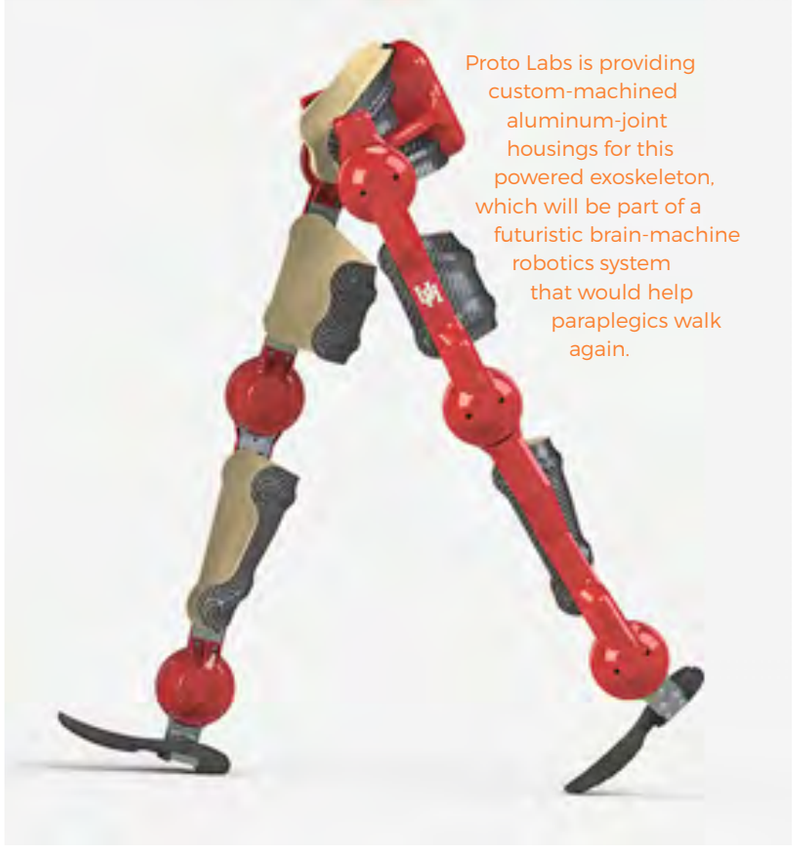
Custom-machined joints, brain-controlled exoskeleton combine to enable paraplegics to walk

A UNIVERSITY OF HOUSTON research lab is developing a powered exoskeleton—with help from Proto Labs, which is providing custom-machined aluminum joint housings—that will be part of a futuristic brain-machine robotics system.

It is a fast-track effort to bring the exoskeleton—amped-up versions of which have appeared in such films as "Aliens" and "Avatar"—from science fiction to real-world use, which would help paraplegics to walk again.

A multidisciplinary research team that includes engineers, neuroscientists, health professionals, and students is working to create, from scratch, a powered wearable robotic device that allows those with lower-limb paralysis from spinal injury, disease, or stroke to regain mobility without a walker or canes.

A sci-fi element lives on in the project, which is taking place at the university's Laboratory for Noninvasive Brain-Machine Interface Systems. As the lab's futuristic name suggests, the ultimate goal is to allow users to control the exoskeleton—commanding it to go forward or backward, to turn, sit, or stand—using their thoughts instead of a joystick, switches, or external operator typical of other devices.



Proto Labs is providing custom-machined aluminum-joint housings for this powered exoskeleton, which will be part of a futuristic brain-machine robotics system that would help paraplegics walk again.

Mind Over Machine - continued

Custom-machined joints, brain-controlled exoskeleton combine to enable paraplegics to walk

The only thing more fantastic might be the extremely ambitious deadline that Jose Contreras-Vidal, the lab's director and Cullen professor of electrical and computer engineering, set for the project. While the lab has extensive experience in brain-machine interfaces, developing a powered exoskeleton robot represented its first venture into developing its own hardware.

Yet the plan is to have a working model ready for a user, known as a pilot, to take part in the powered exoskeleton race at Cybathlon, an international competition in Zurich in October. The event features physically impaired people using the latest assistive technologies, in many cases going up against commercial systems from companies with years of experience and regulatory approval. That means having a working model ready less than 10 months after Contreras-Vidal and students began brainstorming about exoskeletons in a class in the fall of 2015. By comparison, a lower-limb exoskeleton that recently received U.S. Food and Drug Administration approval was the result of an intensive 10-year development effort.

Closed Systems Limit Development

Research at the brain-machine interface lab focuses on developing devices that "listen to the brain, extract intent, and use those signals to control wearable robots," Contreras-Vidal said. In tests, the lab has used brain-machine interfaces to control upper-limb exoskeletons, upper-limb prosthetics with actuated fingers, and lower-limb exoskeletons. The "listening" occurs through an electroencephalogram (EEG) cap, worn over the user's head, that uses an array of electrodes to detect electrical activity in the brain.

The brain-machine interface measures the user's brain waves as he or she carries out a series of motions with the exoskeleton. The system uses advanced algorithms to map the user's brain waves for each motion. The brain-machine

Proto Labs is producing a variety of parts for the University of Houston's robotics system. Photo Courtesy: University of Houston

Mind Over Machine - continued

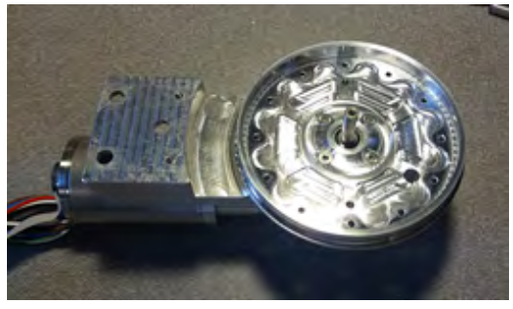
Custom-machined joints, brain-controlled exoskeleton combine to enable paraplegics to walk

Researchers at the University of Houston demonstrate how the robotics system works.

interface learns to interpret the brain signals associated with those motions to understand when the user wants to walk and when he or she wants to stop. The user also requires training to go into those states of mind so the system can interpret them correctly. The lab is using a variety of machine learning approaches to train the machine, making it a pioneer in applying that technique to controlling lower-limb exoskeletons.

"We were probably the first group to demonstrate a noninvasive brain-machine interface to an exoskeleton in a person with paralysis," Contreras-Vidal said. "We have been since trying to push the envelope to better understand the intent of our participants. We can drive the machines to do what we want."

Efforts to continue refining the brain-machine interface, however, encountered a roadblock when most makers of commercial lower-limb exoskeletons declined to open up their systems to let the machine interface run their devices. One company, New Zealand-based Rex Bionics, has allowed the lab to use its brain-machine interface to control high-level functions of one of its exoskeletons, to direct it to turn or stop or start. Contreras-Vidal, though, wanted access to low-level



Researchers conceive a wearable robot with six actuated joints. Covering those mechanical joints and "muscles," are aluminum housings, custom-machined at Proto Labs. Photo Courtesy: University of Houston.

Mind Over Machine - continued

Custom-machined joints, brain-controlled exoskeleton combine to enable paraplegics to walk

controls to specify how the robot can move, step-by-step, to give it a more natural, even individually recognizable human gait. That's when he decided to get into the hardware business, setting out to have the lab develop its own exoskeleton as an open platform on which to test and develop control architectures including its "bleeding edge" brain-machine interface technology.

Quick-Turn Machining Supports Rapid Progress

The lab team conceived a wearable robot with six actuated joints, one at each ankle, knee, and hip, serving as what Contreras-Vidal termed "the muscles of the exoskeleton." Covering those mechanical muscles are aluminum housings custom-machined at Proto Labs. While designing, building, and making adjustments to the device under the lab's tight, self-imposed deadline, getting parts quickly has been critical, according to Jeffrey Gorges, lead research technician. Uploading CAD drawings to Proto Labs' online design analysis and quoting system helped the process get off to a fast start.

"If you were to take the same components to a job shop, they might say, 'OK, in four to six weeks we'll get back to you,'" Gorges said. "With a three-day turnaround with Proto

> "Research focuses on developing devices that "listen to the brain, extract intent, and use those signals to control wearable robots.

Labs, that gives us a whole extra two months to work with. That's huge because we can't test our controls unless we have the hardware in hand. Every day we have in hand is a better day to improve the system."

The lab used its own 3D printer to create "version 0.1" of the housing to evaluate the assembly, assembly processes, and how components would stack inside, Gorges said. The lab is using 3D printing to produce carbon-fiber braces for the exoskeleton and casings for electronics. The Baylor College of Medicine in Houston, which has an orthotics and prosthetics program, is making the braces.

Loading tests weren't possible with a 3D-printed housing, however, so the lab had Proto Labs make a small single joint to test. A second version of the housing from Proto Labs is now in use with design improvements likely to lead to further iterations. For load-bearing joint components, the

Mind Over Machine - continued

Custom-machined joints, brain-controlled exoskeleton combine to enable paraplegics to walk

lab is using aircraft-grade aluminum 7075 for its light weight and rigidity, Gorges said. The material also offers high tensile strength and corrosion resistance. "The big thing is minimizing size and weight for the exoskeleton but also having reasonable cost," Gorges said.

At the lab's request, Proto Labs agreed to sponsor a portion of the cost of the parts it has made. "We were surprised by the rapid turnaround and the interest in the project from Proto Labs," Contreras-Vidal said. "We really appreciated that."

Patent, Approval Application, Competition On The Horizon

All of the parts, including the aluminum housings, have worked well in initial testing, Gorges said.

"Those parts are critical points in the system," Contreras-Vidal explained. "The housing is not only the location for the actuators and the gear reduction but it interfaces with other parts of the system. We've done a lot of bench tests, we have had this joint going many, many times. They have been doing fine."

Contreras-Vidal has filed provision patent paperwork for the brain-machine interface and the exoskeleton. He will seek approval from the FDA, which regulates exoskeletons as Class II devices, once the lab finalizes a prototype. Meanwhile, development of the exoskeleton and training of the brain-machine interface and a pilot will continue as the Cybathlon competition approaches. He also is looking ahead to the eventual commercialization of the system. The market for devices that help paraplegics walk could top $1 billion in 10 years, an industry executive has said.

Enabling people with lower-limb paralysis to walk again is an endeavor with a "high social impact," Contreras-Vidal said. The United States has an estimated 6 million people with paralysis, he said. Lifetime care for a 25-year-old who becomes paraplegic because of a spinal cord injury is estimated to cost $3 million excluding lost wages. Paraplegia also can lead to secondary health problems such as bladder malfunction.

"This person might be able to work again or to increase the amount of work that he or she can do," Contreras-Vidal said. "This person is going to feel better. This person is going to be happier, and so are the family, and relatives, and co-workers."

Gearing Up for Production

Sportech uses quick-turn machining to validate design prior to large-scale manufacturing

Sportech developed durable nylon clips and hooks with quick-turn CNC machining at Proto Labs.

FROM FROZEN TRAILS to rugged desert valleys and muddy creeks, power-sports vehicle drivers put their machines to the test. Producing custom parts for many of those snowmobiles, utility vehicles, and motorcycles—on short production cycles and with manufacturers gearing up for large-scale production—is another sort of test for Minnesota-based Sportech, Inc.

Sportech got its start in 1994 as a home-based business when the father-and-son team of Dallas Carlson and Chris Carlson began making a plastic shield that kept snow from building up in the headlights of certain Polaris snowmobile models.

Today, Sportech is a product development partner to seven of the eight largest power-sports vehicle makers. The company specializes in full-service design, development, and production of custom parts and accessories, going from concept or rough sketches to 3D CAD modeling and rapid prototyping. Its services include thermoforming,

Gearing Up for Production - continued

Sportech uses quick-turn machining to validate design prior to large-scale manufacturing

drape forming, CNC routing, and integrated assembly. Products include windshields, body panels and screen-printed parts for motorcycles, snowmobiles, all-terrain vehicles (ATVs), and utility vehicles (UTVs).

Deadline Help from Proto Labs

When Sportech quickly needs parts, the company regularly uses Proto Labs, says Negri, who leads product development with an engineering and technical staff of 25. One example involves Sportech's development of plastic clips and hooks used to attach a windshield to a specific model of UTV, he says.

Sportech had the design complete but needed a run of parts to test before its customer went into production with larger-scale injection molding. But getting test parts from the mold, once it was done, would take at least six weeks—time that Sportech didn't have.

"We needed to use that time to be testing, and didn't have another six weeks to wait for the parts to come out of the mold to start," Negri explains. "Product development isn't always behind but it seems like we're always in a hurry, so days certainly can make a difference at that stage."

Negri's solution was to use Proto Labs' CNC machining service to produce the clips and hooks while another vendor completed the high-volume injection molding tool.

> We were able to physically test the [machined] parts and validate them, so when the injection-molded samples came in we were able to keep running and hit our timelines.

"We turned to Proto Labs, and they were able to machine those parts in a few days," Negri says. "The customer agreed to validate with the Proto Labs parts. We were able to physically test the parts and validate them, so when the injection-molded samples came in we were able to keep running and hit our timelines."

That helped Sportech help its customer begin high-volume production of the parts, Negri says. More than 100,000 of them have been produced since.

"It gave us confidence in the design," Negri says of the parts Proto Labs produced. "We knew when the [injection-molded] parts did come in, we had a relatively high level of confidence that the tool that we just purchased was going to perform as we designed it. It was great from a durability standpoint but also for an ultimate design validation."

Gearing Up for Production - continued

Sportech uses quick-turn machining to validate design prior to large-scale manufacturing

CNC Machining Versus 3D Printing

Sportech has an in-house 3D printer that it often uses for initial design validation and quick, iterative design changes, Negri says. But 3D printing wasn't suitable in this case because one of the parts had a snap feature that required a higher level of durability.

"When we have to go into testing or have a feature that relies on the material properties of the plastic that we're ultimately going to use, like a snap feature, 3D printing is not a good proxy for the end product," Negri explains. "The only option to test those parts—other than building the tool—is to machine it."

Sportech chose glass-filled nylon 6 to machine the clips and hooks. "Nylon 6 is extremely durable," Negri says, also noting its resistance to ultraviolet light. "It's a tough material that performs well in the harsh environment the product is used in. We have a lot of good experiences using that in our outdoor, UTV-style applications."

Online Quoting and Production Speed

Negri says the turnaround time at Proto Labs is impressive: "They have a really slick process, so we tend to use them for that," Negri says. "Sometimes we come to them when we're in trouble. We've had them build injection molding tools in short order for some limited-run production stuff that we needed really fast, or, if we have a component that failed in testing and need to make changes to it to vet out that solution before it goes to production."

Negri also uses Proto Labs' online system to get quick interactive quotes and design feedback on parts to keep product development moving. In fact, the only time he really needs to speak to an actual person at Proto Labs is when he wants to physically pick up the part himself rather than have it shipped since Sportech and Proto Labs are in proximity to each other.

Sportech continues to develop new versions of those clips and hooks, and many other components, as power-sports manufacturers introduce new models. The popularity of recreational and utility vehicles is helping to drive the company's expansion into a new 105,000-square-foot building that will improve efficiency, support new manufacturing processes and include warehouse space, according to company officials. Construction of the $3.8-million project in Elk River, northwest of Minneapolis in the Twin Cities metro area, is to begin in fall 2015. ●

A Front Seat on Driving Innovation

TRW Automotive's clock spring components take advantage of injection molding at Proto Labs

IN TODAY'S cars and trucks, the steering wheel does much more than steer.

Steering column control modules now integrate an expanding variety of functions into the steering wheel, offering drivers a host of functions for both safety and convenience. It communicates airbag deployment signals in the event of a crash, for example, and enables you to change radio stations without taking your hands off the wheel.

Providing connectivity between all of those helpful buttons and switches and the functions they control—from the turn signals and wipers to cruise control and even heating the steering wheel itself—is the job of the clock spring, a plastic disc about the size of a hockey puck that sits hidden under the steering wheel within the steering column control module.

While you may not give much thought to what happens when you press a steering wheel button and the volume of your song goes up, Rick Bowes certainly does. He's a designer in the body control systems group at Michigan-based TRW Automotive, a global company focused on active and passive safety systems.

The clock spring is positioned in the center of a typical steering column control module.

Injection-molded automotive clock spring
The clock spring is positioned in the center of a typical steering column control module.
"[Automakers] these days want more features packed into smaller packages," Bowes says. "That's our challenge, stuffing all that functionality into that little package. You don't see any wires hanging off your steering column, so they've got to go somewhere."

A Front Seat on Driving Innovation - continued

TRW Automotive's clock spring components take advantage of injection molding at Proto Labs

Iterative Development with Rapid Prototyping

Bowes' focus on continuous improvement to the clock spring repeatedly brings him back to Proto Labs. In the past five years, Proto Labs has made TRW hundreds of prototypes of clock spring rotors, housings, and covers, the components that Bowes says comprise the bulk of the structure of the clock spring assembly.

"In general, there's probably 15 or 20 parts that make up a clock spring assembly," Bowes says. "If at least half of those need to be prototyped, multiply that times each iteration that we do, and it adds up pretty quick."

Proto Labs' turnaround speed was especially valuable when Bowes needed a prototype that combined existing TRW clock spring technology with new design features.

"I was able to effectively utilize prototype parts with the new concept design using the old inner workings," Bowes says of the part, now in production. "I also had to integrate different thought processes and make it work in line with our current assembly process down at our plant. Obviously, Proto Labs came in handy for doing the quick prototypes that served our purposes for evaluation and testing."

Molded Thermoplastic Components

TRW uses Proto Labs' for injection-molded thermoplastic clock spring rotors and covers made from acetal and housings made in PBT (polybutylene terephthalate), Bowes says. "This is the most logical way for these kinds of parts," Bowes says of the injection molding process. "It's right in the wheelhouse since [the clock spring] is roughly the size of a hockey puck. It's good for multiple cavity molds."

A Front Seat on Driving Innovation - continued

TRW Automotive's clock spring components take advantage of injection molding at Proto Labs

Prototyping with injection molding at Proto Labs is cost-effective and works well for testing and evaluating a part, especially if an engineer or designer needs to further validate a part design before moving to large-scale steel tooling. Bowes also occasionally relies on Proto Labs' CNC machining capabilities to mill only a portion of a prototype, which lets him see how a subsystem or design element works.

Both Proto Labs' interactive design analysis in its quoting system and the company's customer support engineers helped with the prototyping process, Bowes says. The system offers feedback on design and pricing information within hours of uploading a 3D CAD model. "It's very convenient for part submissions," Bowes says. "The online interface is very flexible in terms of making adjustments during the quoting process."

Prototyping clock spring assembly parts helps Bowes make sure that design changes won't damage the thin, flexible flat cables (FFCs) inside the clock spring. The FFCs provide the wired connection that carries signals from

WATCH THE VIDEO:

RAPID MANUFACTURING HELPS LOCKHEED MARTIN DRONE TAKE FLIGHT

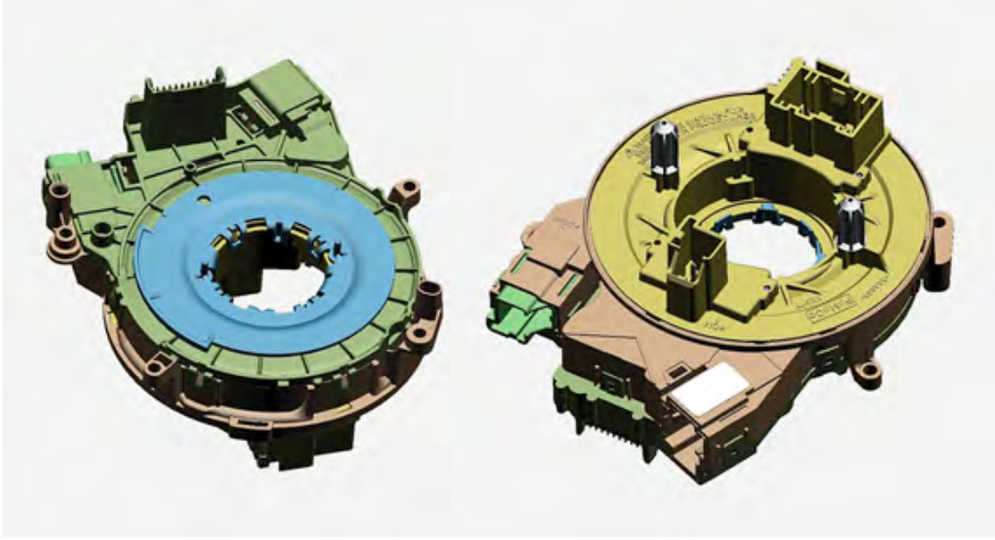
To get its new Indago quadcopter off the ground and into a soaring market for commercial drones, Lockheed Martin turned to Proto Labs for our rapid prototyping and on-demand production capabilities.

The aerospace, defense, and technology giant used Proto Labs' automated design for manufacturability (DFM) and quoting system to quickly move its drone from 3D-printed prototypes to injection-molded parts, and accelerate its time to market. Read more about the development of Lockheed Martin's drone at protolabs.com.

CLICK HERE TO WATCH

A Front Seat on Driving Innovation - continued

TRW Automotive's clock spring components take advantage of injection molding at Proto Labs



The renderings show top and bottom views of the intricate clock spring assembly.

steering wheel buttons and switches through the clock spring, down the steering column, and onto the circuits that control specific functions.

Protecting the Cables

In early designs, the FFCs were wrapped in one direction, resembling the spiral mainspring of a mechanical clock and giving the part its name. A clock spring usually has anywhere from two to four of these FFCs, but sometimes there may be more depending on OEM requirements.

"That's one of the things we focus on during design, to make sure it doesn't get damaged," Bowes says of the thin cables. "You also have to look at the current, to be able to carry the signal through properly. Especially for the air bag; it has to work 100 percent of the time because it's part of the integrated safety system."

Bowes and others at TRW now are working on the next-generation clock spring, which may be ready by year's end. TRW Automotive, which traces its roots to 1904, reported 2014 sales of $17.5 billion. The company, through its subsidiaries, operates in 24 countries and has 65,000 employees. ●

Sea Ray Sets a New Course

Luxury boat builder goes to production in 15 days with aluminum tooling from Proto Labs

Boat manufacturer Brunswick Corp.'s Sea Ray brand designs its luxury series yachts to offer extravagant comfort and top performance. The technology, fixtures, and finishes on the top-of-the-line L650 Fly (which sells in the seven-figure range) rival those of custom homes, with a lavish master stateroom, salon, gourmet galley, and home-theater system all on board. On the water, a push of the propulsion control system's joystick sends the 65-footer in any direction the captain chooses while enjoying a commanding view from the "fly bridge" atop the boat.

No detail on such a craft is too small, to say the least. Not even something as seemingly mundane as draining the L650 Fly's air-conditioning system. In a 2015 redesign, Sea Ray rearranged the AC drain lines so they empty from a single point on the hull rather than out of several points. Designers then created a grill to cover the point on the boats from which all of the lines drain.

"Our customers have high expectations and we work hard to meet those expectations," said Randy Hasson, Project Leader with Brunswick's Recreational Boat Group in Merritt Island, Florida, which produces Sea Ray and Meridian yachts among other brands. "They're the kind of customers who push us to keep excelling."

Redesign Leads to Parts Supply Challenge

The new drain line arrangement—and accompanying grill—soon extended from one Sea Ray model to three. As Hasson explained, the growing number of grills that Sea Ray needed created a supply challenge, which Proto Labs would

> Proto Labs' ability to tool domestically to aluminum and get us that quality of part that we get from injection molding but without committing to hundreds of thousands of parts really opened up our eyes.

Sea Ray Sets a New Course - continued

Luxury boat builder goes to production in 15 days with aluminum tooling from Proto Labs

Proto Labs worked with Sea Ray to build parts for a redesigned air-conditioning drainage system for the L650 Fly yacht. **Photo Courtesy: Brunswick Corp.-Sea Ray Yachts.**

eventually be called on to meet with both its injection molding and industrial-grade 3D printing services.

While the boat builder would have considered using a cast metal part, engineers said the grill had to be made of corrosion-resistant plastic. That's because the part is almost always wet from draining the AC system and from saltwater exposure.

To meet that requirement, Sea Ray chose to have the grill made of cast urethane, Hasson said. The cost of that process escalated, however, because of the added expense of frequently replacing the disposable tooling used in urethane casting as production grew.

"When (the part) was at a really low volume it was okay," Hasson said. "When we started to (include it on) smaller boats we were throwing away that tool every two or three weeks. We were getting only 10 or 11 parts per mold and then you've got to throw the mold away. The parts became very expensive...not in terms of part cost but in terms of having to throw away the tooling all the time."

Sea Ray's relatively low-volume boat production often rules out certain manufacturing methods, which is why it first chose urethane casting over injection molding, Hasson said. The company would not need the large number of parts it likely would have had to buy from a traditional injection molding vendor. The prospect of investing perhaps $50,000

Sea Ray Sets a New Course - continued

Luxury boat builder goes to production in 15 days with aluminum tooling from Proto Labs

or more and waiting weeks or months to have steel tools made for traditional injection molding was another downside.

Conventional injection molding "isn't suited well toward the marine industry, especially custom parts in the marine industry," Hasson said. "For a manufacturer like us, to pay for an injection-mold tool, I don't think we've ever done it."

The grill was manufactured with ABS plastic. This durable, corrosion-resistant plastic was needed because the part would almost always be wet from draining the AC system and from saltwater exposure.

Course Correcting With Injection Molding

Hasson reconsidered after learning that Proto Labs' rapid thermoplastic injection molding service avoids those drawbacks of the traditional process. Proto Labs manufactures its molds from an advanced aluminum alloy, eliminating the time-consuming and costly custom engineering that steel tooling typically requires. Hasson also knew that Proto Labs had been providing molds and injection-molded parts to Brunswick's Mercury Marine division for several years.

Switching the grill to Proto Labs' injection molding process brought immediate quality improvements, Hasson said, noting that the resulting parts were more consistent. A better surface finish meant the injection-molded grill needed less finish work before custom painting. The grill, made of ABS plastic, was much stronger, eliminating issues with breakage of the more brittle cast urethane part.

"Proto Labs' ability to tool domestically to aluminum and get us that quality of part that we get from injection molding but without committing to hundreds of thousands of parts really opened up our eyes," Hasson said.

Sea Ray Sets a New Course - continued

Luxury boat builder goes to production in 15 days with aluminum tooling from Proto Labs

3D Printing for Prototypes, Production Parts

Beyond injection molding, Sea Ray also took advantage of Proto Labs' industrial-grade 3D printing service, Hasson said. Sea Ray, after submitting a CAD file through Proto Labs' online quoting system, had the rapid manufacturer build two or three D-printed iterations of the grill for testing as it worked through design revisions. Once a final design was in hand, some of the 3D-printed grills served as production parts, going on the L650 Fly until the injection-molded ones were ready.

"Proto Labs was definitely able to help us more seamlessly go from prototype to production, which is important in our market, to be able to make that transition quickly," Hasson said. "Other times you'd have to have two different vendors, your injection mold supplier, and a machinist on the side who's making prototype parts, and you've got to coordinate that whole changeover. With Proto Labs, it was far easier to do that."

The speed at which injection-molded and 3D-printed parts came from Proto Labs has helped during design of the grill and in production, Hasson said. Molded grill parts were available in three weeks, "which in traditional injection molding is unheard of," he said. 3D-printed parts shipped in four days.

Injection Molding Expands Horizons

Ultimately, the injection-molded grill delivers the clean, sleek look Sea Ray wanted while quietly performing its job, Hasson said. That success has earned the process greater consideration at Sea Ray.

As a result, Proto Labs has expanded its work for the yacht maker to include injection molding plastic switch covers for another Sea Ray model. Injection molding is now used to create the cover's switch cutouts and rounded edges, which previously had to be machined. Eliminating that step saves a lot of labor, Hasson said, and enables the blank covers to go straight to painting and have the name of each switch function engraved when needed.

"It really has opened up a new realm of things we can do," Hasson said of Proto Labs' injection molding service. "It's helped us to bring innovative products to market faster than what we would have been able to do with more traditional vendors of plastic parts." ●

JOIN THE DISCUSSION

Email article ideas, cool projects or great design stories to the editor at marketing@protolabs.com.

protolabs.com
customerservice@protolabs.com
877.479.3680

USA
Global Headquarters
Proto Labs, Inc.
5540 Pioneer Creek Dr.
Maple Plain, MN 55359
United States

877.479.3680
www.protolabs.com

Japan
Headquarters
2-10-8 Hironodai
Zama-shi, Kanagawa
252-0012 Japan

+81.46.203.9100
www.protolabs.co.jp

Europe
Headquarters
Proto Labs, Ltd.
Halesfield 8, Telford
Shropshire
TF7 4QN
United Kingdom

P: +44 (0) 1952 683047