



Photography by Jake Chamseddine

3D printing **snare drums**

Panic! At The Disco drummer Dan Pawlovich tours the world with a 3D printed snare drum.



Disrupting a tradition

Dan Pawlovich will tell you that drummers love to customize their drum kits. Even in garage bands, like the one he started in as a teenager, drummers will pull their kit apart to paint and change it. That's how Dan learned the anatomy of his drums; as he disassembled the drums to spray-paint them a different color, he discovered what made them work.

"I didn't know it at the time, but that was the start of this. I couldn't stop thinking of ways to improve this design that has been around for generations," said Dan.

This challenge stayed with him over the years as he grew as a musician and drummer. The only way to improve upon the sound of traditional drums, he thought, would be to take as many external parts off the drum shell as possible. At the time, he didn't have the proper tools to make his idea a reality.

Years later, as the drummer for Panic! At The Disco, Dan Pawlovich has finally found the solution and has toured around the world with a snare drum 3D printed at Stratays Direct Manufacturing.

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Dan Pawlovich
Drummer, Panic! At The Disco



Simpler design = cleaner sound

A traditional drum has a wooden or metal shell with metal rims and fasteners that attach the drum head onto the shell. According to Dan, a lone drum shell produces a clear resonate note when tapped softly, but the moment metal parts are attached to the shell, you lose the precision of the fundamental pitch.

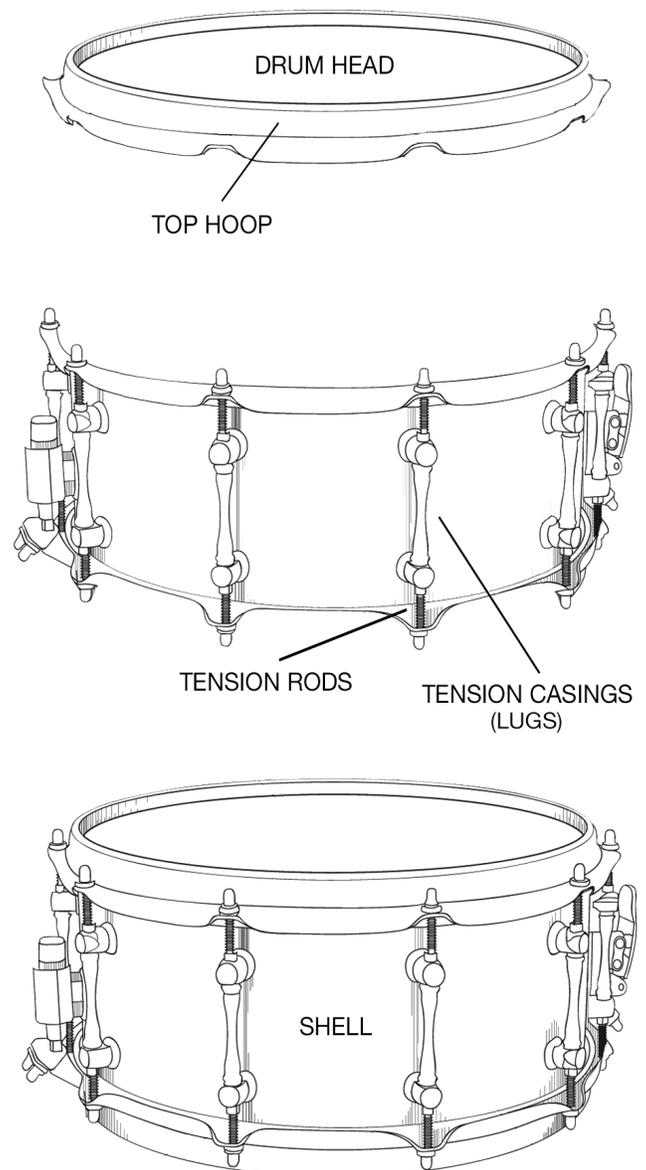
For decades, drum manufacturers have produced euphonious drums with traditional hardware, but Dan saw the potential to produce something that could resonate more freely. By designing a drum with the traditionally metal lugs incorporated into the drum shell, he could eliminate some of the external hardware inhibiting the drum's musical clarity.

3D printing's solution

One day, Dan came across a YouTube video that featured a powder-bed fusion 3D printing technology. In the video, an engineer showed off a 3D printed crescent wrench with fully consolidated features, including moving gears. This discovery was the manufacturing solution Dan needed to realize his design. The 3D printing technology could handle the complexity needed for his drum design.

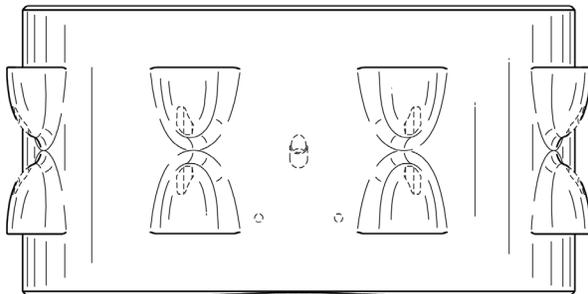
The powder-bed fusion 3D printing technology was similar to Laser Sintering (aka Selective Laser Sintering or LS). LS builds directly from 3D CAD data via a CO2 laser that fuses powdered thermoplastics layer by layer. Like other 3D printing technologies, LS enables part consolidation and complex geometries with the added advantage of no support structures. Parts built with LS are printed in a bed of self-supporting powder; the excess powder is easily shaken out during post-processing.

TRADITIONAL DRUM



Perfecting the design

While consolidation of the lugs into the shell was the ultimate design goal, Dan's initial focus was the longevity of the drum. The shell needed to couple with traditional tension rods, rims and drum heads that would inevitably have to be replaced over time. To meet that requirement, the tension rods would have to be anchored to the shell in a unique way. The answer was hex-shaped inserts Dan acquired from a drum parts shop. Over the next several months, Dan and his designer worked to perfect the cavity that would fit around the insert's hexagonal shape. Once they'd achieved this critical feature, the rest of the shell's design came together smoothly.

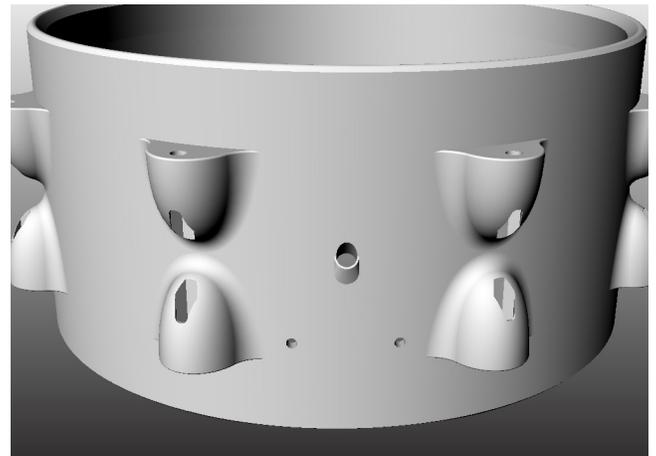


Lug design to replace external tension rods



3D printed red snare with hardware attached

Throughout the design process, Dan prototyped different cross-sections of the drum for fit checks and measurements. Once the design was developed, he found a 3D printing service online and had the full drum shell 3D printed. Dan received a white prototype that looked and felt exactly as he'd envisioned, but it contained offsets in the 3D print's layers. The size of the geometry and complexity of the design had pushed the 3D printer to the edge and a malfunction resulted in a drum shell that couldn't produce the sound clarity Dan was hoping for. Not defeated, Dan turned to Stratasys Direct Manufacturing, a company known for its expertise in 3D printing and advanced manufacturing solutions.



CAD model featuring incorporated lugs and air vent



Top-down underside view of assembled drum

Expertise from Stratasys Direct

Stratasys Direct has been using Laser Sintering to 3D print prototypes and production parts for almost 30 years. Extensive experience and deep-rooted expertise with the technology made Stratasys Direct a perfect fit to produce a successful print of Dan's design.

Dan's previous experience with 3D printing service bureaus included email communication that felt canned and impersonal. When he approached Stratasys Direct, he thought it could be a similar experience, but instead got a phone call from his account representative right away. Speaking with a project expert helped Dan work through key manufacturing considerations and helped build his confidence in the project.

"Stratasys Direct was just a phone call away to figure out the harder issues," said Dan, "and that one-on-one and expertise was crucial to achieve a successful print."

Printing the red snare

Stratasys Direct printed a prototype for Dan using Nylon 12GF material and a proprietary dyeing process called ColorTek to produce a bright red drum shell. Because of the inspiration from that initial YouTube video, Dan chose LS production to achieve the complexity he needed for his snare drum design and Nylon 12GF because he believed it shared similar resonance and mechanical properties to wood.

Nylon 12GF is an ideal material for fine features and surface finishes and has the best heat deflection temperature (HDT) values of available prototype LS materials. The material expands and contracts with temperature changes, isn't damaged with UV light, and can handle humidity - all important factors for a drum exposed to so many different climates on tour. Nylon 12GF can also withstand shock without cracking, chipping or becoming brittle.

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The band meets the drum

Dan was in production rehearsals for a show when the red snare drum arrived at his hotel. Meaning to open the box after the show, Dan left it in the green room. When he returned to the room, he saw the lead guitarist opening the box, thinking it may've been a gift for the band from the venue for a sold-out show. At that point, the cat was out of the bag, or more literally, the 3D printed snare drum was out of the box.

Up until that day, no one in the band or in management knew much, if anything, about Dan's project, but gradually each member of the band and team became aware and excited about his project. Getting feedback on his years-long project fueled Dan's confidence, and he was soon directed on how to begin patenting the design.

"If our guitar player hadn't opened that box, I don't think this would've happened," Dan said. "I'm so lucky to be a part of this team. Not just the band, Panic! At The Disco, but the team around it. I cannot be any luckier to have these people around me who are so smart, forward-thinking, knowledgeable and supportive."

Dan decided to wait for the patent's pending approval before taking it on tour but assembled and tested the drum that night. He invited the band's drum technicians and the band's lead singer Brendon Urie to try it and got encouraging feedback.

Panic! At The Disco's Front of House engineer Spencer Jones said, "Dan's 3D printed snare is a pleasant surprise to mix! Great snap on the high end and well-rounded on the bottom end, which is what I look for in a snare. There's very little EQ and processing needed, and the snare holds its tuning, looks sweet, and is tough and durable for the road. All around, it's an impressive snare drum."

"When Dan told me he was bringing a 3D printed snare on tour, I was hesitant, but also curious. I couldn't imagine what he was describing as something sounding good. Boy, was I wrong. This snare sounds awesome, and it's been a pleasure to work with," said Casey Ervin, Dan's drum technician.

The drum on tour

Three days before Panic! At The Disco's most recent tour record cycle, Dan received confirmation of his pending patent. He packed the red 3D printed snare, along with two industry classics, a Ludwig and his go to - a Noble & Cooley SS Classic Maple.

"I was up against two heavy-weights of snare drums," Dan said. "At the first show rehearsal, I set up my 3D printed snare, and immediately started getting compliments. Our sound engineer and techs couldn't see what snare I was playing from their places off stage. They just said how good it sounded."

Over the next year and a half, Panic! At The Disco traversed the globe on tour. Starting the tour during the winter put them in intense weather conditions. The snare drum went from below-freezing temperatures on the truck into warmer venues day after day. Dan said the 3D printed snare responded similarly to how his wood drums do to extreme temperature changes.

"We've been in below-freezing cold; we've been in really hot temperatures in Australia. I've played it in every single show for the last year and a half, and it's been like a tank. It sounds amazing. It's already proven itself, and that was just the first prototype."

"I'm impressed with the materials ability to endure drastic temperature and climate changes throughout a full touring cycle all over the world and

still retain all of its tonal characteristics that make it a great sounding snare. It has body and a great crack without a lot of the ring and overtones you might expect from your traditional wood and metal snares," said Casey Ervin, Dan's drum technician.

The sound of 3D printed music

In between tour dates, Dan recorded a musical experiment to compare the sound of the 3D printed snare to one of the nicest in his collection. Using the same set up and mic, Dan recorded a short song twice: once with the 3D printed snare and once with the traditional drum. Every four bars in the song, he created an edit to flip between the recordings of the two snares.

He sent the song to a friend and fellow drummer, asking if he could guess which sound came from the 3D printed snare. Although he was sure he would be able to tell which drum was which, much to Dan's pleasant surprise, he unknowingly chose the 3D drum as the better sounding of the two.

"That was a big moment for me," said Dan. "I could hear that it sounded good in the recording. But he was completely in the dark on the experiment, and he was otherwise certain he had chosen the traditional drum."



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New iterations

While on tour, Dan designed a second iteration, this time a 5 ½” deep snare drum. The shorter depth was a challenge as the lugs and shell diameter had to be redesigned, and Dan was still performing on tour. With a few creative solutions, including modeling clay, 3D scanning, cross-section prototypes, complex algebra, and several months of redesign, Dan and his designer successfully created a second iteration.

The shorter depth, wider diameter and new connections with the hardware made the drum sound even better, according to Dan. 3D printed on an LS machine and dyed black, Dan says the 5 ½” deep drum sounds like a traditional wood drum, but with its own unique character and tone.

Recently, Stratasys Direct recommended printing the newest iteration with FDM® technology in ABS and Nylon 12CF to see what the new materials and the different build style of FDM would produce musically. He did a recording with both drums, first without any hardware to hear the pitch of the shell, and then fully assembled.

According to Dan, the FDM ABS shell has lower tone, especially when assembled with hardware. It reminds him of the characteristics of a brass shell, like the Black Beauty drum. The FDM Nylon 12CF shell had the unexpected sound quality of a thicker 15ply wooden shell, which can be anywhere from ¼ to ½ inch thick. When played, the carbon-fiber shell sounds “tight, punchy and loud.”

Dan is excited about how the different materials influence the sound of each shell. “I have three drums, all the same dimensions across the board, but made with two different 3D print methods and three different materials. They sound like completely different categories of drums.”

The diversity of sound from the different plastics offer potential customization for drummers with set preferences. Dan noted that many drummers prefer metal shells like aluminum or drums with a thicker shell. These musicians might be turned off to the idea of plastic, but with a sound quality so similar to their favorite drums, Dan thinks 3D printing could open the possibilities further into truly customized instruments.



Photography by Gabe Vargas

Looking to the future

“3D printing has made it possible for me to improve upon something that’s been working traditionally for years,” said Dan.

Looking forward, Dan sees where this new way of manufacturing drums could go in the future. With his patent published, he is enjoying the creativity of his endeavor and hopes he can inspire other musicians, designers and drum makers.

“Every milestone along the way has purely been the result of learning what’s possible from the design process and materials. A seed has not only have been planted, but it’s clearly taking root. Hopefully soon we’ll get to see others experiment with it even further – especially companies that can better handle projects of this scope and promise and on a much larger scale.”

Dan wants to introduce established drum companies to the 3D printed snare drum and share how it achieved design elements that seemed impossible until just a few years ago. When showing the drum to fellow musicians and technicians, he highlights the lug design and the Treble Hook logo printed onto the shell. Dan hopes it inspires others to think about different methods and ideas on how to take advantage of the technology.

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Stratasys Direct’s interest in this project has added to my sense of pride and ambition. Not only are my family, close friends and coworkers cheering me on, but even the very company I rely on to create these things for me is excited about it.”

Dan Pawlovich
Drummer, Panic! At The Disco

[Learn more about 3D printing at Stratasys Direct >](#)

[Learn more about Dan’s project and hear audio of his drums on his Instagram @3ddrums >](#)



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