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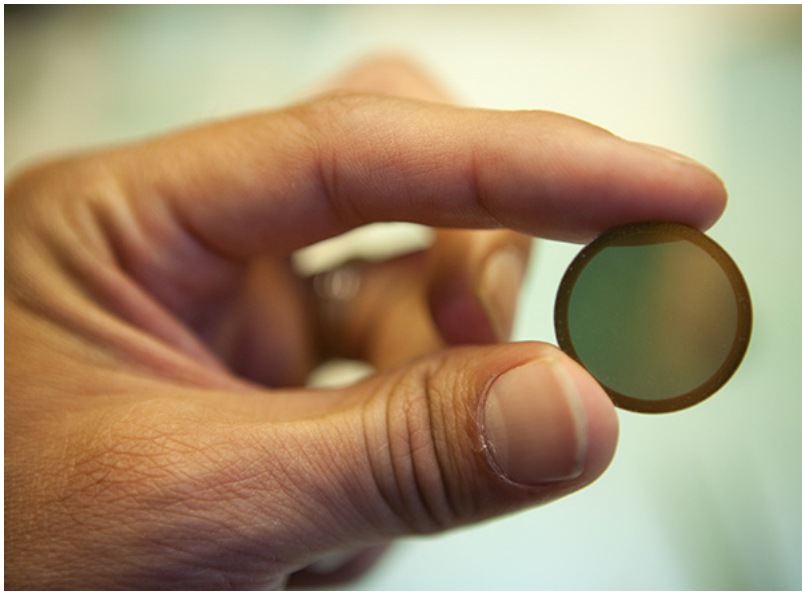
Making an Audio Icon: Inside Shure's Stress-Test Gauntlet



By MATTHEW SHECHMEISTER

If you've ever played in a band or done some home recording, chances are good you've come across a Shure mic. Their products range from entry-level throw-aways to wallet-goring audiophile tools.

And while the company's products are sometimes short on sex-appeal, their ubiquity is testament to their consistent level of quality: Shure knows how to build sturdy microphones. Ironically, this is due in no small part to the company's equally impressive ability to destroy their mics as well.

"You test until something breaks, then you fix it," says Boris Libo, Shure's Manager of Corporate Quality Engineering. "And you keep going until you can't fix it anymore."

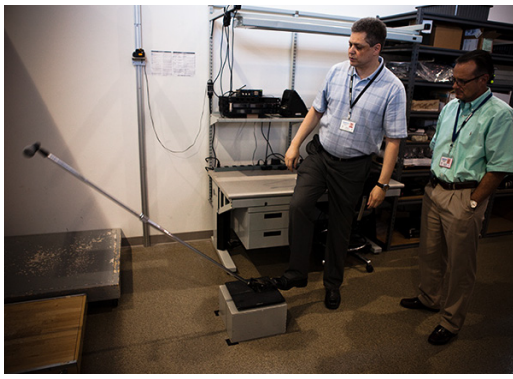
The SM58, a standard for live vocals known for its rugged design, is one of many products that Shure employees decimate on a regular basis. A few mics from every batch are brutalized in Shure's destructive testing facilities to ensure they perform up to par. There they are scorched, smashed, frozen, and bathed in synthetic sweat.

Given the volume of Shure's production lines, that works out to thousands of mics being purposely mangled every year. Wired.com tagged along as the folks at Shure demolished a few unlucky samples from their product line. Keep reading for a tour of a microphone's worst nightmare.

Top right photo: The Who's Roger Daltrey has an endorsement deal with Shure and sent in his SM58, pictured above, for some first aid.

"The SM58, the lead, the whole bit: It's part of me, I built my stage persona around this mic," says Daltrey in a quote from Shure.

Shure boasts lots of endorsements from rock stars, and its SM58 mics have a historic place in the genre. Low-priced and sturdy, they have been a favorite vocal mic of live performers who need equipment that can survive their rock and roll antics.



Right photo: Matthew Koschak, a senior acoustical engineer, holds the diaphragm of a SM27 condenser microphone. The diaphragm is only 1/10,000th of an inch thick, and made of a Mylar material stretched like a drumhead across the tiny frame.

Previous page: Boris Libo, left, and Lane Dulaney, Director of Quality, put a Shure SM58 through the microphone drop test.

Each mic that Shure tests is dropped at least 10 times onto a wooden platform from a starting height of six feet. The platform simulates the floor of a conventional stage, so that the impact is equivalent to a mic being knocked over during a performance.

Top left photo: Shown here is a Shure SM58 following 10 drops it received during its hardwood floor drop test. This mic has significant dent to its grill, which is normally shaped like a scoop of ice cream. Deformations like these can change a mic's frequency response.

"The grill is designed to be softer rather than harder, because it is a very common impact point," says Lane Dulaney, Director of Quality at Shure. "By making the metal relatively soft … it acts as a shock absorber."

After the battering is over, the mic undergoes a variety of tests to determine whether it still has a frequency response that meets the standards Shure sets out for undamaged microphones. Employees also use the more quantitative measurements, plugging in the mics for a classic round of "Test, test, 1, 2, 3."

In addition to the technical importance of the drop tests, there is also the simple satisfaction that comes from breaking stuff.

"Some of the tests can help with stress release. The drop test is one of them," says Libo.

Bottom left photo: In this photo, a Shure UR-1 wireless transmitter undergoes a "sweat test." The liquid in the bottom of the glass container is formulated to approximate the chemistry of human sweat, and is created for Shure from a custom company recipe.

There are off-the-shelf products that simulate perspiration, but Shure engineers determined that the generic sweat just wasn't corrosive enough, and worked with the sweat-makers to develop a unique formula to meet their needs. The liquid arrives in gallon jugs, and smells more like vinegar than a locker room.

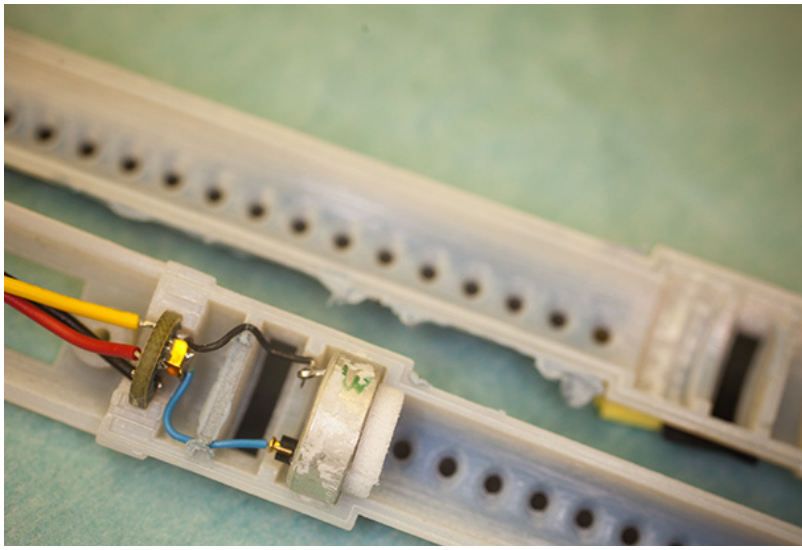
Prolonged exposure to sweat can damage electrical connections, switches, and paint. Products often remain in the sweat bath for 48 hours, sitting atop a perforated gauze pad that is soaked in sweat solution.

Top right photo: In addition to the humid hell of the sweat test, microphones spend time inside these temperature-controlled chambers. They look like refrigerators, but in addition to creating freezing cold conditions, they can be cranked up to a balmy 140 degrees Fahrenheit. At the end of the line is a dumpster-blue device that floods with a salty mist to simulate coastal weather.

Despite the punishment, microphones are expected to survive and still function after the process is completed.

Bottom right photo: The HALT chamber, short for "highly accelerated life test," is designed to batter microphones and other products until they fail. "It's sort of like pushing a car off of a cliff," says Chris Lyons of Shure. "We want to see what breaks."

In the chamber, the microphone sits on a vibrating platform, is heated to above 200 degrees Fahrenheit and then is suddenly cooled to below freezing by a blast of liquid nitrogen. This "ther-



The looming logo at Shure HQ evokes futuristic technology, though the company may be best known for classic models like the SM 58.

mal shock test" stresses circuit boards, wiring, and other components. The HALT chamber has an operating range of -148 to 392 degrees Fahrenheit. The blast of liquid nitrogen can drop the temperature by 100 degrees in a one minute.

Top left photo: After the HALT chamber has pushed a product past the breaking point, Shure employees use an X-ray to determine exactly which components failed first (as Libo does in the above photo).

Shure is particularly proud of the performance of the PGX4D wireless mic receiver, which was still working at 239 degrees Fahrenheit. The plastic of its exterior housing had begun to melt, but the internal components soldiered on.

For smaller products, like earbuds, there is no easy way to physically dissect the damaged gizmo, so X-rays are the only way to isolate the point of failure.

Bottom left photo: Engineering Enhancements Intern Adem Celebi sets up a Shure shotgun mic VP89 in the RF (radio frequency) anechoic chamber. The room is designed to block radio waves in the way a soundproof chamber blocks external sound.

The white Styrofoam tiles along with carbon-impregnated fabric behind them absorb radio waves from outside the chamber. Celebi is mounting a wireless transmitter and microphone on a stand in preparation for tests that will analyze the strength of the transmitter's signal and the directionality of its antenna.

Top right photo: The VP82, a shotgun microphone, is one of Shure's new products. It took about a year from idea to execution. Shotgun mics are highly directional, picking up sounds only from the source at which they're pointed.

"We wanted to make something low-cost in a shotgun microphone," says engineer Matthew Koschak. Shure designed the split-tube, ultrasonically welded microphone with the help of 3-D printing for prototyping.

Shure's North American headquarters is an impressive glass and steel structure that rises amidst the strip malls in Niles, Illinois, a northern suburb of Chicago.

The company was founded back in 1925 as a supplier of radio parts, and quickly developed a catalog that sold kits and components by mail. At the time, homemade crystal radios were common. The technology was simple enough for an average person to assemble a working device, and required no external power supply.

A 1930s catalog referred to Shure's facility as "microphone headquarters," a less-than-modest claim that was in some ways borne out.

According to Clark Johnson of MI Sales Trak, a company that analyzes retail sales of mics and other music products, the SM58 has been the bestselling microphone in the U.S. since 2003. That was the first year his company began collecting data, but the mic had been a giant seller for decades beforehand.

One of their other models, the SM57, is equally ubiquitous and has been commonly used as a lectern microphone by U.S. presidents since Lyndon Johnson back in 1965.

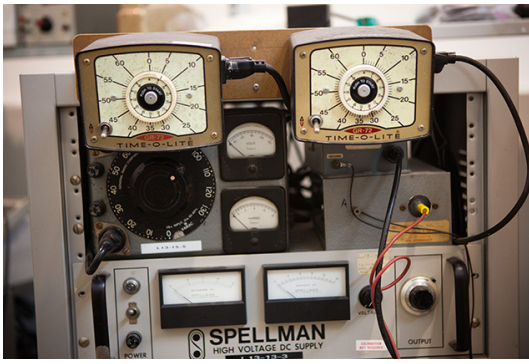
Previous page: This sculpture of Sidney N. Shure, who founded the company that bears his name back in 1925, is modeled in bronze, not carbonite, as it may seem. The sculpture looks out over the vast foyer at Shure HQ.

Above photo: Shure began developing its first microphone in 1931, which went into production a year later. The Model 33N Two-Button Carbon Microphone (above) was billed in a Shure catalog as "Used in Broadcast Stations because of its excellent frequency response, ruggedness and dependability."

Shure takes its history seriously, maintaining a "library" with over 3,000 product samples reaching back to the company's early days. The microphone above is resting on a platform that Shure used to test just how rugged its mics were — by bashing them into the wooden surface and then checking to see if they still worked. The platform was only recently retired, after having sustained one-too-many microphone faceplants.

Shure's 55SH series microphones have been in production since 1951, and are most recognizable for their association with Elvis, who is pictured with one on a U.S. postage stamp that bears his likeness. As of 2006, that stamp was the most popular ever produced, according to the U.S. Postal Service.

A carton full of 55SH Series 2 microphones pulled from the production line to be tested.



Even though most of the Shure's equipment is state-of-the-art, being an 86-year-old company means they still have equipment in use that looks dated but performs well. This steampunky apparatus is a power supply used to charge the backplates of a microphone being tested with up to 1,000 volts of electricity.

The Shure facility in Chicago includes a Pro Tools recording studio and theater where seasoned listeners evaluate recordings.

"No matter what you measure on a microphone, the numbers only tell you so much," says Chris Lyons.

In the studio, audio engineers use their ears to determine whether a mic is up to par, and try to find the best ways to position a microphone for each particular instrument.

Shure employees record audio tracks with different microphones and play them back for an audience that doesn't know which track was recorded with a given mic. The blind tests compare existing mics, Shure prototypes, and competing products.

"We'll throw in some ringers," says Lyons, "recordings that we know are bad ... If you don't rate the bad ones badly, then we know we don't trust your hearing."

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