SUNNEN®
ABOVE AND BEYOND HONING

APPLICATION REPORT

HONING A LIFE-SAVER FOR AEROSPACE COMPONENT MAKER

SONIC INDUSTRIES, PART OF THE SARGENT AEROSPACE & DEFENSE COMPANY, USES SUNNEN SV-1000 TO ACHIEVE PERFORMANCE-CRITICAL ID TOLERANCES AND FINISHES ON LIFE-SAVING FUSE PINS, REDUCING CYCLE TIMES BY 75%

Sonic used to hone fuse pins manually; the CNC-controlled SV-1000 helped reduce cycle times by 75 percent, and increased productivity from nine to 40 parts per day

Torrance, CA – Knowing when to "hold 'em," and when to "fold 'em" takes on new meaning when referring to the fuse pins designed to hold a jet engine on a wing, but to break away in emergency situations, allowing the engine to separate from the wing to prevent catastrophic structural failure and fires. That is the performance dilemma faced by the highly-engineered, precisely-manufactured aerospace components produced by Sonic Industries. To achieve this delicate "hold-or-fold" balance, Sonic relies on a new Sunnen SV-1000 honing system to produce the 5-to-7-micron ID tolerance and proprietary finish critical to the part's performance. The CNC-controlled SV-1000 also allowed Sonic to meet increased customer demand when it replaced a manual honing system, reducing cycle times from 40 minutes to 10 and increasing productivity from nine to 40 parts per day.

Sonic Industries, based in Torrance, California, is a leading manufacturer of high-strength, safety-related fasteners and precision round bar components, and is part of the Sargent Aerospace & Defense group. Sargent has been supplying specialty fasteners, self-lubricated lined bearings, precision engine rings, and hydraulic controls for more than 30 years on both commercial and military platforms; virtually every major commercial jetliner, military fighter, bomber, submarine and cargo plane has included Sargent products. The ubiquity of Sonic fuse pins in today's commercial and military aircraft, and the importance of their proper performance, make the design and manufacture of these small parts as important to air travel safety as the integrity of a wing or soundness of an engine.

The fuse pin, also known as a shear pin, affixes the engine onto the wing via the pylon – the structural component connecting the jet engine to the wing spar. When necessary, it allows the engine to break away under an impact load in the event of a crash or other hard landing, protecting the fuselage from engine fire caused by a dragged engine. Fuse

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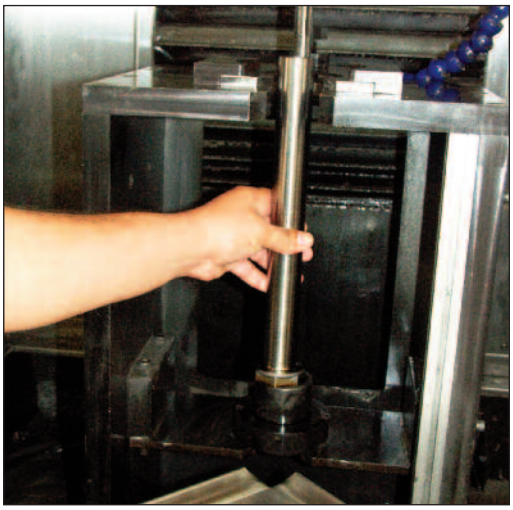
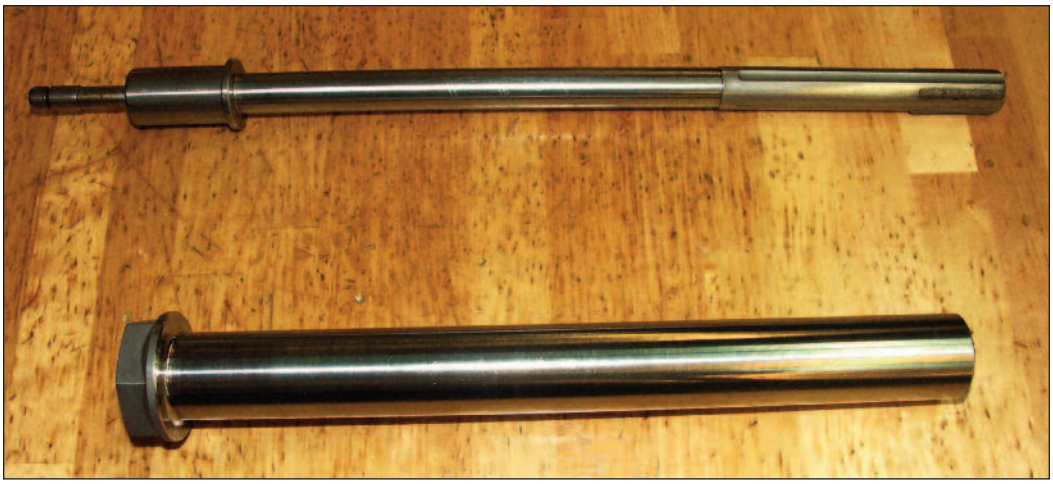


Sonic's fuse pins have various diameters and lengths up to 23 inches. The Sunnen SV-1000 handles diameters up to 3 inches and stroke lengths to 31 inches.



Sonic Industries must meet ID tolerances of 5 to 7 microns, with a surface finish in the range of 8-16 RMS, for its fuse pins. The pins attach jet engines onto the wing and break away in emergency situations to prevent catastrophic structural damage and/or fires.

pins serve a similar function for landing gear assemblies. Located in a structural assembly nicknamed the "doghouse fitting," fuse pins attach the landing gear to the wing and are designed to "fail" in the event of an extreme hard landing, allowing the main landing gear to safely break away from the airplane and prevent rupture of the fuel tanks inside the wing box.

Previous versions of fuse pins were designed with a notch that would act as a "weak spot" and facilitate them breaking on impact. However, a cylindrical pin with a notch is more vulnerable to excessive corrosion and fatigue damage. Therefore, fuse pins were re-engineered without the notch, making ID tolerance and finish the critical factors in their performance.

Fuse pins are made of steel and stainless steel alloys including 318 and 15-5; they have various diameters and lengths up to 23 inches. The pins start as a bar forged to specific geometry and are gun-drilled, then bored to a rough preliminary hole size. The parts are then heat-treated and tested to establish the shear value, and the entire lot is processed to final machining and finish grind on the OD. The heads are finish machined with slots or hexes. The pins are then bored to a specified size and honed to establish the critical ID size, geometry and surface finish required for proper performance.

Prior to acquiring the SV-1000, Sonic honed fuse pins manually with Sunnen MBB 1805 and CV-616 machines. "We needed to increase productivity and decided automating the honing process was the best way to accomplish it," said Roy Franks, Facility Manager of Sonic Industries. "Before purchasing the SV-1000 we conducted time studies with Sunnen, and indications were we could achieve the production levels we were looking for. The machine has since exceeded the time study estimates and the finish is superior to the previous manual-honing method."

While the OD is machined to standard dimensional tolerances and is repeatable, the ID must meet tolerances of 5-to-7 microns (0.0002 in. to 0.0003 in.). The ID surface finish of the fuse pins is also critical, and while the precise surface finish specs are proprietary information, Franks says they fall in the range of 8 to 16 RMS. Consistent size and finish of the ID are very important, as size variations or surface irregularities could affect the performance of the pin. The ID geometry of the fuse pins can vary from a thru hole to a blind hole with an angle and a radius, or just a bottom radius.

By upgrading to the SV-1000 series machine, Sonic is able to use the Sunnen MMT superabrasive tools to achieve the required micron-level accuracy. MMT tools are specifically designed to work with the SV-1000 series machines, and each tool is custom-engineered to the application based on width, length, expansion angle, and number and placement of stones. This customization produces accuracies of 0.0006 mm (0.000027 in.) for diameter, roundness, straightness and taper. MMT tools are precision-machined with a body and feed wedge made from hardened tool steel, and typically last five times longer

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Sonic uses Sunnen MMT superabrasive tools, which last five times longer than conventional designs and can reduce per-part cost by 30 percent.

than conventional designs, reducing per-part cost by 30 percent. More importantly, the custom design of the tools allows placement of abrasives to cope with challenges like blind holes.

Another advantage for Sonic going to the SV-1000 is the machine's longer stroke length. "Our old machines were labor-intensive and had a maximum stroke length of 9 inches," said Franks. "It limited the parts we could produce, but now we're able to make more sizes, and we're doing it faster." The SV-1000 handles diameters up to 3 in. and has a 31-in. stroke length.

Automating the honing process also freed up Sonic machine operators to attend to more than one machine. "With the manual hones our process was hone a little, then check the part, hone a little more, then check the part again." said Franks. "With the CNC hone we 'dial in' the settings on the machine and 99 percent of the time the part comes out to spec. That means the operator can have one eye on the honing machine and one on another piece of equipment." After honing, parts are measured using a scanning air gage.

Sonic was able to achieve a more than 300 percent increase in productivity, but Franks thinks that number can climb even higher. "We didn't get the rotary table with this machine, and we could bump up productivity even more by loading three parts in the rotary table and continuing to hone parts while others are being checked. We're looking at possibly purchasing another SV-1000 and we'll be considering the rotary table with that one."

Sargent Aerospace & Defense Company, founded in 1920, is a part of the Dover Industrial Products' Mobile Equipment Transportation Group, and is a premier global supplier of custom-engineered precision products and services to the aerospace and defense industries.

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X-NR-1012 05/14-POD