Innovator Shaping
Memory Metal
Solutions

Intrinsic Devices’ Tom Borden,
Lord of Nitinal Rings.

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fastening, sealing, and electrical interconnection. Oddly enough, metals returned to the old factory in the form of nickel-titanium and other alloys as complex as the old tin vegetable cans were simple.

The Bay Area fog has peeled away this morning as Tom Borden, President of Intrinsic Devices, steps out in front of his office and makes a beeline for the building’s barista and a hot cup of coffee. He drives away from where Barry Bonds drops baseballs in the San Francisco Bay, sits an old brick building that was once a can factory, and he needed shape memory to make it better. Herm. Other applications were slightly more plausible, according to Borden, like the distiller who came to the company in search of a method to attach a one-way valve for its bottles. “The idea was to prevent counterfeiters from refilling the bottles with a substitute (liquor) after the bottle was finished.” According to Borden, lots of money was spent before the application vaporized. Though they’re still contacted with inventive ideas by overly creative minds, Borden and Co. have settled into a comfortable niche, selling fastening, sealing, and other devices to industries ranging from aerospace to oil. He says that it suits him well... that it allows him to concentrate his efforts.

“We're trying to focus as much as we can on having generic products that multiple customers could use as fasteners for multiple applications,” says Borden. He likes his fasteners to generic nuts and bolts. “It could be used anywhere for you name it,” he says. “It's a screw that, instead of applying an axial force, applies a radial force. It can be used just about anywhere.”

Borden points out that word of his fasteners wide-ranging applicability has spread and the company has experienced steady growth, adding new customers at a comfortable pace. But he also confesses to spending so much attention to manufacturing that some of his growth initiatives are still just that. It didn't seem to bother him a whole lot. “We're really focused on delivering on-time, with high quality,” he says matter of factly.

Intrinsic Devices obtains quality Nitinol and other alloys (6 in. - 1 1/2 in. OD) from Wah Chang, which the innovator uses as is or works down to even smaller diameter bar and wire. “We've got several different processing routes for end products: machining, grinding, forcing, forging and welding,” says Borden. One of his company's shape memory tension rod products follows the machining route. “We machine the rods at a short length and then, at a controlled temperature, stretch them,” he explains. “Our customer built them into his device. Later when the rods are heated above 110ºC, they contract to their memory length, performing a locking function.” According to Borden, the typical amount of shrinkage that would be specified is “on the order of 5%.” He says that the market for these tension rods has potential, but is cautious with his predictions. “Our whole philosophy is just bait a lot, test and get 'em in the water,” he laughs, “but what that application is actually going to turn into, I have no idea.”

What is a “known” is Intrinsic Devices’ flagship product, the UniLok® ring, which the company tout.s as offering new ways to join and seal cylindrical components. If machining Nitinol devices like tension rods is difficult, transforming bar and wire into fasteners and seals isn’t any easier. Borden, a “Lord of Rings” in his own right, says that typically the steps include fabricating a ring shape, heat treating it, then performing any surface finishing or coating operations. The final major step is deformation from the memory shape. “All of the heat shrinkable rings that we make have been expanded first,” he explains.

According to company literature, “nickel-titanium rings shrink 4-5% in diameter when heated. Once shrunk, UniLock® rings apply a uniform gripping pressure that is seamless, powerful, consistent, and permanent. The gripping force can be set between 220 N (50 lb) and 130 kN (30,000 lb) by choice of the ring dimensions. UniLock® rings can clamp a
holder to a delicate optical lens or swage a fitting onto a pipe to seal 400 bar (6000 psi). Intrinsic Devices claims that “no other fastener system provides seamless radial pressure over these force levels with comparable radial close-up.” The company touts other benefits that its fasteners offer over conventional techniques such as crimping, welding, adhesives, elastic assembly, and threaded fasteners:

• Operator insensitive assembly
• Low installation temperature
• Joining and sealing of disimilar materials
• Verification of correct installation
• Repeatability
• Seamless clamping pressure
• Immunity to vibration, shock, and thermal cycling
• Chemical resistance
• Rotary balance

The multitude of applications for Unilok® rings includes hermetic sealing, where they are used to swage thin-walled metal cups onto headers. Intrinsic’s rings are able to join disimilar materials like aluminum and Kovar®, a decisive advantage in this application. This is possible since the UniLock® ring impales the cup on a sealing feature on the header, flowing metal to create the seal. Since the ring does not relax after installation, the seal is maintained.

The company’s ring products are also used to attach small diameter cable electromagnetic shielding braid to connectors or other devices. “Metallic and polymeric braids serving mechanical functions can also be clamped,” according to product literature. This feature offers advantages for applications that subject joints to thermal cycling, heat aging, vibration, and mechanical shock. An installed UniLock® ring has a large elastic interference with its substrate, about 0.5%. This stored energy allows the ring to maintain clamping pressure despite settling, creep, and differential thermal expansion of the braid and connector.

According to the company, other applications include:

• Pipe and tube joints — where brute strength and uniform clamping pressure are important.
• Piezoelectric, magnetic, and optical cluster assemblies — where controlled pressure and thermal insensitivity are often key requirements.
• Electrical interconnections — where the exceptionally high contact closure force generated by the ring produces a gas-tight seal between the contact surfaces, resulting in a stable, low-resistance connection.
• Shaft-mounted components — in which Unilok® rings can fix the location and angle of a component at any point on the shaft (axial preload force can be locked in).

Though focus and the present are paramount, the innovative Borden certainly isn’t limiting his options. The future holds all kinds of possibilities. He points out that the company is working with not one but seven different nickel-titanium alloys. Borden lists them: Nickel-Ti-Iron, Nickel-Ti-Niobium, and then five different binary nickel-titanium alloys. One of these, NiTiNb (“It’s our Alloy H,” he says), is Intrinsic’s flagship alloy. The alloy has an exceptionally wide hysteresis. Hysteresis means: “a retardation of the effect when the forces acting upon a body are changed.” On heating, a shape memory alloy transforms to its high temperature phase and returns to its memory shape at a particular temperature. On cooling, it returns to its low temperature phase and softens dramatically at a lower temperature. The difference in these temperatures is the hysteresis.

“ar order to provide useful clamping force, a shape memory fastener must remain in its high temperature phase down to the minimum operating temperature of the device, say -55°C for an...” [continued on page 8]
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For more information on Intrinsic Devices, contact the company by phone at 415.252.5902, by fax at 541.252.1624, or by e-mail at sales@intrinsicdevices.com. For more information on Wah Chang’s nickel-titanium and other specialty metals, including hafnium, niobium, titanium, vanadium, zirconium, as well as chemicals, the properties listed herein are average values based on laboratory and field test data from a number of sources. They are indicative only of the results obtained in such tests and should not be considered as guaranteed maximums or minimums. The use of these materials is subject to state, local, national, and international laws and regulations. The user is responsible for ascertaining the applicability of any use of the products herein.

Reference

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