Design World

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July 2016

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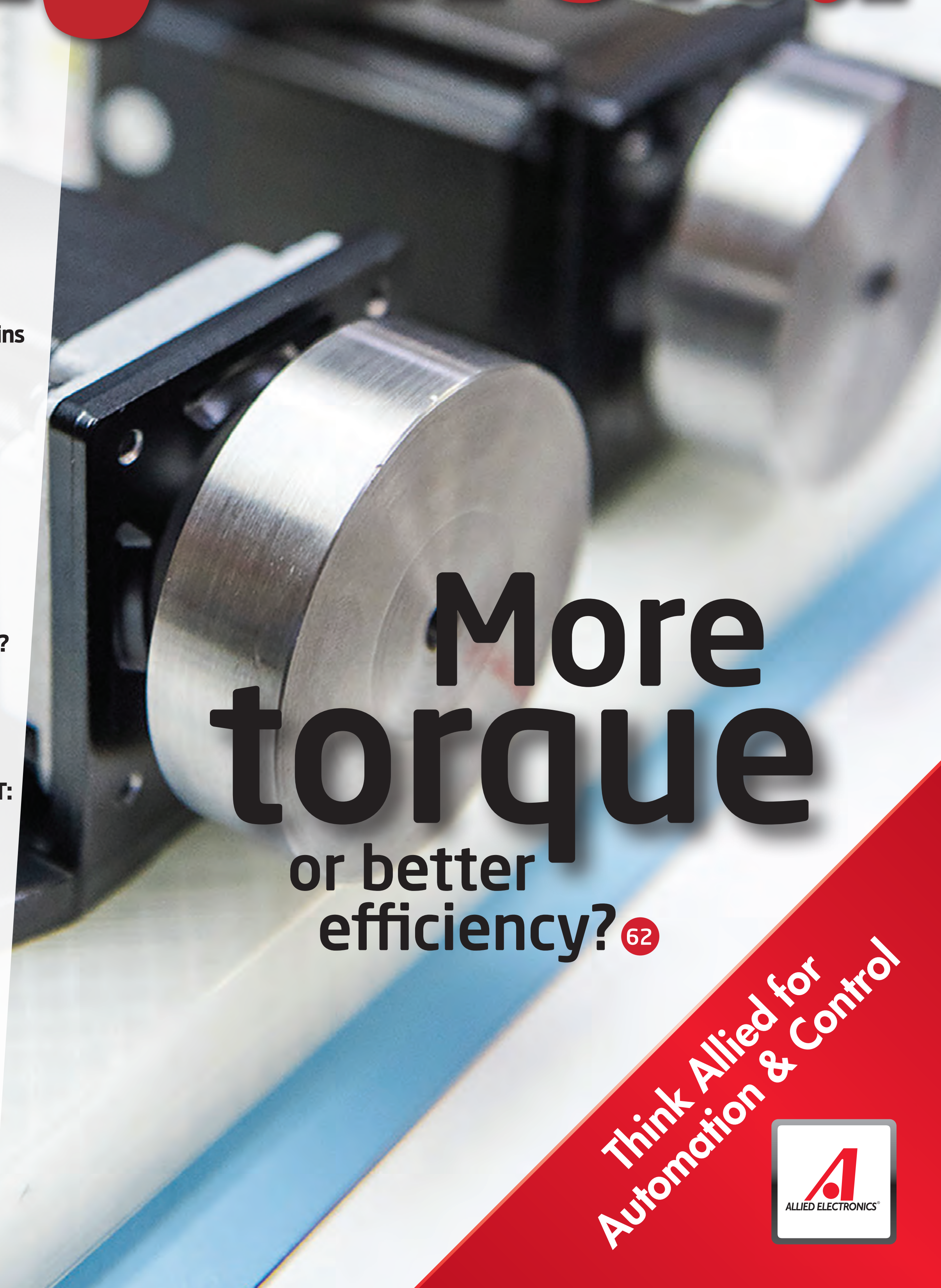

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NEWS:

NI and Hewlett Packard collaborate on BigAnalog Data system

NI and Hewlett Packard Enterprise (HPE) will collaborate on the availability of pre-tested Big Analog Data solutions based on NI DataFinder Server Edition software and HPE Moonshot Systems.

Engineers must collect and manage sensor data that is fundamentally different than what traditional big data solutions typically tackle. This collaboration is expected to result in the availability of a pre-tested best-in-class hardware and software combination for solving engineering data management problems and making decisions from sensor data more effectively.

Combining the HPE Moonshot Systems and DataFinder Server Edition provides a pre-validated, tested solution to manage and analyze the complexities of file-based sensor data. With DataFinder Server Edition software running on HPE Moonshot server blades, users can manage structured and unstructured data generated from any data acquisition analysis node.

NI
www.ni.com/datafinder

Hewlett Packard Enterprise
www.hpe.com/info/moonshot

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Choosing between Adhesives and ultrasonic welding

Adhesives and ultrasonic welding are two of the more popular methods for assembling plastic parts into fin shed products. Here are key questions to consider on why and when to adopt these assembly methods.

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In general, the important considerations involved in making a part assembly decision fall into two broad categories. One set of considerations has to do with your business, its product lines and production needs, and the degree of speed, flexibility, and scalability needed in assembly operations. The second, narrower set of considerations goes right to the nature of the part itself, notably the materials used and the shape, or geometry, of the part.

Adhesives and ultrasonic welding are permanent joining methods. Both create a strong bond between components that won't come apart. So, consider: will the part, once assembled, ever have to be disassembled to allow for maintenance, component repair, or replacement of a battery or bulb? If so, permanent assembly methods like adhesives or ultrasonic welding may be only part of the solution. To allow for disassembly, a product design probably will need to incorporate either mechanical fasteners or snap-fit components.

Flexibility

Of the two assembly methods considered here, adhesives often provide more flexibility in the assembly process. Specifically, this means that adhesives can create bonds between plastic components that use a range of materials and shapes. And, if there's a need to modify the design of one of the plastic components – to make one of the dimensions longer or shorter, for example – the adhesive joining process remains the same. It is comparatively easy to change components and then adapt the adhesive assembly process. If adhesive dispensing is done manually, simply inform the assembler of the change. Or, if automated, adapt the robot's programming to change the pattern of its adhesive dispensing motion.

The notion of flexibility can also make adhesives a good solution for assembly of products in small quantities, including:

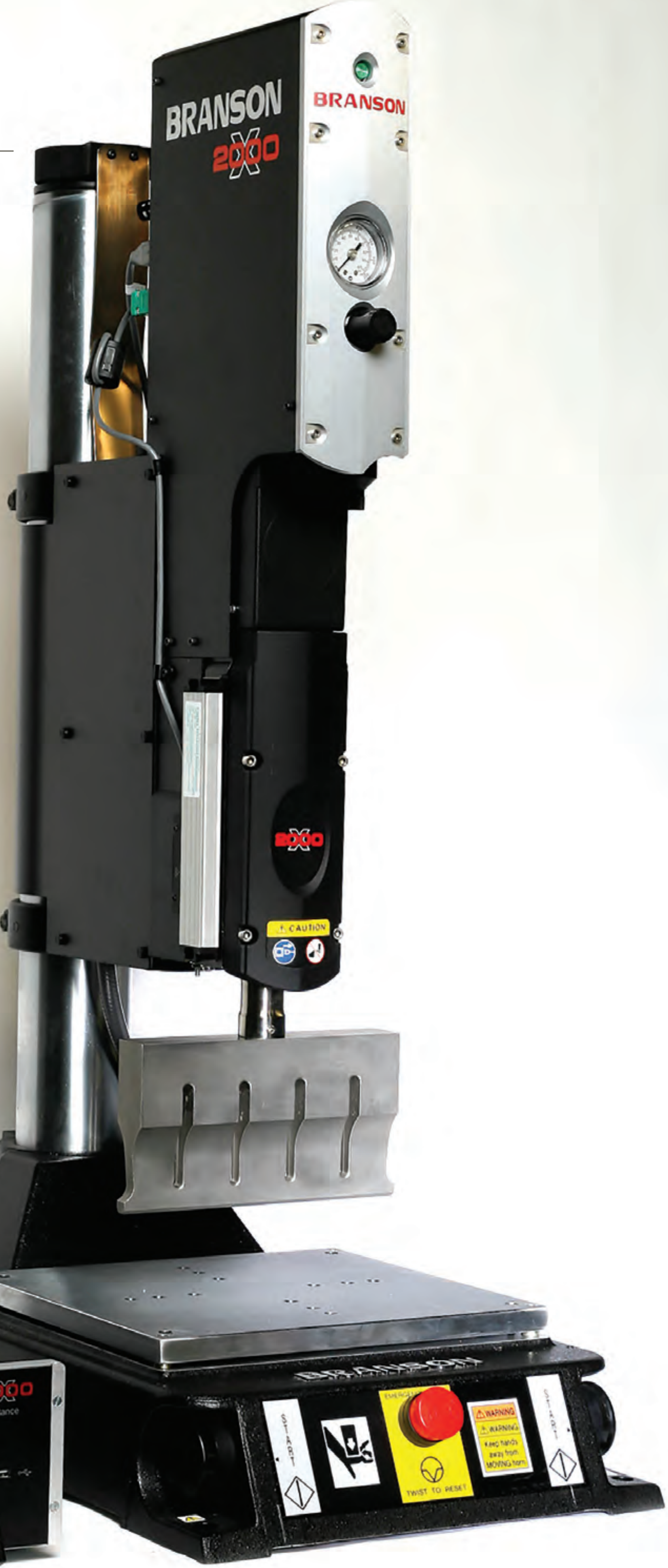
- Prototype designs
- Product samples
- High-mix production runs that include parts of differing sizes or shapes

For all their flexibility, adhesive joining methods come with some constraints. The first involves maintenance. Anyone who has ever used a bottle of glue knows that when the glue is in use, the applicator must be kept relatively clean and the glue applied with consistency and care to ensure a complete and cosmetically pleasing bond. When the number of adhesive applicators increases, the challenge of ensuring process control grows. Assembly managers must ensure that adhesives are flowing smoothly and consistently to assure part strength, necessitating periodic purging and cleaning of adhesive systems and applicators. When not in use, adhesive applicators must be cleaned and capped to prevent the exposed adhesive from curing and clogging, which can lead to waste or production delays.

Another constraint on adhesive methods is that adhesives are consumables. Every adhesive bond made represents an incremental production cost that rises in direct proportion to output. And, if production rises beyond initial cost estimates – if for example, product sales and production ramp up rapidly, perhaps breeding new product variations or options – production costs will likely be reevaluated as management sees the product moving from a developmental to a growth phase.

Production volume

The point of change – in production volume and expected sales – offers an opportunity to consider ultrasonic welding.



An ultrasonic welding system, like the Branson 2000X includes a power supply (lower left), and "stack" (right). Connected to the bottom of the stack is the "horn," which transmits energy into the plastic parts being welded. (In this example, the horn has a blade-like shape.) At the base of the stack, weld tooling (not shown) is fastened to the perforated plate. The tooling holds plastic parts in place for welding.

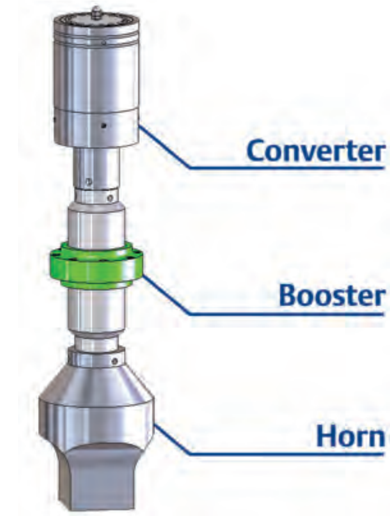
Understanding the ultrasonic welding process

In ultrasonic welding, *high-frequency vibrations are applied to two parts by a vibrating tool, commonly called a "horn" or "sonotrode." Welding occurs as the result of heat generated at the interface between the parts. The ultrasonic vibrations are created by a series of components – the power supply, converter, booster, horn– that deliver mechanical vibration to the parts.*

The power supply takes a standard electrical line voltage and converts it to an operating frequency (in this illustration, 20 kHz). This electrical energy is sent through an RF cable to the converter. The converter uses piezoelectric ceramics to convert the electrical energy to mechanical vibrations at the operating frequency of the power supply. This mechanical vibration is either increased or decreased based on the configuration of the booster and horn. The proper mechanical vibration, known as amplitude, typically is determined by an applications engineer and based on the materials being welded.

Conversion sequence

Mechanical vibrations are delivered to the parts to be welded. The parts also are put under a mechanical load, primarily with a pneumatic actuator. Under this load, the mechanical vibrations are transmitted to the interface between the parts, where it is focused on a triangle-shaped bead, the energy director, which focuses the vibration to create intermolecular and surface friction. This friction creates heat and a subsequent melt, which solidifies into a welded bond.



Detailed illustration of the weld "stack" components, which include the converter, booster, and horn. Horns come in dozens of different configurations, based on the geometry of the parts to be welded.

Using ultrasonic welding for part assembly requires some up-front investment, starting with the welder. Then, there is product-specific tooling, which precisely holds the various plastic components in place before and during the welding process. But, you only make this investment once. With these elements in place, you're in position to begin managing your assembly costs, amortizing a single fixed investment over the ongoing assembly volumes for that part. Whether you're welding 1,000 or 1,000,000 of that part, you don't have to worry about incremental consumables or assembly costs.

The same favorable economics for ultrasonic welding apply to those who plan high-volume part production from the outset. As soon as a product design is finalized, weld tooling can be completed and production can begin. The key to amortizing assembly method costs, comparing costs over time, and realizing assembly cost savings is to have a firm idea of what annual production volume will be. Those with production volumes ranging from tens of thousands to millions per year can often realize a clear financial benefit with an ultrasonic welding process.

Cycle time

Adhesive assembly processes range in complexity. The most basic may consist of a relatively simple fixture for one part and a hand-held adhesive dispenser. An individual assembler may lay down a bead of adhesive on one component and then affix the mating component by hand, either pausing to hold it while it sets or attaching a clamp or fixture to hold it steady during the curing process.

A more complex adhesive assembly process may involve automation. Again, you'll need the base fixture to hold one part, plus any clamps or other means to hold the part while it cures. Some applications may call for a robot. Robots tend to be flexible: you can change the programming, change the fixtures, change the adhesives, and assemble a number of different parts with different geometries using the same robot.

Perhaps the biggest factor with an adhesive assembly process is the cycle time required. The adhesive assembly cycle isn't done when the two parts are brought together; typically, a full strength adhesive bond requires curing time for each part. By contrast, ultrasonic welding provides a permanent, welded bond in one second or less. As soon as the welded part is removed from the weld tooling, the weld cycle is complete. A new part can be loaded and welded immediately.

Materials

Materials selection is an important variable in the effectiveness of assembly processes. In general, it is more difficult to bond dissimilar materials—rubber to plastics or plastics to metals, for example. In cases like these, mechanical fasteners or adhesives are probably the best places to begin.

When it comes to fully plastic assemblies, similar thinking applies. Material selection may be somewhat more diverse when adhesives are used in assembly, because adhesives are more likely to achieve bonding between dissimilar plastics. There are some exceptions—a few polymers that may react chemically or degrade in the presence of certain adhesives – but relatively few.

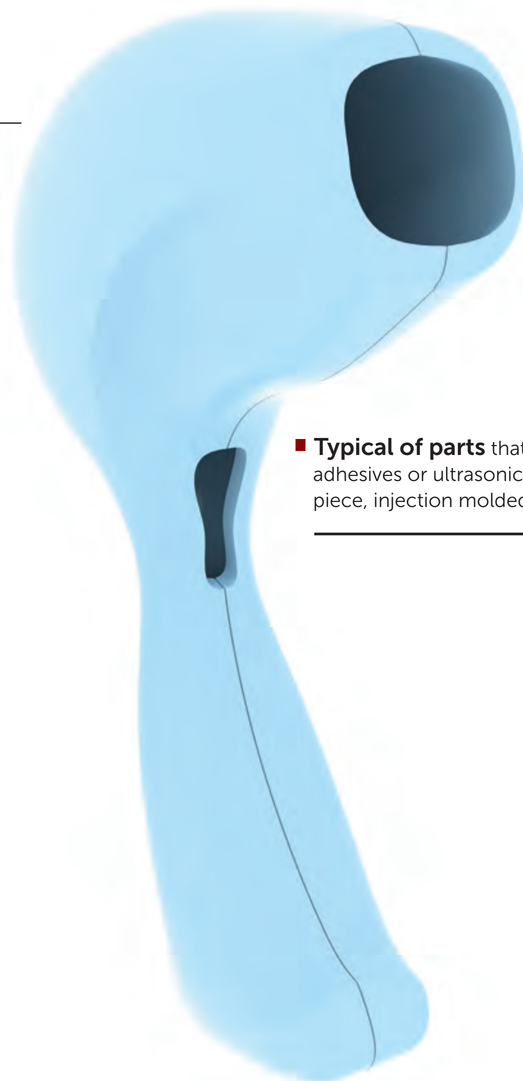
When it comes to ultrasonic welding, similar polymers tend to weld better than dissimilar polymers. However, some dissimilar polymers may be welded if they have similar melt temperatures and melt flow characteristics. Also, amorphous polymers tend to weld better than semi-crystalline polymers, since they have more gradual melt curves and more predictable melt flows between parts, which help to create more consistent bonds. ABS, polystyrene, and polycarbonate are examples of amorphous materials that weld very well.

Semi-crystalline polymers are more challenging to weld because these materials tend to melt and solidify abruptly. These characteristics that can make achieving a consistent melt and melt flow more difficult, making it correspondingly more difficult to get a consistent bond. Examples of semi-crystalline materials that are more challenging to weld are polyethylene, polypropylene and nylon.

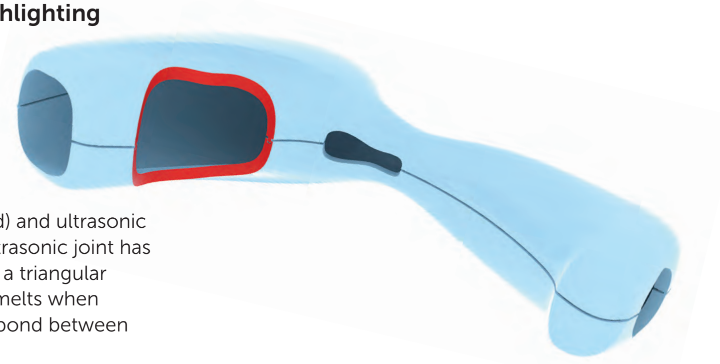
Geometry

The use of adhesive joining methods allows considerable variation in the geometry of parts. As long as the edges to be joined offer sufficient surface area for the adhesive, it's a workable method for joining.

Part geometry imposes a few more challenges when it comes to ultrasonic welding, since the



Typical of parts that may be joined using adhesives or ultrasonic welds is this two-piece, injection molded housing.



Cutaway and red highlighting shows the location of the tongue-and-groove joint in the two-piece housing. Close-ups of the joints show the difference between a tongue-and-groove joint designed for adhesive joining (as noted) and ultrasonic welding. Note that the ultrasonic joint has been modified to include a triangular "energy director," which melts when welded to form a strong bond between the parts.

Adhesives		Ultrasonic Welding	
Pros	**Cons**	**Pros**	**Cons**
Flexibility in part design	Adhesive is a consumable	No consumables	Requires capital investment
Can adhere dissimilar materials	Cure time adds to cycle time	High-volume production	Specific joint design (energy director) required
Low capital expense	Equipment maintenance (dispensing machine)	Easy setup and fast cycles	Vibratory energy can impact delicate components
Works with a variety of part sizes and geometries	Parts must be clamped while curing; some need extra (UV) curing process	High-strength seals	Typically requires dedicated tooling
Great for low-volume production and prototyping	Requires chemical compatibility; certain plastics will degrade	Minimal equipment maintenance	Limited to certain part geometries/contours
	Setup can be cumbersome	Easily integrated with automation	Noise; depending on frequency and part size

structure of the part itself must adequately transmit the energy received from the horn down to the weld joint. Some part shapes will inherently do this better than others. A great example of an easy-to-weld shape would be a cube with walls that are rigid enough to direct energy straight to the weld joint. A more difficult shape to weld would be a sphere, since one half would tend to flex under load, and therefore not transmit the energy as efficiently.

Easy-to-weld parts tend to have these characteristics:

- Relatively flat surfaces (limited contours) so that good horn contact can be achieved
- Surface area on the top of the part over the weld joint area
- Side walls with enough rigidity to transmit energy to the weld joint
- A properly designed weld joint

Every part is unique, of course, so the only way to know whether any design will work with any assembly method is to speak with a knowledgeable professional who can help you evaluate your design, consider your assembly needs, and find the right solution.

Design with the future in mind

One of the wisest things that you can do for your product design – and for your company's bottom line – is to make design choices that keep your assembly options open to both adhesive and ultrasonic welding methods. Perhaps the easiest way to do this is to design a simple "tongue and groove" joint into the mating surfaces of the components that comprise your part. This type of joint offers an inherent alignment feature – the groove – that's ideal for capturing adhesive and aligning the tongue of the mating surface, or for making a strong ultrasonic weld.

Should production need or volumes change, it is easy to convert a tongue-and-groove part from adhesive assembly to assembly using ultrasonic welding. All that is required is to add an "energy director" – a small bead of sacrificial weld material – to the bottom of the existing tongue. Typically, this can be done with a modest "steel safe" change to the mold. Then, during the weld process, the energy director on the tongue melts neatly into the groove, resulting in a precise weld joint that offers high strength and good sealing properties.

Branson Ultrasonics
Emersonindustrial.com/en-US/Branson