Brown's *Quad Series*™ Sets New Standard for More Precise and Consistent Production of Thermoformed Packaging

Highly advanced product designs have given rise to a new generation of food packaging applications that boast exceptional detail, consistency, and precision. The thermoforming process – long-known as one of the packaging industry's most productive and cost-effective plastic conversion technologies - has been at the forefront of this evolution in product design. Machine makers have made steady and significant improvements in developing unique forming capabilities, among them high-tonnage, high-pressure forming, to meet these manufacturing and design requirements of complex and highly detailed packaging.

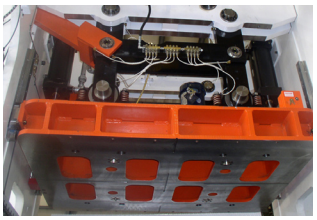
Until now, however, most of these solutions have fallen short in terms of providing the optimum performance sought by brand owners and packaging suppliers. The key goals for these stakeholders have been reduced platen deflection resulting in greater consistency, improved detail, and reduced scrap rate. Now, Brown Machine LLC, Beaverton, Michigan, one of the world's leading manufacturers of thermoforming machinery and systems, has leapfrogged the current technology by introducing the Quad Series thermoforming line which represents the industry's most advanced packaging machinery technology.

The cumulative benefits result in better parts which are made faster and with reduced scrap.

A New Benchmark in Form Station Technology

High-tonnage, high-pressure forming has been used for several years but Brown has taken the technology to a new level of performance in high-tonnage coining (stamping) applications that provide match metal forming of precise product dimensions within specific areas of the product. Coining technology offers precise and consistent material thickness within the coined areas, minimal flatness variation on flat flanges, and an increased process window for better material distribution. This new machine introduction is specifically targeted for production of thermoformed packaging made of polypropylene (PP), amorphous PET (APET), and other advanced materials which are considered to be more demanding plastic materials in terms of processing, requiring high-pressure forming and low-deflection capabilities.

Heavy Duty Frame Structure

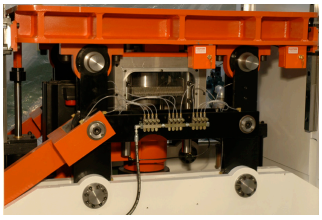

Honeycomb Platen Construction

The new Quad Series comes fully equipped with a variety of premium features that raise the bar of performance capabilities and production. The focal point of the novel line is a new forming station that provides thermoformers more precise and consistent thermoformed product than ever thought possible. With up to 175 working tons, 260 tons of maximum strength, and 150 tons of coining force (based on 54-in x 54-in forming area), this new forming station ensures virtually zero deflection across the entire mold area. Deflection measured at 0.002-in per platen is significantly less than competitive thermoforming machines. This is a significant achievement that bodes well for processors because the platens essentially don't move, thus eliminating any bowing and ensuring that the products across the complete mold are consistent.

"What we continually heard from our customers was the need for higher coining forces coupled with higher part consistency across the complete shot," explained Jim Robbins, Brown Machine Vice President of Marketing. "Our technology fulfills that demand, enabling processors to make more demanding, precise, and better thermoformed parts."

The innovative Quad Series form station design (with patent pending features from Brown) combines continuous thermoforming technology with stamping (coining) technology to produce highly detailed parts at high speed with reduced variability and greater consistency. The system is also available with Brown's patented roller screw third-motion technology that improves material distribution, reduces starting gauges, and provides a greater processing window. The cumulative benefits result in better parts which are made faster and with reduced scrap.

The Quad Series frame, toggles, platens, and drive assemblies can withstand tremendous force without any significant deflection, resulting in greater product consistency. Each platen is driven by a servo motor and four mechanical toggle assemblies that are corner-



Roller Screw Third Motion System

Dual Crank Arm Connection

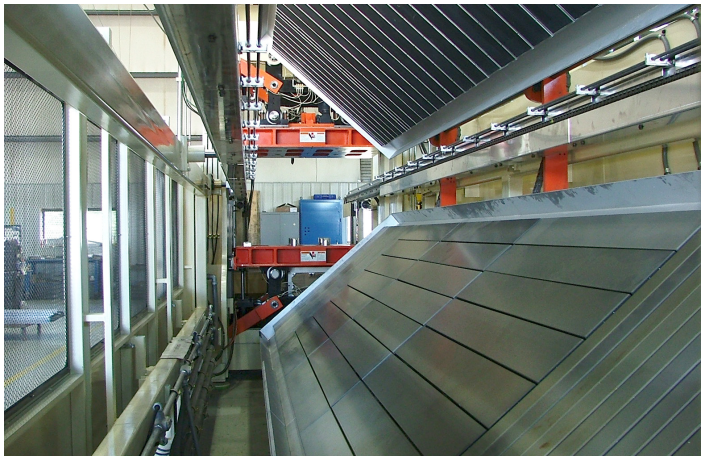
guided with linear bearings. The toggles are strategically positioned on a honeycomb platen design to eliminate deflection and guarantee consistent material distribution across the complete mold area, up to 64-in by 64-in. This ensures consistent product dimensions for integration with automated downstream applications like lip rolling, printing, heat sealing, and other operations. Extended platen depth on all models provides for additional tool support. Symmetrical drive loads throughout the toggle linkages and drive system eliminate all over-hung loads.

Unique Features Bring Added User Benefits

The Quad Series delivers several new features and breaks new ground in many key areas of construction and capability. First, a unique feature is an individual frame structure with upper and lower web-constructed heads for captured toggle links that are bolted and doweled to slab sides. There are also independent top and bottom platens fabricated and precision machined from solid upper and lower plates with internal reinforced webs. The construction also permits extended platen depth for additional tool support.

Each platen in the Quad Series is driven with a single servo motor and gearbox with dual-crank arm connection. High-load/extended-life needle bearings are utilized throughout the forming station and a strategic crank-arm position is used for optimized power efficiency. Positive alignment of the dual-crank arms to the crank shaft eliminates slip and provides for easy toggle alignment. The design also incorporates symmetrical drive loads throughout the toggle linkages and drive system so there are no over-hung loads. Balance cylinders are used on the top and bottom platen to equalize the weight of the platen and tool resulting in increased cycle times and efficient platen movements.

Standard features included in the Quad Series line are user-friendly controls with an independent power source, rigid chain rails with motorized auto “V” system, multiple zone top and bottom panel heater oven banks, high-capacity servo valves for vacuum and blow flow, high-volume vacuum and air reservoirs, and quick tool-change systems.



Panel Heater Oven Banks

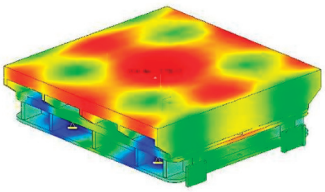
Among the key options are form station stroke and tonnage, roller screw third motion (patented), syntactic or roller in-feed system, sheet edge pre-heaters, and servo water tool temperature control.

"The Quad Series was developed to successfully process PP and is a game-changer with no real competitor in the industry"

Customer Cites Quad Series Success

One of the first commercial users of the Quad Series thermoforming machine was WNA Polar Plastics, a Montreal, Canada-based manufacturer of thermoformed food containers and drink cups made of polypropylene (PP) and polystyrene (PS). The Canadian thermoformer bought Brown's CS-4500SP Quad Series model late last year to produce food containers and lids made of PP. "Unlike PS and PET, which brings a longer history and a broader knowledge base, thin-gauge PP is a 'tricky' material which is less stable and forgiving and has less of a track record," explained Alain Wan, Tooling and Design Manager for WNA Polar Plastics. "The Quad Series was developed to successfully process PP and is a game-changer with no real competitor in the industry," said Wan.

Wan points to the machine's rigid and sturdy platen construction, its wide processing window for better material distribution, and easy-to-handle, operator-friendly features. WNA cites the machine's consistency to produce detailed parts, high productivity, and virtually zero scrap rate. The human machine interface (HMI) is highly effective and user friendly, permitting process adjustments at the operator control panel while the machine is in operation, as opposed to older technology where some adjustments required machine stoppage, thus contributing to machine downtime, according to WNA.



Finite Element Analysis (FEA)

Extensive Product Development

Brown undertook an extensive product development effort both internally and externally to create the Quad Series thermoforming machine. Early in the development process, the company assembled an internal focus group consisting of process engineers, mechanical engineers, manufacturing, and sales and marketing. This group formalized a design strategy and machine concept and then later met with a larger group at Brown to get further process and manufacturing input in order to further refine the design.

Brown took the proposed machine design to a range of customers for their input and critique. Their input was considered and implemented and the company met with all key functional groups within the company including customer service, manufacturing, and vendor support in order to lay out a plan for building the new Quad Series. Finite Element Analysis (FEA) of the station and components were then completed to confirm

the design. A demonstration machine was built and trialed and later was introduced to the U.S. market in June 2009 at the NPE exhibition in Chicago. The first commercial unit was installed in February 2009 and today more than 25 units have since been sold or are in production. Key end-use applications include food packaging, cups, lids, and other disposable packaging for the food and horticulture industries.

Models are currently available in varying mold sizes up to 64-in by 64-in, with the capability to produce parts with depths of 4-in to 12-in. A 74-in by 74-in form station version is also available for shallow draw containers. Custom sizes are available upon request.

Brown Machine LLC, Beaverton, Mich., is a global leader of thermoforming technologies, and engineers and manufactures a complete line of continuous and cut-sheet thermoforming equipment and related tooling/peripheral equipment. Brown has designed and developed numerous thermoforming innovations over the last 55 years and has machines operating in over 65 countries worldwide.

For more information, call (877) 702-4142 or visit www.brown-machine.com.

BROWN®

Global Leader in Thermoforming Solutions

World Headquarters: Brown Machine LLC, 330 N. Ross St. Beaverton, Michigan 48612, USA

Ph: 989.435.7741 | **sales@brown-machine.com** | **www.brown-machine.com**

TF: 877.702.4142

Fx: 989.435.2821

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