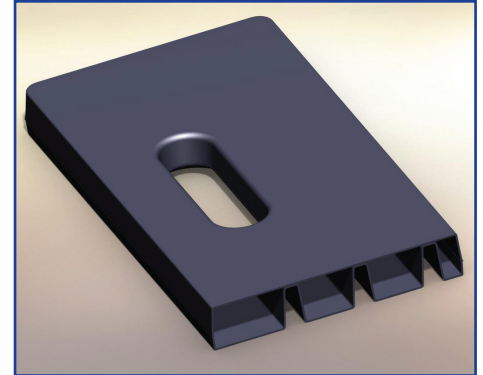


## THERMOFORMED SOLUTIONS THAT ARE BOTH STRUCTURAL AND MOLDED ON BOTH SIDES

Are you looking for a thermoformed solution that offers **structure** as well as size? Or **molded features on both sides** of the part instead of just one side? **Continuous Improvement Engineers at Johnson & Johnson's Optima Battery Division** needed just such a solution. So did **design engineers at 3D Systems**. Twin-sheet thermoforming offers just that. It is a process whereby two sheets of plastic are thermoformed concurrently and, while still at the thermoforming temperature, are brought together under high pressures to create a welded bond wherever desired. This process yields a two-sided part whose strength comes from the many "beams" created in this process, either at the perimeter or within the part.



The economics of twin-sheet parts is also attractive insofar as it eliminates many typical secondary operations required in the thermoforming process, and after molding, it is processed as one part, not two.

## WHAT TYPE OF EQUIPMENT IS REQUIRED?

- Classically, the equipment was a 2 oven machine that would allow each sheet to be heated separately, allowing the first sheet to be formed while the second sheet is still in its separate oven. Then the second sheet would index and form, and the two platens brought together. This worked fine in the world of heavy-gauge olefins.
- But with the expansion into the types of materials demanded by many of today's applications, and with the economic drive to reduce gauge and therefore costs, we have refined the "single-oven" technique. This allows both sheets to be heated and formed concurrently, allowing less surface temperature drop which is a challenge with thinner gauges and non-olefin resins. This aspect is critical to achieving a robust weld between the sheets.

## WHAT KINDS OF PLASTICS?

- Almost any thermoplastic material can be utilized as long as it can be procured in sheet form. Moreover, dissimilar materials can be combined as well as different gauges or different colors to yield different properties or visual effects.
- Traditional materials for the twin-sheet process were the polyethylene family. However, ATI has vastly expanded, through a process we call "technical twin-sheet", the breadth of materials we can twin-sheet. This includes ABS, FR ABS, Acrylic PVC, Polycarbonate, Polypropylene, Polyurethane, TPO, PETG and Noryl (PPE). This allows for a broad array of part applications and designs.



## WHAT KINDS OF SOLUTIONS DOES IT OFFER?

- Through the geometry of welded beams and vertical members, the process achieves tremendous stiffness and rigidity due to tension and compression of those features. And it does this with very low mass, so the parts are characterized as being very light with an exceptional strength-to-weight ratio. The combination of the two sheets usually yields a much stronger part in terms of stiffness and rigidity than that of a similar mass of plastic from just heavier gauge.
- Because the parts can be mostly hollow, they provide excellent thermal insulation, and can be foam-filled if necessary. The air space in the part also can provide significant acoustic deadening.
- Finally, unlike traditional thermoformed parts, twin-sheet parts have molded features on both sides. Oftentimes, these features can also have insert-molded features such as threaded inserts.

## WHAT KIND OF APPLICATIONS HAVE WE FOUND?

Applications are **very diverse**. They range from items such as **cushioning systems** (fig. #1) made with flexible urethanes to a **surgical helmet** (fig. #2) which provides the doctor with a barrier against fluids by mounting a face-shield and provides cooling as the helmet acts as a duct for an internal fan; a **processing tray** (fig. #3) supporting 200 lbs at 200°F for 20 hours with minimal deflection; a **machine base** (fig. #4) that not only supports a heavy piece of equipment but also creates a wiring chase and mounting manifold for valves; storage **deck covers** for automotive aftermarket; **thermal ducting** (fig. #5) for medical, aircraft and bus transportation; **insulated lids** (fig. #6) for air-conditioning power management equipment; a machine base for heavy medical equipment that provides **impact absorbing protection** (fig. #7) ; **pallet boards** for food service that are readily cleanable; therapeutic **hospital bed siderails** (fig. #8); and, a **structural flooring system** (fig. #9) for modular animal enclosures.

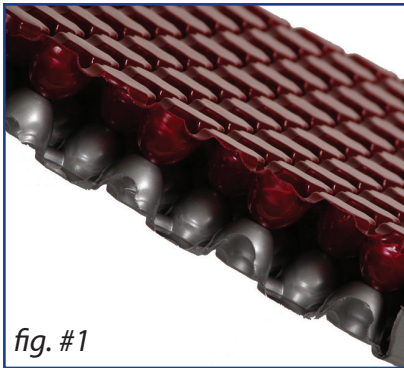


fig. #1



fig. #2



fig. #3

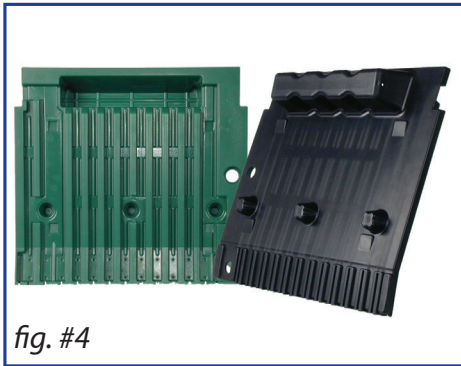


fig. #4



fig. #5



fig. #6



fig. #7



fig. #8



fig. #9

## HOW DOES IT COMPARE TO OTHER PROCESSES?

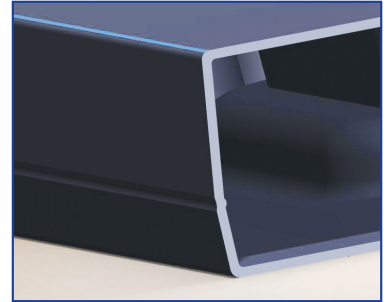
**Blow-molding:** Twin-sheet thermoforming generally has tooling costs that are significantly lower, can produce much larger parts, and the process can work with two different materials or gauges. Lastly, the process can oftentimes accommodate parting-line geometries impossible to do in blow-molding.

**Roto-molding:** This cannot produce parts with internal structural members such as beams or columns, and generally the resin options of roto-molding are much more limited.

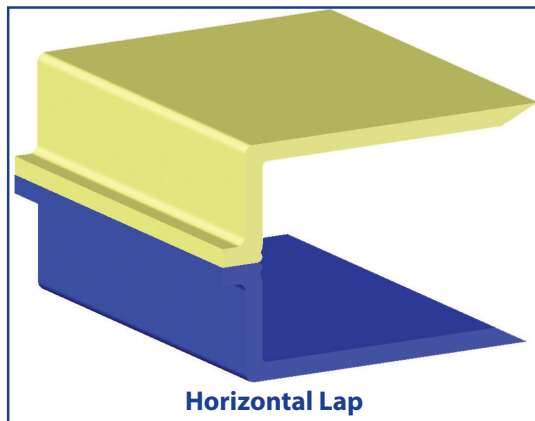
## PARTING LINES

In the twin-sheet process, we have design flexibility with regards to where the parting line is and what appearance it can have. We can do curvilinear parting lines and we can orient parting lines so they are not visible on the finished surface. Moreover, under certain conditions, we can mask the parting line in the trimming operation.

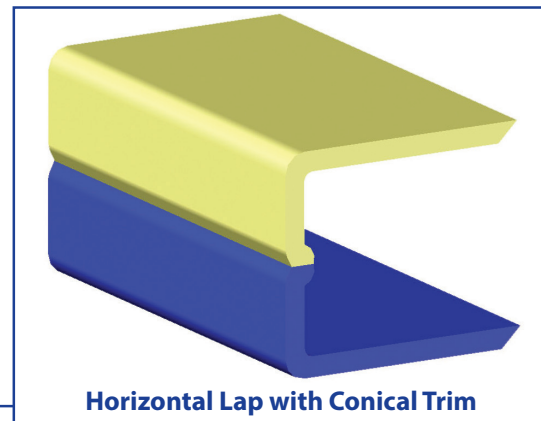
The welds that create the parting lines are generally stronger than the surrounding plastic. That is because we compress the two original sheet thicknesses to 50% of their starting gauge. The results are not only an excellent bond created by high pressure and heat, but the surface area of the bond is increased as the result of this compression. Notice that the material at the weld line are actually extruded into the interior cavity of the part, creating a very robust weld.



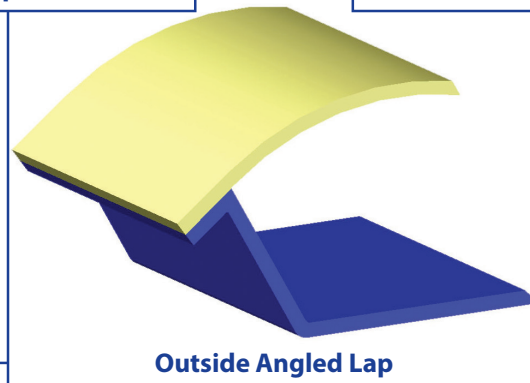
## VARIOUS TYPES OF PARTING LINES AVAILABLE IN TWIN SHEET THERMOFORMING



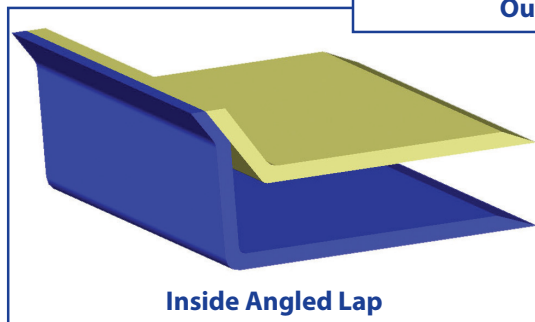
**Horizontal Lap**



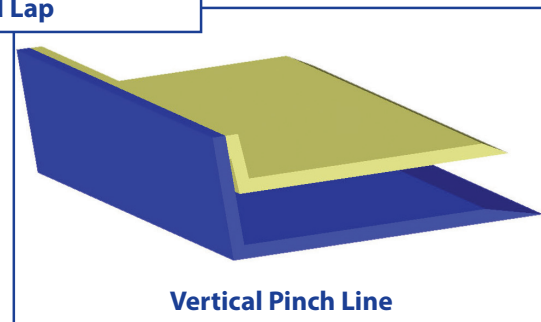
**Horizontal Lap with Conical Trim**



**Outside Angled Lap**



**Inside Angled Lap**



**Vertical Pinch Line**

## DESIGN ASSISTANCE

While most engineers understand what they are looking for in a structural part, few have the expertise or experience to create the parting line details. Details oftentimes complicated by process constraints in the thermoforming process. ATI offers this assistance. We will take your 3D solid model, and, through a dialog with your engineering staff, create the twin-sheet part that conforms to our processing rules and performs your intended function. **[Request a FREE Quote for your Thermoforming Project Today!](#)**

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