Twin-Sheet Forming is the Best Medicine

Specialty Manufacturing Inc.

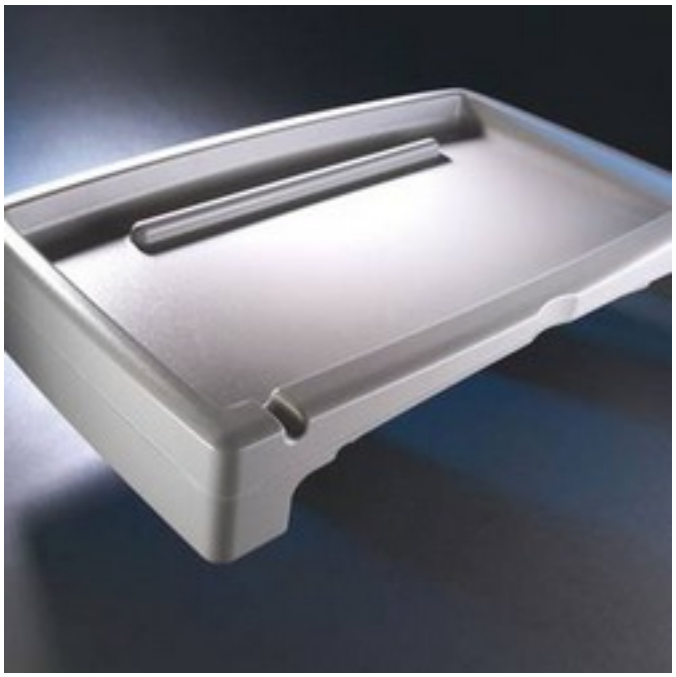
When is a medical tray not a tray? When it’s a crash bumper, a patient’s walker, or a makeshift briefcase. Philips Medical Systems knew from experience that its portable medical devices needed to be able to withstand abuse far outside the scope of the intended design.

The accessory tray for Philips Medical Systems’ iE33 echocardiography system is produced by twin-sheet thermoforming.

When the Philips team established specifications for an attachable accessory tray for its mobile iE33 echocardiography system, they thought beyond a simple flat surface with an upturned edge. In addition to physical durability, the tray also needed to withstand institutional cleaning products, match the system’s industrial aesthetics, and integrate seamlessly with the cart’s existing injection-molded parts. So the team turned to Specialty Manufacturing Inc. (SMI) [1], a trusted vendor that specializes in plastic forming. SMI recommended Kydex T, a proprietary thermoplastic sheet from Kleerdex Company LLC, to do the job.

The accessory tray for the iE33 echocardiograph is intended to hold specialty transducers and other ancillary tools used in ultrasound exams. However, the medical environment can be harsh, particularly on equipment carts. Units regularly

bang into walls and doors, patients use the carts to leverage their way out of bed, and technicians often overload the trays with file folders, supplies, and miscellany of all sorts.



After significant research, Philips opted awa y from single-part construction because the points of attachment could prove to be a weakness. They also considered and declined a glued, two-part assembly over concerns about aesthetics and strength. Instead the Philips team chose to produce the tray via twin-sheet thermoforming, a process that creates hollow parts by molding two sheets of plastic simultaneously. The halves fuse together in the mold, sealing the seam with heat and pressure generated by the forming tools, thus eliminating the need for adhesives, and improving the mechanical transition between surface planes.

Two Kydex T thermoplastic sheets are molded simultaneously and fused together under heat and pressure while still in the mold.

The twin-sheet process also gave Philips its best choice for securely joining the tray to the cart. In this method, the fasteners do not pierce the plastic; instead, they are encapsulated as the plastic is drawn around them. SMI used four Nut-sert fasteners installed into the forming tool on pins holding them parallel to the direction of the draw. As a result, the fasteners are held rigidly in place, flush to the surface, without the added cost of a secondary operation.

As important, twin-sheet thermoforming significantly expands design possibilities. Each side of each half can be individually contoured and colored. The sides can also be fabricated from raw materials of different types and thicknesses.

Working with SMI, Philips was able to completely evaluate its material options for the iE33 system’s tray. According to Haydn Forward, SMI’s vice president of sales, “The material choice was complicated by numerous factors, such as the need to withstand

In the twin-sheet thermoforming process, four Nut-sert-brand fasteners are encapsulated by the thermoplastic sheet, holding them firmly in place and eliminating secondary operations.

cleansers commonly used in medical institutions, and the ability to withstand impact and abrasion."

Philips' specifications called for the tray to withstand 50 pounds (22.68 kg) of force, which narrowed the search. In the end, the team chose the flame-retardant Kydex T, which provides excellent impact resistance and color consistency. Despite issuing high durability specs, the team recognized that tray breakage in demanding medical environments would always be a possibility. Thus, they needed to account for the part being replaced in the field. Therefore, it was essential that the custom-color sheet selected to match the other cart components, be uniform and color-stable from batch to batch over time. Further, the product is documented as being non-harmful to human and plant life. The material's elasticity and formability were additional benefits that particularly helped SMI during production.

"The application also called for matching the texture of injection-molded components on the cart," notes Forward. "Kydex T provides the formability and repeatability

Twin-sheet thermoforming allows molding of different contours on opposite sides of the part. High rigidity and modulus of elasticity enable Kydex T sheets to form a clean joint, which is disguised by the decorative indentation around the tray's edges (photo foreground).

characteristics to accurately pick up the tool's acid-etched texture during forming."

Manufacturing begins by heating two Kydex T sheets. At temperature, the sheets are pressed against female mold cavities via positive air pressure of at least 50 psi (344.73 Pascals). The pressure also embeds the fine surface details into the pliable sheets in a process similar to pressure forming. The thermoforming significantly increases the area of the sheet, reducing its initial thickness from 0.187in.(4.8 mm) to a finished thickness range of 0.08 to 0.06in.(2.0 mm to 1.5 mm), depending on the depth of the draw.

While both sheets are still at forming temperature, the tools are pressed together under heat and pressure, bonding the two sheets along mold-designed knit areas. As the weld zone forms, pressure spreads the weld inward, adding strength to the joint. After being released, the tray's seam is trimmed. Jack Schrieffer, SMI's engineering manager, pointed out that the unusual combination of rigidity and elasticity in Kydex T allowed the joint to essentially disappear, eliminating a visible pinch line that would have detracted from the tray's aesthetics.

“The treatment of the parting line between the top and the bottom made it, in my opinion, very unique,” said Joseph Peters, who coordinated the competition. “They were able to meld the two halves, and then, with a post production trimming operation, completely erase any evidence of the joint. I said to myself, ‘How did they do that?’ and I have been in this business for over 30 years. To me, that’s the sign of a winning part."

Links:
[1] http://www.smimfg.com