Case Study

The Benefits of Custom Designing and Testing Pallets

A Case Study of Vantage Plastics' 45 X 48 Single Sheet Pallet And 40 x 48 Twin Sheet Pallet

VANTAGE plastics

Vantage Plastics manufactures many pallets and trays for customers. Currently Vantage plastics has existing tooling for several different pallets from which several variations can be made. Many of these products were custom designed to provide solutions for specific customer needs. Thus, additional pallet designs will be added as customer and industry needs arise.

In this case study we chose to test our single sheet 45" x 48" pallet since it is a highly popular footprint for a pallet. Its dimensions allow it to "cube out" a semi-trailer load to maximize shipping density within the logistics chain. Given the outcomes of these tests, and based on the variables which were changed, inferences can be made as to how we can develop performance outcomes on any of our other pallets or designed product solutions. We also ran tests on our 40" x 48" twin sheet pallet to show how performance can be significantly improved due to the design dynamics of twin sheeting while using thinner gauge sheet. "Twin sheeting" involves using two separate extruded plastic sheets, forming each separately, then fusing them together under pressure while still hot. This process lends itself to design dynamics which can substantially increase product strength. It is a process which is not available from many thermoforming companies.

The Value of Testing:

Testing trays and pallets used for shipping is very important. Since products moved with, or contained within pallets and trays are often very valuable, fragile, or needed to meet timing requirements at the next destination, protection is extremely critical. This is especially true for many Vantage Plastics' products as they are often custom designed and manufactured to meet specific customer requirements. Lots of added stress can be added to parts during normal movement around a warehouse and during transportation of goods. One rough road on a pallet or tray's journey could push its limits enough to fail and ruin the goods that it is holding, which could result in a major loss to any business. There are many tests and standards in place to make sure that pallets or shipping containers will be able to withhold what they need, to ensure safe travel of parts from point A to point B. ASTM (American Society for Testing and Materials) and ISTA (International Safe Transit Association) publish Standards and testing methods to ensure the quality of the shipping components.

In this case two separate tests were performed. Those being "static weight bearing capacity", and "forklift simulation" testing.

Background:

Vantage Plastics' testing procedures are meant to determine how several controllable variables can affect the performance of the pallets, trays, and various other products we manufacture. Some of these variables include engineering design, material thickness or "sheet gauge", and material makeup. These variables individually, and combined affect strengths and weaknesses of our products made of HDPE (High Density Polyethylene) sheets after being formed. This paper refers to tests which have been run on a specific, widely used, Vantage Plastics' Pallet (the 45" X 48" single sheet pallet) formed in different gauges and material makeups. In this case "gauge" refers the original thickness of the extruded sheet before forming. Vantage Plastics' affiliate company called ***Airpark Plastics*** can extrude plastic sheets ranging in thickness from .030 inches to .500 inches. "Material makeup" can range from "Virgin resin" which has never been used before, to blends using part new and recycled resins, or completely recycled resin. In this case study pallets made from 100% virgin resin were compared to pallets made from a 50% virgin 50% recycled resin blend. Results of the tests show the weight loads these pallets can withstand once formed after changing the variables of material blend, and/or starting sheet thickness (gauge). Testing Procedures match RC-9 Standards with standard static load compression, and forklift simulation testing. Testing can be done to match ASTM and ISTA standards to meet customer demands. While these tests were conducted on our 45 x 48 "single sheet" pallet, and our 40 x 45 twin sheet pallet please note that Vantage Plastics is capable of manufacturing numerous other pallets and can design then manufacture additional pallets based on customer needs.

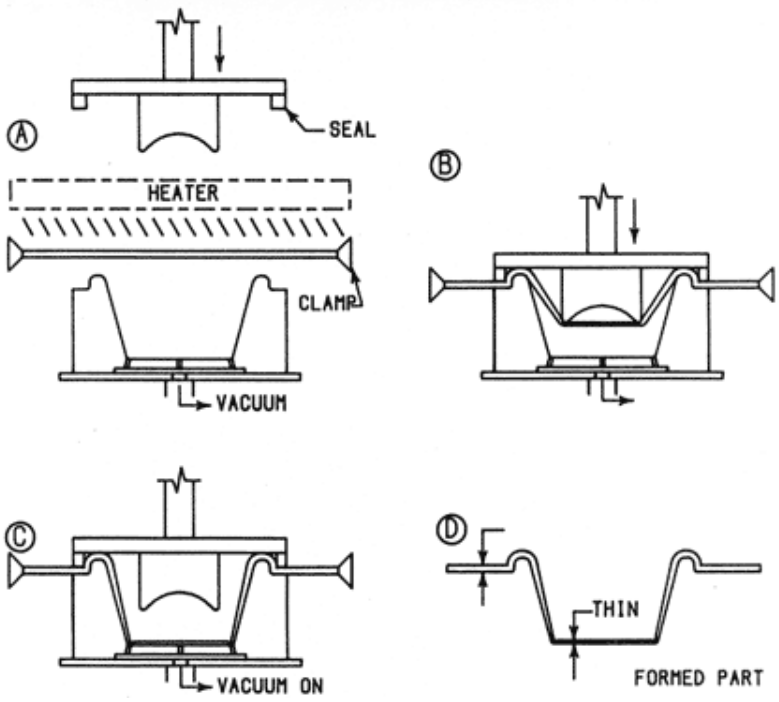
Please note that twin sheet pallets start with two separate sheets of plastic. Engineering design allows for these two sheets to be formed separately, then welded together under pressure while still hot, to create structural strength not possible with a single sheet product.

High Density Polyethylene:

While Vantage Plastics can work with several forms of plastics, High Density Polyethylene (HDPE) is our primary material. High Density Polyethylene is a petroleum-based thermoplastic with a high strength-to-density ratio. HDPE gets its strength from molecular branching, giving it stronger intermolecular forces and tensile strength. The difference in strength exceeds the difference in density, giving HDPE a higher specific strength. HDPE can also withstand higher temperatures 120 °C/248 °F (for a short time) without losing much part integrity. There are also many benefits to using HDPE parts, such as, HDPE is completely recyclable and has a high chemical resistance.

Thermoforming:

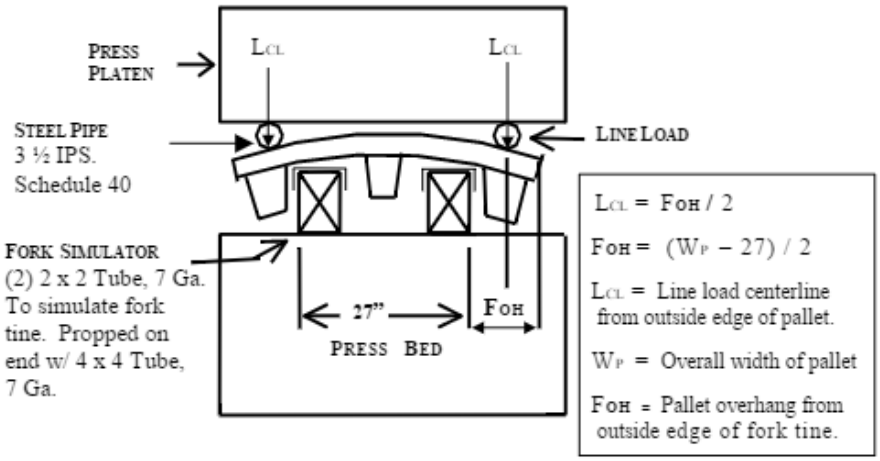
Thermoforming is a process that forms parts from plastic sheets. The plastic sheet is first heated until it becomes malleable. Then, while the sheet is still warm, it is draped over a mold and air is vacuumed out so the sheet forms to the mold. The sheet is then cooled on the mold, and once cool it is removed and holds the shape of the mold and creates the desired part. Vantage Plastics has the capability to thermoform single sheet and twin sheet parts.



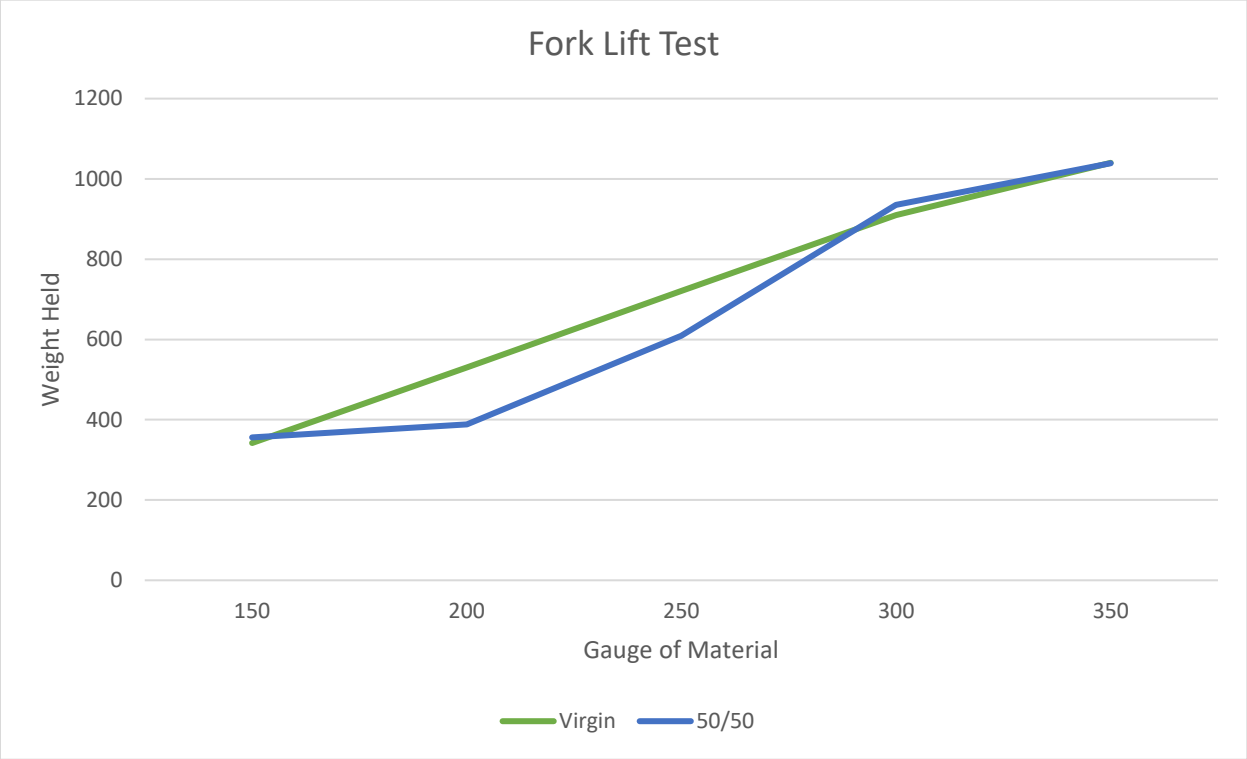
Testing Procedure:

Forklift Simulation: 45 X 48 Single Sheet Pallet

The forklift simulation test is designed to determine how much weight a pallet will hold with no more than a one-inch deflection when being moved around by a fork-truck. The test was completed on an annually certified Emerson model 7200 compression tester, with a capacity of 20,000 pounds, held onsite at Vantage Plastics. This test is achieved by putting two large pieces of wood underneath the pallet to simulate the forks on a fork truck. Then two poles (three inches in diameter) are placed on the outside top edges of the pallet. A 250 LB preload is put on the pallet. Once the preload is reached, force is then brought down onto the poles at a rate of .5 in/min, causing the pallet to flex. Once the pallet has deflected one inch, the weight being held is recorded.



Data Collected:

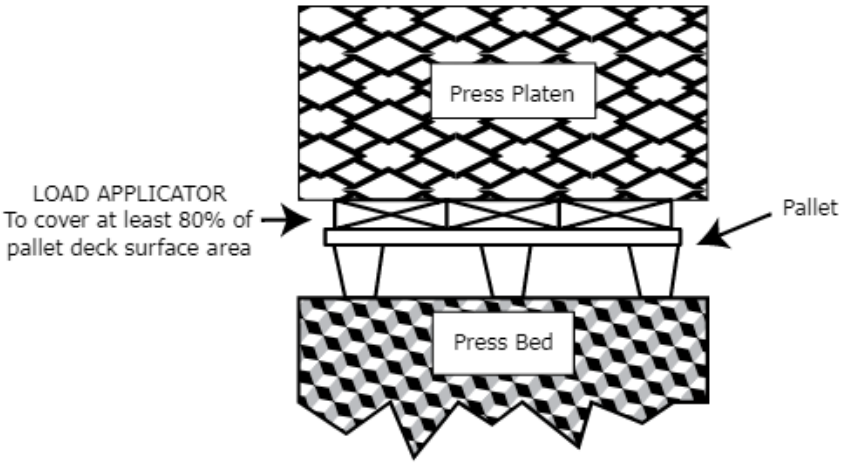


Graph demonstrates weight bearing capacity for a fork-truck simulation on a 45 x 48 plastic pallet, as impacted by the starting thickness, or "gauge" of the HDPE sheet used to manufacture the pallets.

This Pallet being a single sheet design is not the best design for this test. While test results were reasonable it is a test designed to show an extreme case of pallet stress. Normally there would not be as much weight on the edges alone. The thinner gauges had ribs that split during the test. The .250-gauge pallet ribs stayed together which held more weight in the end. A pallet specifically designed to hold weight on the outside would hold more. Most cases show virgin holds more than a 50/50 material blend, although the higher gauged blend performed similarly to virgin material. Blended material using some portion of recycled resin can help reduce customer product cost.

Static Compression Test: 45X48 Single Sheet Pallet

The static compression test simulates a static load that a pallet will hold when deflected .5 inch. We also did a much harder stress (max weight 20,000 lbs.) test to determine what a plastic pallet can do. This procedure is carried out by placing a pallet in the compression tester, then placing a piece of particle board cut to the size of the pallet in top. Then blocks are used to make sure the walls of the pallet don't get in the way. Then weight is added until .5-inch deflection is reached, and the weight is recorded.



Data Collected:

Compression testing shows that plastic pallets can hold incredible weights. The difference in a 10th of an inch of material can hold almost triple the weight. Typical jobs for pallets may only be around 10,000 lbs. on the high end. Plastic pallets and trays have an incredible strength to weight ratio, and the weight held will only go up with thicker sheets being used.

Graph demonstrates the Static weight bearing capacity of a single sheet 45 x 48 pallet made of HDPE, as it is impacted by the starting thickness, or "gauge" of the sheet used to manufacture the pallets.

Testing: Twin Sheet Pallet

Twin Sheet Pallet Testing:

While the test done on this twin sheet pallet is not as extensive, in that we did not test several gauges or material blends it demonstrates the impact of using two separate fused together sheets, which offers significant design alternatives in creating a pallet. The testing procedures for twin sheet pallets matches the testing for the single sheet pallets. A standard static compression test and a forklift simulation test. In this example, two relatively thin sheets made of a blend of 50% virgin and 50% recycled material were used. The top sheet being .110 gauge and the bottom sheet is .130 gauge. The dimensions of this pallet are 40" x 48", which is reasonably close to the 45 x 48 single sheet pallet.

Data Collected:

Twin sheet pallets hold much more weight. The structure and design of the twin sheet methodology makes these pallets much stronger and allows them to hold much more weight. The forklift simulation test showed that this twin sheet pallet could hold about 1300 lbs. which exceeds the amount held by the 45 x 48 single sheet pallet made of a much higher .350 starting gauge sheet. The standard Static Load Compression Test maxed out our compression tester, holding 20,000 lbs. without even deflecting a .5 inch.

Difference in Gauge:

The gauge refers to the starting thickness of the sheet that is being used to form the finished part. As the sheet is formed over the production tool it is stretched. This stretching causes the sheet to become thinner in spots. The further the material must be drawn to conform to tool dimensions equates to the ultimate thinning of the material in the most distant locations. Different gauges are used for different purposes; a thin gauge product would be used for applications that don't require a lot of weight to be held or little stress will be inflicted on the part. Thick gauge parts are much sturdier and can handle a lot of weight and force, some applications would be holding very heavy objects, such as automobile transmissions, or engines, as an example.

.150 Gauge

.350 Gauge

The gauge of the sheet used to make pallets creates a significant impact on their ability to hold weight. A difference between two tenths of an inch is the difference of holding 5,000 lbs. and 20,000 lbs.

Testing Thickness:

As part of our testing process the pallets were sawed into pieces so the thickness of the material could be measured at critical locations. Thus, various points were measured on the test pallets, with results showing the thickest part of the pallet is at the bottom of the legs, and at the deepest drawn points the material can be stretched to almost .08 of an inch, and still hold significant weight.

Difference in Blend:

Blend refers to the material makeup of each sheet. There are unlimited options when choosing a blend for a product to be made. Virgin material (brand new, never used) can be used to ensure parts meet the exact parameters needed when being formed, but any number of additives can be used to give a part ability that it wouldn't have with just one material. Add-ins can be used to improve, strength, flexibility, heat resistance, hardness, etcetera. Recycled material is an option too. Using recycled materials is good for the environment and can help offset product costs. Parts that live beyond their useful life, or that become damaged can be ground up, re-extruded, and formed into new sheet that can be made into new products. Vantage Plastics is continually working to develop new material blends. As an example, foaming agents are being used to create lighter weight products. Our VanTech® compounds can be applied to the surface of our sheet goods to prevent chaffing by sharp parts, or to create a surface that helps control sliding of finished products over other surfaces.

The Vantage Plastics Approach:

Vantage Plastics is a leader in the plastics industry, driven by our mission: Forming Solutions, Forming Better Lives, and Forming Sustainable Futures. We are dedicated to truly understanding our customers' needs, challenges, and goals. Through a comprehensive process of gathering information about your specific requirements, we develop tailored solutions that deliver measurable return on investment (ROI).

Our approach has consistently led to significant improvements for our customers, many of whom discovered new efficiencies and cost savings after engaging with us. By leveraging our capabilities to design, engineer, prototype, manufacture, and recycle products, we offer unmatched opportunities for innovation and sustainability.

Contact Vantage Plastics today to learn how we can help you achieve substantial improvements and drive your business forward.