Panel Processing
An Employee-Owned Company

Slatwall Load Capacity

SLATWALL PANELS
(Slotwall)
Factors Affecting Display Load Capacity

By

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The appeal and utilization of a stand-alone store display or perimeter wall system is sometimes marred by slatwall panels with paint or laminate chipped or fractured near the edges of the slats and/or sections of inserts or the panel face itself bowing outward toward the customer. In extreme cases, especially when inserts are not employed, the panel may become further disfigured when overloaded hooks actually tear pieces out of the decorative face. As a supplier of slatwall, we share the concerns of the store owner, the store fixture designer/manufacturer, and the display hook manufacturer; we all want fixtures and wall systems that give good service and remain attractive for at least ten years.

Why would a slatwall installation give unsatisfactory service? Was the board core material strength substandard? Were the hooks poorly designed? Did the fixture frame or wall mounting system not provide adequate support? Perhaps the hook was loaded beyond reasonable capacity or the insert (if used) was substandard either in design or manufacture.

In an effort to answer some of these questions we designed and built a test apparatus which examined the behavior of slatwall panels under tightly controlled conditions. These conditions represented various combinations of board strength, hook type, insert possibilities (including no insert at all), and common installation methods.

TESTING METHODOLOGY

We researched and selected several types of hooks for evaluation, targeting common types that are commercially available. Then we built the test apparatus shown in Figure 1 (prior to testing) and Figure 2 (after testing) to simulate either a "captured" panel in a store display (inserting the panel in the metal channels on both sides) or a perimeter wall installation (screwed through the bottom of the T-slots to the 2x4's anchored to the block wall at 16" centers).

FIGURE 1

FIGURE 2

We selected ¾" thick medium density fiberboard (MDF) panels from different suppliers that were advertised as both "normal" and "high strength" slatwall grades. These corresponded to published Internal Bond (IB) strengths of 120 pounds/square inch (psi) and 150 psi respectively (as determined by ASTM D 1037-96a Part A). We also tested a "high IB" particleboard that some of our customers have been using in applications that don't require blemish free finishes. These panels were then machined with T-slots at 3" centers on our production equipment utilizing our standard insert and non-insert tooling. After installation in our test apparatus, they were then fit with various commercially available hooks and subjected to steadily increasing loads out at the end of each hook until either the panel or the hook failed.

We began with normal strength MDF core material and a few of what we considered very heavy duty hooks. It quickly became apparent that, especially in panels utilizing our standard aluminum insert, these hooks fail well before the panel. Even in non-insert, normal strength MDF samples, the hooks were typically not capable of supporting loads representing some of the more extreme applications that we had witnessed in actual store installations (up to 100 ft lbs). We surmised that manufacturers of these hooks design them so that they deform before they cause damage and permanently disfigure the slatwall. However, we found no supplier information to support that premise. Eventually it became prudent to eliminate hook variations from our investigation and we designed and fabricated our own based on best practices learned from the above exercise. We made sure to maintain the tang width (2.5 inches) consistent with most commercially available "heavy duty" hooks. It is shown in Figure 3a and Figure 3b.

MOST HOOKS AREN'T DESIGNED STRONGER THAN THE PANEL!

FIGURE 3a

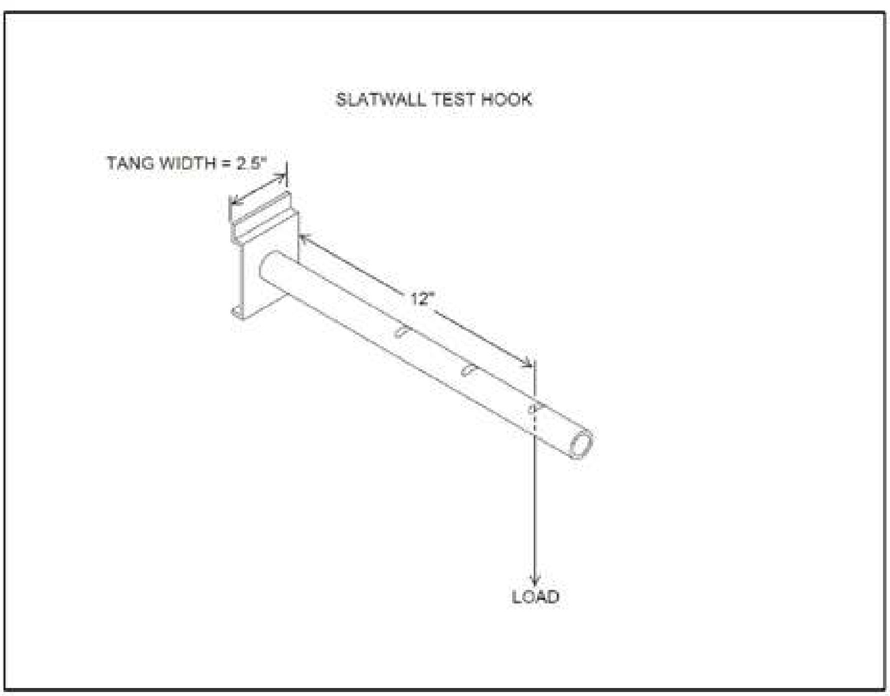

FIGURE 3b

Now it is not our intent to bore those with a technical background here but we should explain the hook loading terminology referred to in the preceding paragraph and throughout the remainder of this discourse. It is unilaterally accepted that the factors determining the stress placed on a slatwall panel are the weight (pounds) of the load and the distance that load (feet) is hanging away from the face of the panel. This translates to a moment arm of force depicted in units of pounds-feet (lbs ft) or foot-pounds (ft lbs). These units are identical and ft lbs is the accepted convention. While some of our customers may ask for a panel that will support "X pounds" we always make sure to ask how long the hook is, how far out on the hook that "X" weight will be hanging, and/or if that weight will be applied uniformly from the face of the panel out to the end of the hook. A 10 pound load at the end of a 12" long hook is equivalent to a 20 pound load at the end of a 6" long hook....they are both calculated as 10 ft lbs. And we should add that the engineering formula to determine the loading in a uniformly loaded hook application is also very simple...1/2 x Load x Prong Length. In other words, 20 pounds of product uniformly distributed over the same 12" hook mentioned earlier is 10 ft lbs. Our test hook weighs 3.2 pounds that is distributed uniformly along its 1 foot length so it contributes 1.6 ft lbs of load to each test (1/2 x 3.2 lbs. x 1 ft.).

After settling on our own hook capable of carrying very heavy loads with negligible deflection we began testing "normal" strength MDF with and without inserts installed and finally achieved repeatable board failure results. Please note that our hook was always placed at the exact left-right center-line of the sample (8" from either edge) as placement closer to the edge compromised the load handling capacity of the panel. Also, we always attached our load (the cable) at the very end of the hook, 12" from the face of the panel.

HEAVY LOADS SHOULD NEVER BE APPLIED NEAR THE EXPOSED EDGES OF THE SLAT!

This cable, after going through a simple pulley system, was attached to one end of a 0-200 pound range spring scale equipped with both a resettable "Max Load" indicator and a "Zero Offset" adjustment. The other end of this scale was then attached to the cable of a manual winch with a very high turn down ratio (50:1). After zeroing the scale to compensate for the weight of the pulleys/connectors, we very slowly turned the winch handle to add "weight" to the end of the hook until failure. The maximum scale reading was then recorded. The load values shown in our Table 1 are simply the hook length (1 ft) multiplied by this scale reading (lbs) plus the constant 1.6 (ft lbs) related to the uniform weight load of our hook calculated earlier. Note that failure occurs rather abruptly with essentially no warning. Large segments of the panel face (between the slot into which the top tang of the hook is placed and the next slat above it) pop off usually to a maximum depth of the underside of the "T" section. When using our standard aluminum inserts, the face that pops off is normally full width of the sample (16"). See Figure 4 (with inserts) and Figure 5 (without inserts) for examples of failed panels. Note that after each test we moved the hook into a new or "virgin" T-slot at a different elevation to document test repeatability. Each result reported here is the average of at least two tests performed in "virgin" slots in the same panel. If results of those two were not within 2 ft lb of each other, a third and fourth test was run and the results of all four then averaged.

FIGURE 4

FIGURE 5

Once satisfied with our test methodology, we set out to isolate the variable of "captured" versus "rigid" installation. We first tested panels held only by the side channels to simulate a "captured" installation. We then applied those same loads to identical panels (cut and machined from the same master 4'x8' sheet) rigidly affixed to 2"x4" studs with drywall screws through the T-slot bottoms. We were pleasantly surprised to find that there was essentially no difference in the loads that caused failure. It should be noted, however, that the screws and studs were on 16" centers and, as mentioned earlier, the load always applied at the left-right center-line. Compromises in failure level (especially in non-insert, normal strength slatwall) will occur when the load is applied near the outside edges of the panel where the T-slot profile is visible.

INSTALLATION METHOD ("CAPTURED" or "RIGID") HAD LITTLE EFFECT ON FAILURE POINT.

Next we examined the insert variable. The tests that we ran while we were proving out our methodology and comparing common installation methods had utilized only our two standard slot profiles. One of them is used for applications without inserts and/or requiring a decorative plastic insert. The other profile is for applications utilizing our normal heavy duty aluminum insert. These three scenarios (non-insert, plastic insert, and aluminum insert) are reported in Table 1 for the different classes of panels noted. We also spent some time testing different profiles that we occasionally "custom make" for some of our customers. While it would be improper to share the exact details of our customer's proprietary insert designs and associated T-slot profiles we can share some interesting generalities we discovered.

An insert of any kind improves load capacity by spreading the top hook tang's counter balancing reactive force out over a large area of the underside of the slot. Therefore, a "stiffer" insert is better. Think about flipping a partially cooked egg with a butter knife instead of a spatula. The knife breaks through or folds the egg but the spatula doesn't. And then think if that blade of the spatula was so flimsy that the weight of the egg caused it to bow or droop significantly either side of its centerline where the handle attaches. That same egg might still fold or crack in the middle. That is where the extra stiffness comes in. It actually lets the insert spread the aforementioned reactive force out farther lowering the stress concentration that the tang (butter knife) imparts to the interior of the board.

Commercial insert suppliers won't typically publish a stiffness value but they might disclose a Modulus of Elasticity (MOE) for the actual material of construction and in some cases a Section Modulus (S) calculated for the insert's geometric cross section about its horizontal axis. A higher value for either of these relates to increased stiffness of a given insert. This explains why, for the same geometric cross section of an insert, an aluminum one will carry more than a plastic one and an insert of better grade aluminum (higher MOE) will do better yet. The Section Modulus explains why, for the same material of construction, increased wall thickness, wider bottom "T" segment, narrower throat width, or any combination of the three will carry higher loads. Figure 6 defines these Section Modulus variables.

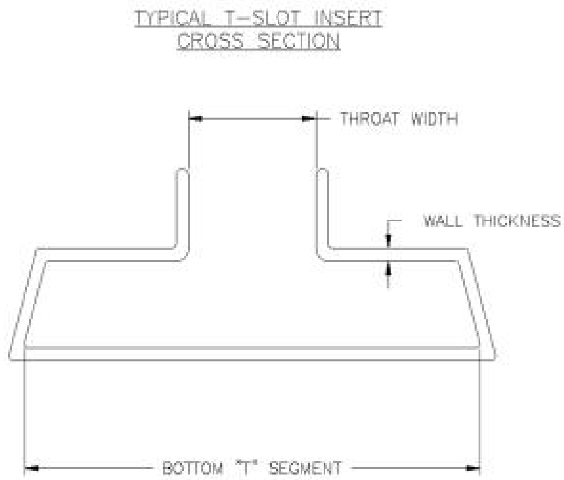

FIGURE 6

INSERTS MADE FROM MATERIALS OF HIGHER MODULUS OF ELASTICITY (MOE) AND EXTRUDED IN GEOMETRIES OF HIGHER SECTION MODULUS (S) CARRY HEAVIER LOADS.

The last variable was board strength. As mentioned earlier, mills typically delineate normal and high strength slatwall stock by their Internal Bond Strength (IB). Mills can attain these IB's by any combination of board density, resin type and amount, press cycles, wood fiber size and species, etc. Because we also want substrates that "finish" well (paint/laminate, machining, etc.), we always include density in our specification in addition to IB. For "normal" MDF stock we purchase panels with a density of 45 lb/ccf (pounds/cubic foot) and an IB of 120 psi. We've found this specification provides the best combination of finishing, load capacity, and economy. However, occasionally customers anticipating very high load requirements will ask for "high strength" panels for which we stock raw panels with a 48 lb/ccf density and an IB of 150 psi. For particle board stock, we generally purchase panels with a density of 50 lb/ccf and an IB of 150 psi. Table 1 depicts the failure loads observed for the the three materials mentioned above manufactured with no inserts, standard plastic inserts, standard width aluminum inserts, and extra wide aluminum inserts (longer bottom "T" segment). It must be noted that these are breaking loads and not working loads. We recommend normal maximum working loads at 66% of these values to compensate for a wealth of variables out of our control.

GRAPH DEPICTS BREAKING LOADS…WE STRONGLY RECOMMEND WORKING LOADS BE LIMITED TO 66% OF THE VALUES SHOWN!!!

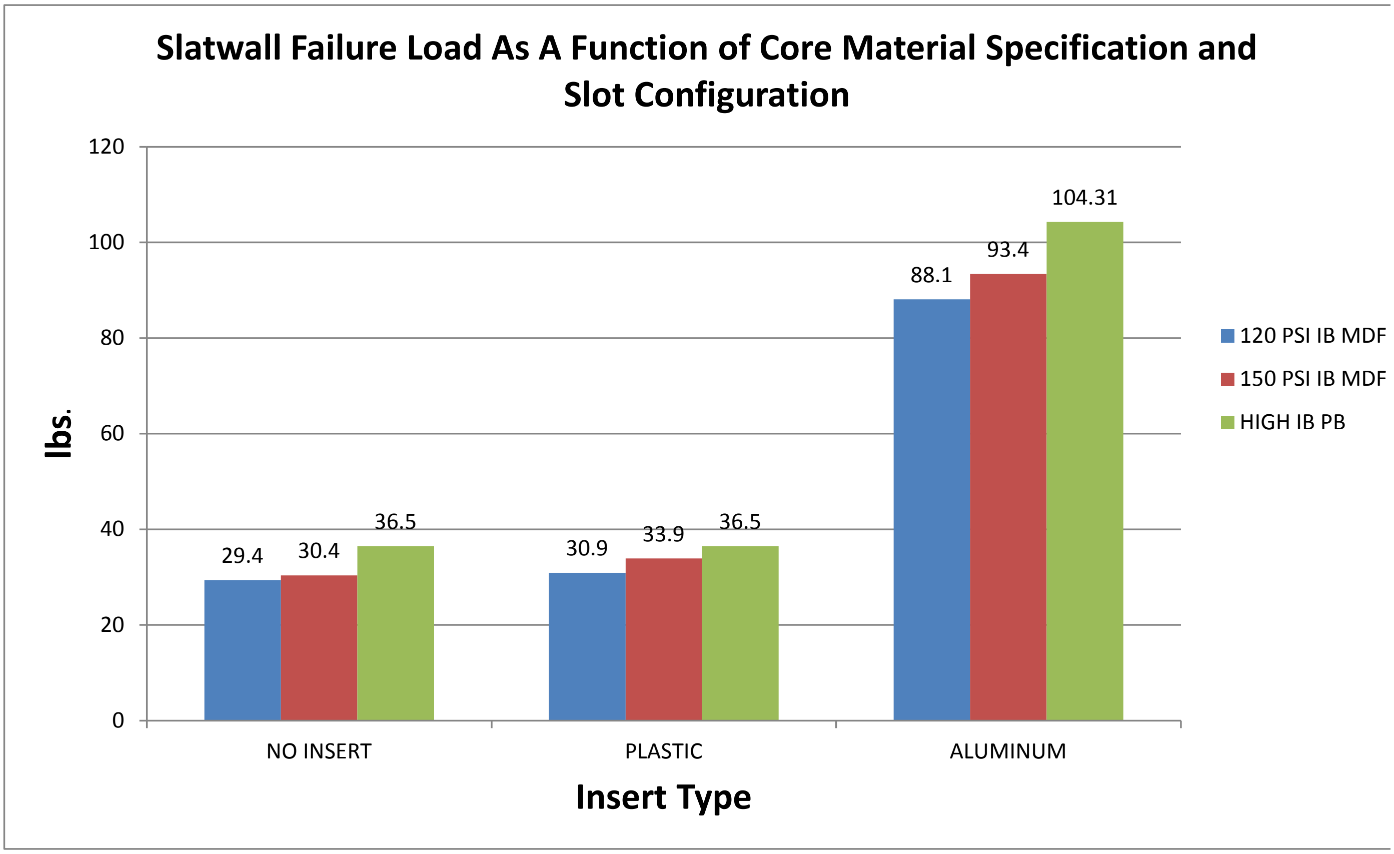

TABLE 1

In conclusion, we hope we have shared enough of our experience in this field to assist a prospective customer in making an informed decision when considering what type of slatwall panel to purchase for a given application. It is not easy to balance aesthetics and functional considerations against things such as hook design and load capacity for every display while still satisfying the economic constraints present in today's retail marketing budgets. If further information is required or you have any questions about selecting a slatwall display panel our expert customer service representatives will be happy to assist. In addition, if a customer is considering a new hook design, slot profile, core material, or some combination thereof and resultant load carrying questions arise please feel free to contact our engineering department. They will be happy to offer sound technical advice and, if warranted, test your new components.

ABOUT THE AUTHOR

Thomas L. VanMassenhove, PE is the Vice-President of Engineering for Panel Processing, Inc., a fabricator and finisher of wood based components for industrial use. He is a registered Professional Engineer and has worked in the hardboard, pulp and paper, and wood products industry for over 40 years at the plant, corporate, and consulting level. He is the co-holder of a United States patent for a proprietary process and associated equipment used in the manufacture of wet process hardboard.

At various points in his career, Mr. VanMassenhove mentored under R. M. Granum, founder and longtime Chairman of the Board of Panel Processing, Inc., and O. B. Eustis, a widely recognized consultant in the wood and wood products industry. While Mr. Eustis passed away in 1986 and Mr. Granum in 2003, each had over 50 years of experience in in the wood industry in various research, production, and executive management positions. They contributed significantly to Mr. VanMassenhove's extensive understanding of wood fiber and its' function in the manufacture, finishing, and utilization of wood based panels.