THE RELATIVE PERFORMANCE OF NEW AND USED GMA WOOD PALLETS

An Executive Summary by Dr. Marshall S. White, Director, Pallet & Container Research Laboratory Wood Science & Forest Products

Editor's Note: Dr. White presented the following information comparing new and used GMA pallets at the recent NWPCA Recycling Meeting. Note that comparing new pallets with #2 and #3 used pallets makes engineering sense, but typically the don't compete for the same applications in the marketplace.

The USDA Forest Service, Southern Research Station at Virginia Tech has funded wood pallet recycling research which includes documenting the relative performance of new and used GMA style wood pallets. An understanding of the relationship between pallet repair methods and pallet performance will lead to improved procedures for the recycling of wood pallets.

Test Methods

A total of 1867 new, multiple-use and used (remanufactured and repaired) GMA pallets were randomly sampled from 20 different locations throughout the United States. The pallets were carefully inspected and then tested for strength and stiffness when in racks spanning the stringers (RAS) and spanning the deckboards (RAD). The test spans were 44- and 36-inch respectively and a uniform-load applicator was used. Sample pallets were tested for structural durability in the VPI FasTrack which is an accelerated rough handling testing protocol that simulates unit-load material handling practices.

Pallet Repair Methods

The remanufactured pallets sampled, were pallets fully reassembled containing all used parts. The repaired pallets sampled represented 2 grades to 11 grades depending on sampling location. Repaired grades, however, were generally segregated according to the method and frequency of stringer repair. These repair methods were (1) the replacement of a stringer, (2) the use of full companion stringers, (3) the use of half-companion stringers, (4) the use of plugs, (5) the use of metal connector plates, and (6) the use of corrugated metal fasteners to close stringer cracks.

For comparative purposes, the repaired pallets were divided by laboratory staff into three grades labeled A, B, and C. These generally reflected the most common grading procedures performed by pallet recyclers as determined by sampling. The moisture content of the wood in the new pallet was 17% to 20% at the time of testing. The moisture content of the used pallet tested was typically between 10% and 12%.

TABLE 1

Table 1 is a description of these graded, repaired pallets, according to the number and type of stringer repairs performed. Half-companion stringers were, by far, the most common repair. Metal connector plates appeared in all three grades, and Grade C contained a relatively large number of plugs. All grades included deckboard repair and replacement.

TABLE 2

Table 2 contains the average and variation of deckboard thicknesses for new, remanufactured, and repaired GMA pallets. The average deckboard thickness for the pallets was between 5/8- and 11/16-inches. As expected, the variation in deckboard thickness was significantly

Table 1: Average Number and Method of Stringer Repairs in Repaired Pallets Sampled from the United States.

Required Pallet Grade	Replicates	Average Number of Stringer Repairs/ Pallet	Methods of Stringer Repair and Average Frequency per Pallet: metal plates	replaced stringers	companion full stringer	companion half stringer	companion plugs	corrugated fasteners
Grade A	570	0.15	0.14	-	-	-	-	0.01
Grade B	239	1.04	0.22	0.04	0.03	0.73	-	0.02
Grade C	353	1.69	0.32	0.04	0.04	0.75	0.52	0.02

Table 2: The deckboard thickness variation of new and used wood pallets.

Pallet type	Replicates	Average Thickness (inches)	Range of Average Deckboard Thickness (inches)
New	340	0.614	± 0.120
Remanufactured	365	0.632	± 0.225
Grade A Repaired	570	0.649	± 0.278
Grade B Repaired	239	0.657	± 0.154
Grade C Repaired	353	0.642	± 0.273

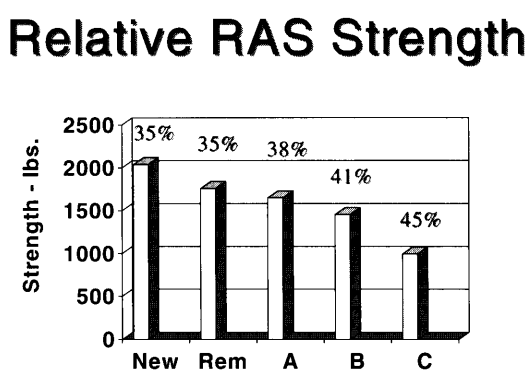

Figure 1. **The relative bending strength of new, remanufactured, and Grade A, B, C repaired, GMA wood pallet spanning the pallet length (percentile represent coefficient of variation).**

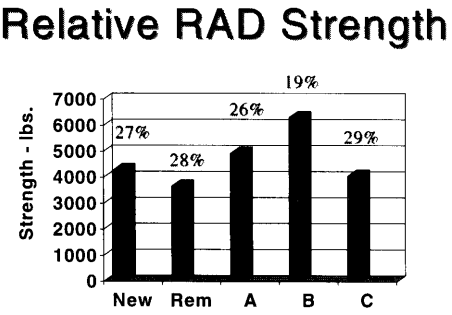

Figure 2. **The relative bending strength of new, remanufactured, and Grade A, B, C repaired, GMA wood pallets spanning the pallet width (percentile represents coefficient of variation).**

greater in the repaired and remanufactured pallets. The variation of deckboard thickness in new pallets reflects differences in target thickness, which in this study included 0.5, 0.625, and 0.688 inches.

Relative Racking Strength

Figures 1 and 2 contain the relative racking strength of new and used GMA pallets when suspended across the stringers (RAS) and across the deckboards (RAD). The numbers above the bars represent the level of variation (coefficient of variation). As expected, strength variation is typically greater for the used pallets. The charts are the lower 5th percentile strength and, therefore, reflect the influence of this variation on performance. The A, B, and C grading procedures appears to segregate pallets well according to RAS strength. The relative RAS strength of new pallets is greater than the used pallets.

However, the RAD strength of the repaired pallet is comparable or better than the corresponding new and remanufactured GMA pallet. This trend follows identically the trend of deckboard thickness in Table 2. The repaired pallets contain thicker deckboards and of these repaired pallets the thickest boards were measured in the Grade B pallets. This may reflect an historic trend of deckboard thickness reduction. That is, thinner deckboards are entering the pool and will be the repair and remanufacturing resource of the future.

Relative Racking Stiffness

The level of deformation of a pallet under load will affect material handling efficiency. Figures 3 and 4 contain the relative i.e. lower 5th percentile stiffness of the new and used GMA pallets spanning the pallet length (RAS) and width (RAD), respectively. The stiffness trends across the pallet width are identical to those observed for pallet strength. The A and B repair grade pallets are stiffer than the new pallets reflecting the thicker deckboards. However, stringer repairs apparently do not significantly restore RAS stiffness. Used stringers sometimes contain unrepaired cracks which significantly compromise racking stiffness in this mode. The percentiles above the bars in each of these figures denotes the level of variation. The variation observed for racking stiffness across pallet length is almost twice that of new pallets. The Grade C repaired pallets retain about one-third the stiffness and one-half the racking strength of a comparable new GMA pallet. However, such repaired pallets can safely support light loads in racks.

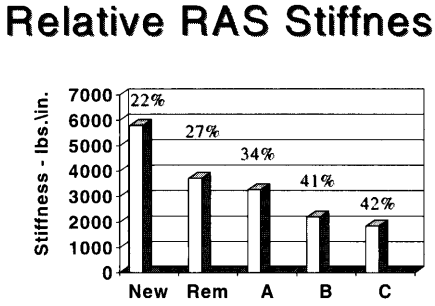

Figure 3. **The relative bending stiffness of new, remanufactured, and Grade A, B, C repaired, GMA wood pallets spanning the pallet length (percentiles represent coefficient of variation).**

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Relative Stacking Strength and Stiffness

The results of the pallet bending tests, spanning pallet width, indicate that the stacking strength and stiffness of remanufactured and repaired GMA pallets will typically be greater than that of comparable new GMA pallets. This is because the average thickness of the deckboards is greater and the span between the stringers is often less in repaired pallets because of companion stringer components.

Relative Durability

The relative durability of the new and used pallets, in terms of handlings survived in the VPI FasTrack rough handling protocol, is found in Figure 5. The average durability of the B and C repaired pallet is significantly less than the new pallet of similar design. The repair grading system tends to segregate pallets according to durability, i.e. the lower grade of repaired pallets are less durable than the higher A Grade pallets.

The lower racked across stringer (RAS) strength of the repaired pallet is attributable primarily to the high level of variation in stringer repair method. The lower durability of the repaired GMA pallets is attributable a large variation in the observed quality of repairing the connections between deckboards and stringers. The performance of repaired and remanufactured pallets is most readily improved by reducing these variations. This can be achieved by standardizing the repair practices and segregating deckboard into thickness groups reflecting a narrow range.

Conclusions

. Pallet repair grades segregate pallets according to strength, stiffness, and durability.

· The performance variation of remanufactured and repaired pallets is greater than that of new pallets.

· Performance variation increases as repair quality decreases.

· The strength and stiffness of used and repaired GMA-style pallets is best improved by reducing the variation in stringer repair techniques and deckboard thickness.

· The durability and functionality of used and repaired pallets is best improved by standardizing fastening practices.

· Greater standardization of repair practices will reduce variation and improve the performance of remanufactured and repaired wood pallets.

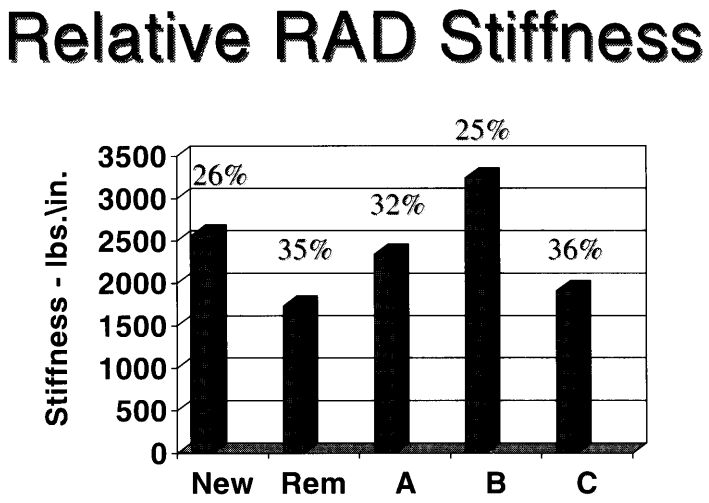

Figure 4. **The relative bending stiffness of new, remanufactured, and Grade A, B, C repaired GMA wood pallets spanning the pallet width (percentiles represent coefficient of variations).**

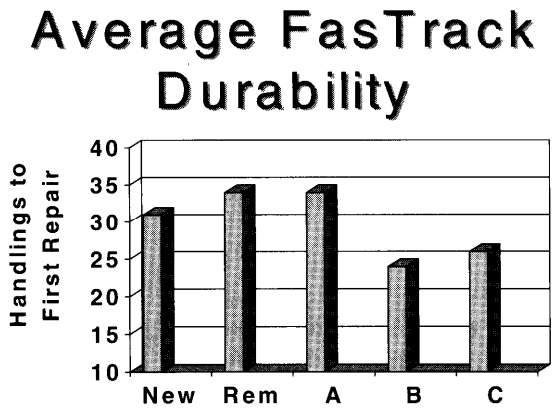

Figure 5. **The relative durability of new, remanufactured, and Grade A, B, C repaired, GMA wood pallets.**