

TEST

12/12/07

**Summary Evaluation of Rumber® vs.
Rough Cut Oak Skids on Reusable Metal Containers**

Purpose: Rumber® a 60/40 percent recycled, rubber/plastic extruded material is used as a wood substitute in different applications, such as decks, trailer floors for live stock, heavy equipment, and other products. A suggestion was made at Corpus Christi Army Depot that Rumber® be used as skids on reusable metal containers. A variety of reusable metal containers were forwarded to LOGSAPSCC for use in testing and evaluating Rumber® as skids.

Objective: Through comparative testing and evaluation, it is to be determined if Rumber® is a viable substitute for oak skids used on reusable metal containers. Since, Rumber® is a wood substitute, a test plan of wood, containers, material, and mechanical handling type tests would be used.

Introduction: Rumber® stock #4126 material was received for testing in 8 - 3½" x 4" x 8' boards and 1 - 2½" x 3¼" x 8', the specimens have a profile of landscaping timber with curved sides. Oak specimens of rough cut, in the green, and cut to the size of finished dimensional lumber 8 - 3½" x 3½" x 8' and 1 - 2½" x 3½" x 8' @ a cost of \$12.00 and \$9.00 per board, were ordered from a local lumber mill.

Observations: The first noticeable difference is that Rumber® is flexible and the boards or planks were arched over the pallet with the ends almost touching the floor. The oak boards were rigid, stiff, cantilevered, and straight off the edge of the pallet. Processing Rumber® with traditional wood cutting equipment is different than processing wood.

The use of black pencil, pen, and markers on wood is traditional, but it is impossible to see on Rumber®. It is suggested that opaque light colored markers, such as white or yellow paint, china markers, and industrial crayons be used for legibility on Rumber®.

Another issue with Rumber® is that the sawdust is hot and heavier than wood sawdust, which resulted in the dust collector not being capable of removing the Rumber® sawdust away. When the sawdust accumulates it solidify's into hard clumps. When using the table saw in ripping the Rumber®, the black dust melted and hardened behind the blade causing the sawdust to clog. Since the table saw did not have an easy access, the dust was removed by breaking up the clumps with a stick and pulling it out by hand.

While performing the kerf cutting test, the blade of the powered circular hand saw overheated and bound up on the 17th kerf cross cut. Overheating could be reduced if the companies recommendation of increasing the tooth offset, and cutting a wider kerf while reducing friction on the side of the blade. This recommendation was not used because testing was directed towards extreme hot and cold in field conditions. It is noteworthy, that sawing Rumber® is 3½ times slower than cutting oak because Rumber® is softer and does not cut clean.

When using Rumber® in attaching skids, the material did not grip the carriage bolts while tightening. In assembling the H-1 Transmission Container, the new carriage bolts would turn and could not be tightened. The carriage bolts were replaced with hex head bolts and a wrench could hold the bolt from turning. However, it was discovered that the hex head of the bolt was able to embed itself into the Rumber® and could be tightened using only one wrench.

Testing: Two reusable metal containers were used in performing the comparison testing of Rumber® skids. The H-1 Transmission Container was filled with blasting grit to give it a gross weight of 3000 lbs. This container was used for the Hot/ Cold, Rotational Corner Drop Test (Append., Photo 1). The AH-1 Main Rotor Hub Container was loaded to a gross weight of 3000 lbs and used in the PUSH/PULL Test (Append., Photo 2 &3).

Results: Test results are shown in the following Results Comparison Table.

	Rumber®	Oak
Tensile Strength, perpendicular to grain, strain ASTM D143	679.73 lbf 333 psi	1992.12 lbf 1064 psi
Water Absorption ASTM D1037	< 1%	10%
Hot/Cold Rotational Corner Drop ASTM D6179, 9.2 Method "B"	Pass/Pass skids absorbed shock & flexed upward while resting on end of skid	wood skid remain stiff and rigid
Push/Pull MIL-STD-648C, 5.9 FED-TEST-STD. - 101C, 5011.1, 6.5, 6.5.1, 6.6	Pass/ Pass GWT/skid = 1500 lbs load on skid = 12.29 psi Avg. Mass Loss = 2.08%	Pass/Pass GWT/skid = 1500 lbs load on skid = 12.39 psi Avg. Mass Loss = 2.25%
Wedge Test 90° wedge on end grain, 3½x3½x6"	fractures @ 7696 lbf deformation = 1.61"	fractures in two @ 22,833 lbf deformation ≤ 1"
Nail Withdrawal End grain Radial surface Tangential surface ASTM D143, 18, six penny, common	Note: Rumber® has no grain 24.86 lbf 34.03 lbf <u>31.31 lbf</u> Avg. 30.06 lbf	109.84 lbf 292.28 lbf <u>247.40 lbf</u> Avg. 216.5 lbf
Kerf Cutting Preconditioned 24 h @160°F, 2" depth, kerf cutting, continuous, cross cuts, with new 28 tooth, combination blade	Result Cut 18, circular hand saw stalls from blade overheating & melting material Time = 362 seconds	Result 18 cuts, without burning wood, no noticeable performance loss Time = 103 seconds
Raw Material Cost/lineal foot 9/07	\$3.50	\$1.50 green, RC

Conclusion: Wood is three times stronger in both tensile (perpendicular to grain) and compression (wedge test), and over seven times stronger in nail holding power. Also, wood is: stiff; rigid; dents; swells; absorbs water; saws well; floats; and is directional with grain. Rumber® is more: soft; flexible; resilient; stable in water; shock absorbent; floats; and is without grain. Rumber® is difficult to saw continuously on wood cutting equipment where heat build up is a problem. There was no difference in cross cut sawing (radial arm saw) and drilling Rumber® as compared to wood. The interior texture of Rumber® is irregular due to the pebble like nature of the rubber and the air bubbles formed during curing. Fragments of metal wire were observed in Rumber® when the cross cut profile was viewed under a microscope. Contrary to the results of the Push/Pull Test, oak is harder than Rumber®. The oak skids were rough to begin with and more mass was lost than Rumber® of which the surface was smooth before testing. However, wear should not be a significant issue under normal conditions. Rumber® passed the Push/Pull test and the Hot/Cold (160°F/0°F) preconditioned Rotational Corner Drop Test.

Recommendations: Rumber® should be considered as an alternative substitute to hardwood skids on reusable metal containers, if costs can be justified. Rumber's® manufacturer claims that it will not; rot, crack, splinter, absorb water, termite and insect proof, and resistant to UV radiation. Rumber® claims a service life of 4-5 years for trailer decking, and exhibits properties common to rubber tires and high density polyethylene. In the extruding process the outer skin of Rumber® is comprised primarily of plastic, and the core is rubber. It is flexible, so its use needs to be limited to supported compression type application, and its shear properties are weak. Skids should not extend beyond the perimeter of the container more than a few inches. Rumber® offers profiles that have square with flat surfaces (stock #4129, actual dimensions 3³/₈ x 5³/₄). It was discussed that dimensional stability with the Rumber® Sales Staff, and stock #4126 could be manufactured within standard dimensional lumber tolerances. Prior to ordering Rumber®, verify that true dimensions can be attained. Rip cutting Rumber® should always be avoided. Some stock reusable metal containers have fittings for skids that require dimensional lumber sizes.

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Appendix

Appendix
Photographs

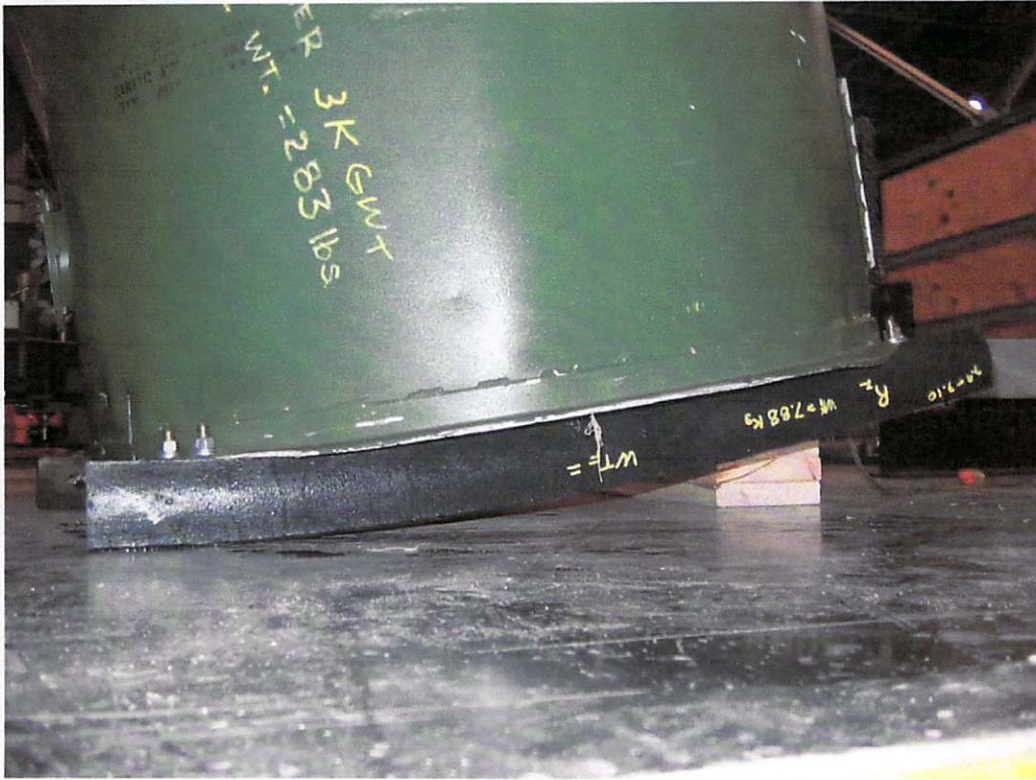


Photo 1. Rumber® Skid Resting on Corner After Cold Rotational Corner Drop

Appendix Photographs (continued)



Photo 2. Push Test on One Skid



Photo 3. Pull Test on Rumber® Skids