

Trailer Decking Technology Study

Trailer Research and Development
Contract No. DAAE07-99-C-S016

November 30, 2000

MTS Technologies, Inc.
2800 Shirlington Road, Suite 1000
Arlington, VA 22206

Contact: Kristine Hutzell
Phone: (814) 262-3734
Email: hutzellk@mtstech.com

Executive Summary

The U. S. Army Tank-automotive & Armaments Command (TACOM) uses Apitong, an Asian tropical hardwood, for semi trailer flooring. However, TACOM has found that this material is becoming expensive and has a long lead-time. In addition, because of the widespread use of tropical hardwoods for trailer decking, various environmental issues pose concern for its future availability; therefore, alternatives to Apitong are sought-after.

MTS Technologies, Inc. was tasked to identify alternatives to Apitong for semi trailer flooring applications. Many feasible Apitong alternatives were identified. After studying the mechanical properties of the identified alternatives and contacting trailer/product manufacturers, it is recommended that the following materials be further considered for testing as alternatives to Apitong:

- >> Rumber
- >> Plastic Lumber
- >> Transdeck
- >> Strongwell SAFPLATE with DURAGRID
- >> PepCore/NoreCore
- >> Covered Deck Recommendations
 - Havco
 - HPA Monon

Table of Contents

EXECUTIVE SUMMARY	i
1.0 INTRODUCTION	1
2.0 OBJECTIVE	1
3.0 TRAILER DECKING BACKGROUND	1
3.2 PROCUREMENT ACTIVITY FORM REQUIREMENTS	3
3.3 TACOM CRITERIA	3
3.4 PREVIOUS TACOM SEMI TRAILER DECKING STUDIES.....	3
3.5 TROPICAL HARDWOOD	3
3.6 HARDWOOD AS A DECKING MATERIAL	7
4.0 EVALUATED TRAILER SYSTEMS AND REQUIREMENTS	10
4.1 M127 SERIES	10
4.2 M128 SERIES	10
4.3 M129 SERIES	10
4.4 M172 SERIES	11
4.5 M870 SERIES	11
4.6 M871 SERIES	11
4.7 M872 SERIES	11
4.8 M989 SERIES	11
5.0 ALTERNATE DECKING PRODUCTS	11
5.1 RUMBER®	12
5.2 PLASTIC LUMBER	14
5.3 TRANSDECK.....	18
5.4 STRONGWELL SAFEPLATE WITH DURAGRID	19
5.5 PEPCORE™/NORCORE®	20
5.6 COVERED TRAILER ALTERNATIVES.....	21
5.7 ALUMINUM	24
6.0 CONCLUSION	25
TABLE 1 SEMI TRAILER DECKING RECOMMENDATIONS MATRIX	27
TABLE 2 – CONTACT LIST	30
APPENDIX A-CID A-A-52520	A-1
APPENDIX B – LIST OF CITATIONS	B-1

Trailer Decking Technology Study

1.0 Introduction

The Intratheater Mobility Systems Management Office (IMSMO) contracted *MTS Technologies, Inc.* to conduct an engineering study of the wood decking used on various semi trailers procured by/manage by TACOM. The purpose of the study was to determine what new or applicable technology is available to replace the current wood decking material utilized. The wood planking on the decks of semi trailers is one of the maintenance cost drivers for fielded trailers and the IMSMO initiated this engineering study to find potential alternate materials to replace the current substance utilized to reduce cost and lead time, and to improve trailer deck life cycles.

2.0 Objective

The project objective was to provide an overall analysis of the trailer decking material currently preferred by the U. S. Army and used on semi trailer systems managed by TACOM and provide recommendations for potential alternatives. In order to provide suitable alternative recommendations, the current material used was evaluated with regard to properties and availability as well as user feedback, from a replacement and maintenance perspective. Previous decking materials studies provided by IMSMO and *MTS* were reviewed to determine the validity and continuing applicability of prior recommendations. *MTS* investigated COTS and GOTS technology utilized in the trucking industry and other materials used within various branches and commands of the DOD. Subject matter experts were utilized in the analysis of various types of natural and artificial materials potentially appropriate as substitutes for the current material. For the purpose of this study, the decking analysis was only conducted on customer recommended trailers with wood decking managed under TACOM. This approach enabled *MTS* to individually review decking requirements, such as various weight constraints and mission requirements, and determine the needs of specific trailers as opposed to all-encompassing recommendations not tailored to specific vehicle requirements.

3.0 Trailer Decking Background

Several factors have affected the selection of trailer decking materials, such as established criteria and military specifications. The following were identified as basic guides to established standards for current decking material selection and purchase. Please note that the current material predominantly used, Apitong, does not meet the military specifications for hardwood.

3.1 Commercial Item Description (CID) A-A 52520

CID A-A-52520 is titled “Hardwood: Floorboards and Platforms: For Military Vehicles (Metric)”¹ and replaced the previous Military Specification MIL-H-3912G, canceled in September of 1995.² The CID in its entirety can be found in Appendix A of this document. The basic requirements of the CID read as follows:

- 3.1.1** Floor boards and platforms shall be fabricated from domestic hardwoods, such a Maple, Red or White Oak, and American White Ash.
- 3.1.2** Species grown in lowlands or swamps are unacceptable.
- 3.1.3** The hardwood must conform to the NHLA Rules for Measurement and Inspection of hardwood and cypress lumber.
- 3.1.4** The hardwood must be air or kiln dried to maximum moisture content of 15 percent or less at the time of treatment.
- 3.1.5** The preservative treatment must be conducted after all cutting, machining or trimming is complete. The hardwood preservative treatment shall be a pressure treatment of light solvent solution of copper naphthenate (to a net minimum retention of .64 kilograms per cubic meter) and comply with AWPA P8. The solution shall contain 1 percent copper but no less than 34 grams of copper per gallon at 16° C. The hardwood treatment must be monitored, tested and checked using procedures outlined in AWPA C2. There are exclusions in the treatment process for certain hardwoods, such as White Oak.
- 3.1.6** Following treatment, wood must be free of tack and ready for painting within 72 hours of drying. The wood surface should be free of oily, waxy or greasy residues. The surface must be compatible with the Chemical Agent Resistant Coatings used within the military.
- 3.1.7** Defects such as knots, end splits, warping, hit-or-miss surfacing and wood destroying organisms must be extremely limited or non-existent, in conformance with A-A 52520.
- 3.1.8** During acquisition, use of any wood species other than those falling under A-A-52520 must be specifically noted on the acquisition document.

3.2 Procurement Activity Form Requirements

3.2.1 Wood must pass the Truck Trailer Manufacturer's Association recommendation practice #67-91 for 12, 000 pound floor rating.

3.2.2 Boards must be square edged.

3.2.3 Minimum board length is 5 feet and width should be between 5 to 8 inches.

3.2.4 Material must conform to A-A 52520.

3.3 TACOM Criteria

Although TACOM did not identify any new criteria in regards to trailer decking, there were specific characteristics identified by TACOM during an analysis on trailer decking conducted by *MTS* in November of 1996. These desired requirements are assumed to remain in effect and were considered during the completion of this study.

3.3.1 Domestic hardwoods are preferred over imported.

3.3.2 Locally procured materials are preferred.

3.3.3 Less expensive material is desired.

3.3.4 Less lead-time in procuring replacement materials is desired.

3.4 Previous TACOM Semi trailer Decking Studies

3.4.1 *MTS Technologies, Inc.* conducted an in-depth analysis of Apitong and hardwood alternatives in November of 1996.³ The analyses and recommendations contained in that report continue to be valid and *MTS* commends the report as a source for hardwood alternatives. Digital or hard copy versions of this report are available upon request.

VSE Corporation conducted an analysis of the M8712 and M872 trailer decking in September of 1995.⁴ This report should also provide a source of information on potential domestic hardwood replacement materials for semi trailer decking.

3.5 Tropical Hardwood

The past few decades have shown a tremendous proliferation of American importation of tropical hardwoods. As the exploration and exploitation of

tropical rain forests has increased since the 1950's, many new types of woods were introduced into the commercial market. The current preferred imported hardwoods utilized by the U. S. Army for semi trailer decking are known within the commercial industry as "Apitong:" and "Purpleheart". Apitong is the most common found within the trucking industry queried. While imported hardwoods do not meet the requirements of A-A-52520, they have been accepted as decking materials for military and commercial semi trailers for many years. The future of tropical hardwood as a commercial material is uncertain. While commercial suppliers of Apitong and Purpleheart generally insist that they are abundant, some suppliers and experts within the EPA and USDA disagree. The harvesting of natural tropical rainforests is under scrutiny on an international and national level. Most tropical hardwood is not "farmable". In other words, it must grow within the natural rainforest environment and individual trees take decades or even hundreds of years to meet harvestable growth. Putting aside the environmental concerns in using protected woods, supply and lead-time are indisputably affected by these factors. Wood preparation also requires lengthy drying processes, which can further delay lead-time, as well as preservative treatments. Identifying alternate materials becomes not only desirable but also necessary from a logistical perspective.

As part of the methodology of this study, subject matter experts were contacted and various discussions included a review of criteria recommended in hardwood and decking material evaluations from a user perspective. The scientific analysis of wood includes a variety of criteria and the analysis of tropical woods presents specific challenges to the scientific community because of the rapid introduction of many species into the U. S. marketplace. Often, the accepted mechanical properties of tropical woods must be derived from international literature and may not be acceptable to regulatory bodies for assigning design properties. The basic criteria utilized by the USDA Forest Service was also used and recommended as the basis of evaluation by many trailer manufacturers. It is important to note that various international testing procedures are used in the evaluation of tropical hardwoods and these tests may vary according to the body conducting the analysis.

3.5.1 Hardwood Suppliers

Discussions with several importers of tropical hardwoods (Angelina Hardwood, Aztec International, YVR Forestry Ltd., Babcock Lumber)⁵ indicated that their perception of the Apitong and Purpleheart markets suggests there is no shortage or long lead-time associated with the procurement of these woods. They contend that although there is a long preparation time involved for processing these woods, a good supplier will stock up on his supply to ensure prompt compliance with the needs of their buyers.

While these points may be true for some suppliers today, the future of imported hardwoods certainly appears uncertain. *MTS* contends that reliance on an uncertain foreign source in a politically unstable environment is not a desired position for the U.S. Army. Alternative recommendations should be tested to determine their applicability for semi trailers. The main points emphasized by these **tropical hardwood suppliers** were:

- 3.5.1.1 Apitong is readily available and continues to be the wood of choice for commercial flatbed manufacturers.
- 3.5.1.2 Lead-time is subjective and dependent upon the supplier.
- 3.5.1.3 No new import issues have been identified regarding Apitong. Normal inventories reflect typical factors that influence lead-time, such as weather, strikes, steam ship schedules, fuel costs and international relations.
- 3.5.1.4 Pricing has not increased substantially over the past several years and the first price increase (7%) since 1997 occurred in October 2000.

For the “small time” buyer, such as individual maintenance shops looking to replace one or two decks, other issues affect the ability to procure these woods. Apparently, providing large buyers, such as semi trailer manufacturing companies, with Apitong is the focus and priority of lumber companies and they ensure these buyers’ needs are met. Smaller purchasers are at the mercy of the local lumber industry to meet their needs. Cost is another fluctuating factor in procuring trailer deck replacement materials. While the Philippines was originally the main source of Apitong for the U.S. while we maintained a strong force there, a lack of consistent reforestry efforts quickly depleted a large portion of their natural hardwoods. Countries such as Malaysia, according to Aztec Industries have much more stringent reforestry procedures and are able to adequately manage their sources of tropical hardwoods used in trailer decking. Aztec International also indicated that the length of maturity needed for harvesting an Apitong tree is much shorter than the lifespan of these trees documented by the DOA. They indicated that it only takes approximately seventy years for these trees to reach harvestable growth. One consistent comment made by decking end users throughout this analysis was that the lead-time for Apitong is lengthy and for some, obtaining it was impossible, so that alternate sources had to be utilized, despite the preference for Apitong.

3.5.2 Apitong Characteristics

Apitong (scientific *Dipterocarpus* spp.) is of the family Dipterocarpaceae and is widely scattered throughout the Indo-Malayan region. Over 70 species make up this group but they are marketed collectively, with the *Dipterocarpus* trade names of Keruing and Apitong. The Malaysian varieties make up a large number of species and contain the most variables when analyzing the wood properties. Apitong trees grow 100 to 200 feet in height with trunk diameters from 3 to 6 feet. General characteristics include a moderately coarse texture, straight grain, low luster and sometimes troublesome resin exudation, especially in high temperatures, which can interfere with machinery and finishes. Apitong rates well, at a 12% moisture content rate (not green), in its bending strength, modulus of elasticity and maximum crushing strength. The wood dries slowly, which influences lead-time, and can have considerable degrade and shrinkage during the drying process. Durability varies according to species and the heartwood is susceptible to termites. Apitong is rated as moderately resistant to preservatives, can cause blunting of cutters and can be difficult to glue. It is generally used commercially for construction, boats, flooring, pallets, veneer and railroad cross-ties, if properly treated. Semi trailer manufacturers often recommend Apitong and it is generally accepted as a decking material. It is unclear why the U. S. Army originally chose Apitong over other comparable imported and domestic hardwoods because it does not meet the military specifications for hardwood decking. Apitong does possess a variety of qualities that prove advantageous for decking and is indisputably the industry's first choice for semi trailer decking.

3.5.3 Purpleheart Characteristics

Purpleheart, (scientific name *Peltogyne* spp.) of the family Leguminosae, has similar properties to Apitong, although it is slightly stronger and heavier. The *Peltogyne* trade names are Purpleheart and Amaranth. Purpleheart grows from Southern Mexico through Central America and into Northern Brazil. Most purpleheart is imported from British Guyana, Brazil, Surinam and Venezuela.

The trees average 90 to 170 feet tall, and logs typically have a diameter between 2 and 4 feet. Commercially harvestable trees are 150 to 300 years old. The grain of the cut wood is typically straight, but may be interlocked. The texture is moderate to fine.

Purpleheart saws, planes and turns well. It glues well, and holds nails and screws satisfactorily. Due to its density, it dulls cutting tools. The heartwood is reported to be extremely resistant to impregnation with preservative oils, but the wood is highly durable in resistance to fungi and termites. It is used for cabinets, furniture, flooring, construction and many specialty items.⁶

Purpleheart has been successfully utilized by several trailer companies and is recommended by them as an alternative to Apitong. It is reported to have little cracking during installation and little warping during storage. However, it should be noted that the cracking that occurs during installation is more than that of Apitong floorboards. To prevent cracking, countersinking installation holes at the ends of each plank is recommended.

For the purpose of this analysis, other imported tropical hardwoods will not be evaluated because they face the same uncertain future in terms of harvesting and replenishable supply as Apitong and Purpleheart. They are also less favorably accepted for the application under study.

3.6 Hardwood as a Decking Material

In order to evaluate potential replacement materials for hardwood decking, understanding the value and characteristics of hardwood as a decking material is necessary. MTS discussed hardwood decking during on site visits to U.S. Army National Guard and Reserve units that utilized the trailers included in this study. Valuable feedback was obtained from organizational maintenance shops and the battalions they service. Various U.S. Army installations were also contacted to discuss maintenance issues regarding trailer decking and their experiences with hardwoods and potential replacements. Issues such as lead-time and supply were also discussed. MTS also analyzed questionnaire data and discussions conducted during inventory visits to U.S. Army bases over the past year.⁷ The information and experiences conveyed by hands on users of the trailers included in this study were remarkably similar in their content and quite valuable in this analysis.

MTS also utilized U.S. Army Technical, Maintenance Manuals and Fielded System Reviews (FSR) for the trailers under review for this study. The FSR conducted for the M872 series in March of 1993 used data collected from January through December of 1989 by the Material Readiness Support Activity (MRSA). The majority of the data collected came directly from M872 operators and maintenance personnel. Decking was noted in this report as a continuing maintenance concern due to the deterioration of the M872 wood board bed. During the hauling of track

and wheeled vehicles, the chock blocks were repeatedly nailed to the bed and these areas in particular showed wood deterioration. The overall issues raised are quite similar to information collected during various conversations with organizational maintenance shops and during completion of the inventory study noted above. TACOM's Directorate of System Engineering was to evaluate a SMART initiative on using treated Southern Yellow Pine for semi trailer decking.⁸ The results of the SMART initiative were not available for review. For the purposes of this study and because of the research conducted, Southern Yellow Pine is not a recommendation for decking. As previously indicated, identification of hardwood alternatives was not the purpose of this report. Some trailer manufacturers and end users did identify Southern Yellow Pine as a possible decking source but indicated that the wood is viewed as inferior to hardwoods such as Apitong or Oak.

The main points of hardwood as a decking material are summarized as follows:

- 3.6.1** The inherent factors that put wood in the forefront of raw materials for a variety of applications remain intact. Its unique characteristics and abundance make it a natural choice for a multitude of uses too numerous to name. Wood has a high ratio of strength to weight with an excellent record of durability and performance as a material. Wood is available in numerous sizes, shapes and species and dry wood is a good insulator against heat, sound and electricity. Many of its characteristics can be enhanced with the use of preservatives, water proofing materials and specialized paints/stains. It works well with tools, adhesives and fasteners. Damage to wood is often repairable and alterations are facilitated by its compliant characteristics.
- 3.6.2** Wood is an excellent decking material for heavy equipment haulers for a variety of reasons. The loading and unloading of heavy equipment necessitates a decking material that is conducive to that process. Wood provides a compliant surface and allows the "wheels" of track and wheeled vehicles to grab the deck and not slide off. Users stressed that any material used for the decking of semi trailers that haul heavy equipment must have that quality of wood. Aluminum or plastic would only work, most believed, if it were not "slippery" and allowed the equipment to grab the surface for loading and unloading. Possible coatings for these substances were discussed, but it was stressed that the weather, sand and other environmental factors quickly disintegrate coatings, paint, etc.
- 3.6.3** Input indicated that non-heavy equipment haulers, such as cargo vans, do not have the requirement of line haul semi trailers to

provide a decking material conducive to the loading/unloading of track and wheeled vehicles. These types of trailers would be good candidates for alternate materials.

- 3.6.4** Wood provides a good working surface for nailing and tie downs. Many contacts indicated that modifications are sometimes necessary with certain trailers to meet mission requirements. Wood provides an excellent surface to work with and modifications are made easier because of its excellent construction properties.
- 3.6.5** Because of its strength and durability, wood provides a strong base for hauling and loading/off loading of cargo. The fewer the knots in individual boards, the less likely distinct stress spots will develop. One of the advantages of tropical hardwoods like Apitong is that it has fewer knots and imperfections than many other decking hardwoods.
- 3.6.6** Wood, through its own natural properties, is susceptible to decomposition. Any wood is going to rot, bend and break under the weight of heavy equipment and cargo. In addition, when wood is continually exposed to wet, cold and hot weather, decomposition can be expected to accelerate. Coatings and preservatives only work for a short time; eventually, all wood decks will rot when they are not stored inside. The most prevalent and consistent comment made by maintenance technicians and users queried is that the unprotected storage of trailers is the number one cause of the wood rot and decay. Combine this with the years of unsheltered storage, lack of weather proofing efforts and continual nailing, and no natural wood will hold up. The location of the units storing/using the trailers will also influence the effect of the elements on the wood. Units located in areas known for the harshness of sea air, high humidity, snow, sleet, rain, pollution or excessive heat will definitely see faster deterioration of the decks. Weather proofing measures conducted as a preventive measure throughout the life of a deck should extend its usable lifespan. Simply coating and painting new decks and allowing them to then sit for years in unsheltered areas without preventive maintenance checks and reconditioning will lead to shortened deck life. The costs incurred in refurbishing decks and replacing boards with properly weatherized replacements should be compensated through longer deck life and fewer maintenance costs.
- 3.6.7** Most agreed field evaluations would be necessary to test any potential wood replacement materials. Chief Warrant Officer Johnston of OMS #21, 876th Engineering Battalion expressed the

willingness to test various materials as potential wood deck replacement boards on trailers at his facility. Several vendors also indicated a willingness to participate in testing to determine the needs of and response to alternate decking materials.

4.0 Evaluated Trailer Systems and Requirements

The following trailers managed under TACOM were evaluated in regards to the decking currently utilized as well as the established criteria for individual systems. Decking recommendations shall focus on the following trailer systems; however, the results of this analysis can be extrapolated to include other trailer systems with similar wood decking concerns. Obviously, the mission requirements and hauling criteria affect the decking needs of a semi trailer. The conditions noted by various military personnel regarding the loading/unloading of heavy construction equipment and vehicles onto semi trailers would necessitate that those trailers utilize a “gripping” substance, as noted in Section 3.6.2. The use of forklifts to load/unload specific trailers also influences the material employed. Due to these factors, the potential decking products available in the commercial market offered different opportunities for semi trailers with distinctive requirements.

4.1 M127 Series

The M127 series consists of stake semi trailers that haul up to twelve tons of cargo. Discussions with military personnel indicate that these semi trailers transport a variety of supplies/equipment but not heavy equipment/vehicles. The weight requirements for the M127 decking allows for potential use of a variety of decking materials.

4.2 M128 Series

The M128 series consists of cargo van semi trailers that haul up to twelve tons of cargo. The decking of the M128 is enclosed. This fact combined with the limited weight requirements (in comparison with larger semi trailers) make the M128 an excellent candidate for testing of a variety of replacement decking materials.

4.3 M129 Series

The M129 series consists of semi trailer supply vans with enclosed decks that haul up to twelve tons of military supplies and maintenance tools/parts. This series is an excellent candidate for testing of a variety of replacement decking materials.

4.4 M172 Series

The M172 series consists of lowbed semi trailers that can haul up to twenty-five tons. The weight requirement of this semi trailer limits the potential decking requirements as compared to the less prohibitive requirements of the semi trailers discussed above. The M172 series shows potential for testing of a variety of products for use on exposed decks with higher weight requirements.

4.5 M870 Series

The M870 series consists of low bed semi trailers that haul heavy constructions equipment up to forty tons. This series provides the highest weight requirement for decking. As with the M172, the exposed deck and high end weight requirement make the M870 series a good candidate for products used on exposed semi trailers only.

4.6 M871 Series

The M871 series consists of platform semi trailers that haul up to 22½ tons of containerized and bulk cargo. Again, the weight requirements necessitate use of particularly strong and durable decking materials that will resist decomposition due to the weather, environment, etc.

4.7 M872 Series

The M872 series consists of flatbed semi trailers that haul up to 34 tons of containerized and bulk cargo. As with the other 800 series trailers, replacement decking must meet the stringent requirements of these semi trailers.

4.8 M989 Series

The M989 series is a HEMAT (Heavy Expanded Mobility Ammunition Trailer) that hauls up to eleven tons of cargo. The original M989 is quite different from the M989A1. All discussions with military personnel regarding this vehicle applied to the M989A1 version. Because of the less stringent weight requirements, this series is a good candidate for a variety of recommendations.

5.0 Alternate Decking Products

Alternative materials for natural hardwood are rapidly becoming commonplace in the current construction and manufacturing industries. There is an abundance of engineered woods, plastic lumbers and composites available for a variety of applications including structural construction, home decking, ship decking,

bridges and even semi trailers. *MTS* examined numerous materials to determine the best potential replacements for the hardwoods used on U.S. Army trailers. Many products recommended in place of natural wood have not been used for tested on actual trailer decks but this fact does not preclude their use. The industry surrounding semi trailers is not quick to change and many factors must be considered in this evaluation, such as the “tried and true” philosophy towards Apitong, established relationships with existing lumber suppliers, the excellent properties of tropical hardwoods, a lack of testing regarding alternate materials and comparable costs of alternatives and hardwoods. The long term cost benefits of utilizing materials that last much longer than wood are often not considered in the decking decision within the commercial market. The number one benefit of plastic lumbers and composites is their ability to resist the elements, insects, moisture and decay while maintaining excellent strength and durability. Another advantage is the ability for “engineered” products to be customized to specific applications. Unlike wood, these lumbers can be manufactured, cut, colored and reinforced specifically for particular applications. Many of the military installations contacted expressed an eagerness to try alternative products on the market today. Trailer manufacturers contacted also indicated a desire to try substitutes to hardwood. Many manufacturers stated that their customers usually determine the flooring used; again Apitong has been used for many years and remains the first choice of available hardwoods. The industry reflects this predisposition and manufacturers are resistant to change because their customers are resistant to change. However, during completion of this project, several manufacturers requested the results of this survey be conveyed because of their willingness to also find an Apitong substitute.

Contact information for the sources utilized during product research is included in *Table 2*. Product specifications and samples are also included, as available, under separate cover (*Appendix C, Product Literature and Appendix D, Product Samples*). Please note that the end users surveyed, various maintenance managers, equipment supervisors, etc., do not represent scientific evaluations or organizational product endorsements. Each end user relayed their personal and professional opinion of the product in question but these estimations should not be construed as recommended representing the organizations where they are employed.

5.1 Rumber®

Rumber® is a blend of recycled tires and plastics in a patented process that creates a strong, durable, environmentally friendly material. Rumber boards’ features include rot resistant, impervious to water, durability, ease to nail/screw, traction surface, easy to clean and a limited manufacturers warranty. The boards will not crack or splinter, are insect proof, unaffected by UV, impervious to salt water, are tough and never need sealants. Rumber also resists industrial spills, such as oil, diesel fuel and

® Rumber is registered to Rumber Materials, Inc.
Trailer Decking Technology Study

grease. The recommended service temperature range is -40° to 130° F and the natural carbon black ratio is such that flame-retardants are unnecessary.⁹ The Rumber Equipment Trailer flooring recommendations for vehicles over 40,000 GVW include installing 9” centers with 3 x 3/8 inch angle iron supports.

Rumber is currently used by the Texas, Oklahoma and Colorado Departments of Transportation as well as within the Alabama National Guard. End user feedback indicates that the product is very well received.¹⁰ The end users surveyed indicated that the initial use of Rumber did cause adjustments for the maintenance staff but it was well worth these adjustments in the end. The weight savings incurred by the use of Rumber as opposed to Apitong is offset by the requirement of additional reinforced cross members but the longevity of the material makes it practical. If used the right way, the benefits Rumber provides, according to the end-users surveyed, far outweigh the adjustments necessitated during initial utilizations.¹¹ The state of Texas encourages the use of recycled products and some DOT districts have been using it for about eight years. Bob Barker, district Equipment Manager for the Texas DOT, indicated that initial implementation had its problems, such as a somewhat slick surface and the support modifications previously noted. However, Rumber did make modifications to ensure better grip on newer products not yet extensively fielded by the DOT. Mr. Barker said the initial decision to use Rumber was impacted by the long lead-time for Apitong and the environmental concerns of using tropical rainforest hardwoods. Their only warranty experience consisted of a minor problem when two orders contained some damaged pieces upon delivery, but Rumber Materials Inc. replaced the pieces immediately. Although they had never had another need to call upon their warranty agreement, he is confident the company will stand behind their product. The contacts also indicated that they believe the product will outlast the warranty.

The Texas Department of Criminal Justice manufactures trailer for their state DOT. They use Rumber for these trailers and feedback mirrors that of the DOT. If used correctly and properly reinforced, they believe it is superior to the natural hardwoods used before its inception.¹²

One important point made by these end users was that the ramps used to load vehicles are still made of Apitong. They continue to use the hardwood material for the ramps to ensure excellent grip when loading/off loading vehicles. Rumber is currently developing a new product for specific use on ramps to improve traction and durability.

Some other customers using Rumber for semi trailer/trailer decking include the Washington State DOT, Boeing Aircraft in Wichita, Kansas and Seattle, Washington, and Atoka Trailers in Atoka, Oklahoma. Boeing

indicated a serious splintering problem with the Apitong in the trailers subjected to forklift operation. Employee injuries were occurring on these trailers so they switched to Rumber Decking. Seattle Boeing is currently in process of switching their semi trailers to Rumber.¹³

Atoka Trailers is currently involved with Rumber Materials in the development of a prototype trailer using Rumber with a unique center support structure that uses 16 inch centers supported every eight inches with a welded “T”. This configuration is being researched and developed to continue to decrease the weight of decking in their oil field equipment hauling semi trailers. Atoka already uses Rumber with the nine-inch supports but is participating in this effort to further the advantages of the Rumber material. Commercial trucking companies are continually attempting to reduce the weight of their trailers to increase their cargo carrying capability. Because Rumber requires nine-inch centers, this can add to the weight of the trailer. As discussed, Rumber weighs less than Apitong so this extra support weight is offset. However, for decks replacing Oak with Rumber, Oak weighs slightly less than Rumber so the additional supports can add some weight. If the R&D is successful for this prototype trailer, Rumber will offer even further potential to semi trailer manufacturers. Other products that offer potential benefits to semi trailer users/manufacturers are Rumber kickboards for van trailers to prevent forklift damage and Rumber trailer bumpers to protect lights, etc. When semi trailers pull up to docks. Rumber bumpers will not crush upon impact and have predrilled holes, to customer’s specifications, for faster installation. Both products are currently being utilized within the semi trailer industry.

Overall, based upon product research and end user feedback, Rumber is an excellent alternative to hardwood, and with proper use and knowledge, provides an excellent opportunity for testing on Army semi trailers.

5.2 Plastic Lumber

Plastic lumber, boards fabricated from recycled plastic, shows excellent potential as an alternative to hardwood. In general, plastic lumber has a higher quality than wood because it lacks knots (and other defects), warps or bows, and possesses the ability to custom design for specific applications. Plastic lumber is a non-toxic alternative to chemically treated and painted wood. Additives are incorporated into polymers to alter and improve their basic mechanical, physical or chemical properties. Plastic lumber also provides a good service temperature range, generally from -20° to 120° F. Additives are also used to protect the polymer from light, heat and bacteria, to change color, or to improve surface appearance exposed to the surface. When colors are added, the product will not fade

in outside applications. Because of the uniqueness of plastic lumber, the protective characteristics are throughout the lumber, unlike wood, which must be surface treated/painted regularly to maintain surface resistance.

Plastic wood can be nailed, drilled, screwed or cut using the same methods as conventional wood. However, as with wood, removal of nails or screws will leave a hole in the substance. Wood holes can be filled with “wood glues” but these glues will not adhere to plastic lumber. Nevertheless, shavings can be placed in the hole and soldered to bond the hole. There are also methods available to determine the surface (smooth, rough, ribbed) needed for specific applications and virtually any color can be produced.

Plastic lumber manufacturers and distributors often have an engineering staff devoted to development of specific configurations for different applications. This diversity can provide a tremendous advantage in the design of semi trailers. Anthony Caulfield or Caulfield Associates, for example, is the engineer active in the plastic lumber business for many years. His knowledge of the advantages and disadvantages of plastic lumber was extensive and the most important point he made was that optimal performance could be obtained with plastic lumber with a knowledgeable company/engineers, proper support of the deck, use of recycled products and a deck configuration designed for specific needs of specific trailers.¹⁴ Discussions with various engineers at different companies supported Mr. Caulfield’s contentions and the promise of plastic lumber for trailer decking is excellent. It costs less and last longer than wood, with warranties available from a selection of vendors.

5.2.1 ReNEW Plastics™ Perma-Poly™ Lumber

Perma-Poly Decking Lumber is a solid recycled product made of plastic recycled materials. ReNEW Plastics was the first manufacturer to produce plastic lumber and possesses abundant knowledge regarding plastic lumber use and applicability. Perma-Poly requires no painting or sealing, is UV resistant, can be made with an anti-skid finish, has a life expectancy of over eighty years (Ohio Department of Natural Resources) and has a weight comparable to Oak.¹⁵ The recommended service temperature range is -40° to 110° F. Perma-Poly can be nailed and cut like wood, will not chip or crack and is used in numerous applications. Boards can be customized into a variety of shapes, colors and sizes, and is impervious to water and corrosion. Common applications include pier decking, dump truck lining, agricultural machinery floors and sides, construction vehicles, building

TM Renew Plastics is a division of N.E.W Plastics Corp.

TM Perma-Poly is a registered trademark of N.E.W. Plastics Corp.

construction and “clean rooms” where sanitary conditions, decreased bacteria build up and easy clean up are imperative.¹⁶

Mid-State Tank in Sullivan, Illinois experienced problems with the hardwood used in their tank trucks as a buffer between the tanks and truck chassis. According to Mid-State, the wood did not last despite numerous attempts to weatherize and protect it. They switched to Perma-Poly plastic lumber and are very satisfied with the results. An added benefit has been the color matches the truck chassis without the trouble of ever painting it again. Other tanker end users include Eastern Tank (Patterson, NJ), LT&E Inc. (Arcola, IL) and Garsite LLC.¹⁷

ReNEW participated in an Ohio Department of Natural Resources (ODNR) project comparing various plastic lumber products used on a walkway on Kelleys Island on Lake Erie. The ODNR Project Coordinator noted that the ReNEW products were the best quality overall.¹⁸ ReNEW Plastics possesses the experience and technical expertise to develop the appropriate decking lumber for semi trailers. The customization features of plastic lumber allow much more flexibility than wood for developing specific products and utilizing an experienced company such as ReNEW is advisable.

5.2.2 Black Rhino TriMax™ Structural Plastic Lumber

TriMax Structural Lumber is a construction material made from recycled plastic and reinforced with fiberglass. It is suited for outdoor structural applications that require superior strength and durability. TriMax products are manufactured in dimensional lumber and timber sizes, particularly in large cross sections, in almost any transportable length. TriMax resists insects, will not rot or splinter, is impervious to petroleum, possesses excellent strength and high impact resistance, is moisture resistant, contains no contaminants, never needs painted or treated and is an environmentally sound choice because it is recyclable. TriMax products come with a limited fifty-year warranty not to rot, split, crack or splinter.

The U.S. Air Force has conducted testing of TriMax and is currently using it on some of their trailers. The U.S.A.F. MEEP Project (Management & Equipment Evaluation Program) conducted specific testing on TriMax from March until September of 1997. The lumber was installed on a 1 ½ ton S-1600 international flat bed truck. The vehicle transported a variety of

TM TriMax is a registered trademark with U.S. Plastic Lumber
Trailer Decking Technology Study

Materials/supplies such as drums of oil and anti-freeze, palletized cargo, skid mounted equipment and construction supplies. Results indicated that TriMax was much easier to work with than wood, quite reliable and durable, required no painting or preservatives, and did not chip or splint. Therefore, the U.S.A.F. recommended TriMax use on “non-nuclear certified vehicles”, understanding the structural limitations of this material in its operational environment.

Nellis Air Force Base, located in Nevada, is using TriMax on some of their trailers. They only recently started using plastic lumber within the last few years and indicated that TriMax shows excellent potential for use as a hardwood alternative. The only drawback to date has been some concern over the “slickness” of plastic lumber, which is a noted concern for many decking materials. Use of rubber, rather than leather, soled shoes is certainly recommended for use on the trailer decks with plastic lumber. TriMax can be purchased through distributors such as Black Rhino Recycling and detailed recommendations for specific applications can be developed as well.

5.2.3 Outwater Plaster Lumber

Outwater Plastic Lumber consists of 100% recycled plastics with fiberglass reinforcement for structural applications. As with most plastic lumber, different formulas are available for different applications. The specific lumber that has the most potential as a decking source is Phoenix™ Plastic Lumber, available as a structural fiberglass plastic lumber. The technical properties of this plastic lumber, as with most used in place of natural wood, are comparable or superior to other woods used as decking materials. Outwater is maintenance and paint free, permanently colored, guaranteed not to rot or warp, impervious to water and insects, customizable, UV resistant and specially textured for non slip surface. The service temperature range is -20° to 120° F. Plastic lumber will expand/contract 1/8” over a fifty-degree temperature change. Plastic lumber holds nails 90% and screws 50% better than wood and can be cut, nailed, screwed and drilled with standard woodworking tools.¹⁹

While Outwater/Phoenix Plastic Lumber has not been utilized as a semi trailer decking material, it shows promise for the application. Testing of the material, as with all recommendations, on semi trailers in the field would produce definitive results as to its use as a substitute for Apitong.

5.2.4 Everlast Plastic Lumber

Everlast Plastic Lumber (EPL) is a structural grade lumber made from 100% recycled plastic. As with other plastic lumbers, EPL is used for home decking, docks, fencing, walkways, lawn furniture, piers, etc. EPL exhibits the same durable, resistant features as the other highlighted plastic lumbers. Specific testing was conducted on EPL through Lehigh University in 1997.²⁰ EPL fared very well in these tests, the results of which are included with the various company literature included with this report. As with the other plastic lumbers discussed, EPL should be evaluated in a field environment to determine its potential for use as a semi trailer decking source.

5.2.5 Bedford Plastic Timbers®

Bedford Plastic Timbers is another plastic lumber well used in the construction industry. Made of recycled plastic, Bedford is a maintenance free, long lasting, highly durable, environmentally friendly, splinter free, oil resistant, UV protected product. Again, as with most of the plastic lumber products, their main use as a decking material is limited to marine and construction applications. This does not preclude its use as an alternative to hardwood but does necessitate specific testing to determine strength and surface traction. As with the other plastic lumbers, extra trailer supports are indicated that might equal the weight savings incurred. However, the long lasting durability and maintenance free characteristics of these products ensure long term cost savings and benefits.

5.3 Transdeck®

Transdeck Trailer Flooring is a wood-based laminated panel product made from premium-quality Douglas fir veneers bonded with waterproof phenolic adhesive and protected by moisture barrier coatings. Transdeck is specifically designed for use as a semi trailer flooring with layers oriented to deliver maximum strength when the panels are installed perpendicular to cross member supports. Transdeck is manufactured by Ainsworth™ Lumber Co., Ltd in Canada as *Ainsworth Engineered Transdeck* and distributed by Argonne Distributing, Inc. The major advantages to Transdeck over hardwood include lighter weight, increased trailer rigidity, excellent prevention of moisture absorption and retention, impact/abrasion resistance, non-slip properties, easy installation with

[®] Bedford Plastic Timbers is registered to Bedford Technology, Inc.

[®] Transdeck is registered to Ainsworth Lumber Co., Ltd.

[™] Ainsworth is a trademark of Ainsworth Lumber Co., Ltd.

fewer screws, prolonged service life and resistance to oil and chemical damage. Transdeck has many of the attributes of hardwood, such as ease in nailing, screwing, etc.

Transdeck was recommended by several trailer manufacturers. The only major negative to Transdeck mentioned by end-users is that forklift loading appears to be harder on the materials than Apitong although Ainsworth claims damage only occurs if users work with a load above the rated maximum. Transdeck is guaranteed for five years as a semi trailer material, which seems to be the norm for various replacement materials.

Because Transdeck is designed specifically for semi trailers, testing has been conducted. These test results are contained in the product literature accompanying this report.

5.4 Strongwell SAFEPLATE[®] with DURAGRID[®]

SAFEPLATE fiberglass gritted plate consists of a combination of pultruded fiberglass plate and an anti-skid grit surface. Fiberglass reinforced pultruded materials have begun to replace many conventional construction materials. When used as grating, it offers the highest strength unit to weight ratio than steel, aluminum, wood and other plastics. Fiberglass reinforced pultruded grating is not only engineered for strength, but is resistant to many corrosive products. Pultruded grating is also repairable, which offers another advantage over standard materials. Generally, a multi-purpose polyester resin is needed to repair any damage. SAFEPLATE is a textured solid sheet flooring that is used in wet and dry applications. The main features of SAFEPLATE that indicated potential for use as a trailer decking material is high strength, skid resistance, lightweight, impact and corrosion resistance, cost effective and easy to install with a variety of colors/finishes.

DURAGRID is the custom fiberglass and grating also manufactured by Strongwell Corporation. Again, fiberglass grids are corrosion resistant, strong, lightweight, high impact, produce minimal waste and made to specifications. Current applications include industrial, marine, transportation, recreational, agricultural and chemical plants.

Mullen Equipment Corporation, a Strongwell manufacturing representative, recommends DURAGRID with a layer of SAFEPLATE for use as semi trailer decking. As previously indicated, there is a variety of applications for which plastic or plastic/fiberglass provides an excellent alternative to hardwood. Specific product configurations could be developed at an engineering level for specific load/fit requirements of

[®] SAFPLATE is registered to Strongwell Corporation

[®] DURAGRID is registered to Strongwell Corporation

semi trailers. The SAFPLATE and DURAGRID configuration does not possess a surface conducive to nailing or screwing. A hole would have to be drilled first, then the nail driven into that hole. The same requirement holds for screws or any hole needed. Strongwell did indicate that their product could be prefabricated with holes but this seriously detracts from its applicability as a decking material. Strongwell manufacturing would recommend detailed products for the specific needs of individual trailers, as requested. Some definite advantages to a DURAGRID/SAFPLATE combination are its strength, durability and non-skid surface.

5.5 PepCore™/NorCore®

PepCore is the thermoplastic product originally known as NorCore Plastic Honeycomb. PepCore/NorCore is a structural core material made from a variety of different engineered thermoplastic sheets including polycarbonate, the best recommendation for trailer decking. PepCore has been used for a variety of applications including transportation, construction, architectural and industrial. The lightweight, flexural rigidity, dimensional stability and moisture resistant qualities make it a desirable material. A cross section of PepCore shows a three dimensional array of trusses or diagonal interconnected supports. This design feature is found within nature for lightweight but strong functions, such as a bird's wings. By laminating facing material onto the core, PepCore provides a strong, durable core while the facing provides its own unique characteristics, dependent upon the application and facing selection. The facing materials successfully utilized include steel, aluminum, fiberboard, plywood, veneer, plastic, glass, cement, PVC, vinyl and high-pressure laminates. PepCore has been successfully used as an interior for panels and floors for a variety of transportation applications, such as emergency vehicles.

The most attractive feature of PepCore is its strength to weight ratio. This strength is increased through the addition of face material laminated to it. A four by eight foot panel of one inch PepCore weighs only 25 pounds, compared to a particleboard sheet of similar size, which weighs 125 pounds. PepCore can be cut, drilled and machined with common woodworking tools. PepCore is lightweight, strong, dimensionally stable, and resistant to warping, deflection, fire, moisture, impact and chemicals.

Phelps Engineered Plastics, Inc. recommends several product combinations that may be suited for trailer flooring applications. Facesheets may be fabricated of steel, aluminum or fiber-reinforced plastic (FRP). Specific mechanical properties are highly dependent on the final system. Phelps has supplied PepCore to many transportation customers

that have used the materials for flooring, doors, roofs and walls. There is a variety of facing material with potential for semi trailer flooring. One detriment to PepCore is that the honeycomb structure under the facing is not conducive to nailing/screwing. Phelps engineer Gabe Karamanis discussed the “nailability” of their product and offered several solutions. The PepCore flooring could be manufactured with pre-designed areas for nailing; the specifications would be dependent upon the system under development. The PepCore could also be easily cut with basic woodworking tools and any section could be removed where a nailable material, such as a chock block, could be inserted and affixed with a contact adhesive. Another alternative would be to simply fill the NorCor with a filler, such as EVA Hotmelt, during manufacture or even when fielded, which would allow the material to be nailed/screwed normally.²¹ Most facing materials would not be recommended for exterior applications unless they showed excellent promise overall for resistance to the elements and vehicle/cargo loading. However, as with most plastic suppliers noted, Phelps suggests specific recommendations could be made for facing materials dependent upon the specific needs of individual trailer systems.

5.6 Covered Trailer Alternatives

5.6.1 Havco™

Alternate hardwood was not considered for evaluation in this study because Apitong is undeniably the best hardwood for decking purposes. However, covered semi trailers provide a unique opportunity to utilize alternate materials, such as Havco laminated hardwood flooring. Laminated hardwood has significantly more consistent strength properties than standard oak, for example. The fiberglass reinforcement at the underside of the composite floor has the ability to even out the strength variations of wood. A semi trailer manufacturer originally recommended Havco. As research continued, several users of Havco flooring were contacted and gave excellent recommendations for its use in their covered semitrailers.²² Trailmobile Trailers Southwest Region VP indicated that the evaluations for any new product used within their corporation undergoes quite stringent testing and that many products fail. Although Havco is too new of a product to their company to provide a field evaluation, they did indicate that it passed all the necessary testing requirements and was ordered in 500 trailers either currently being built or recently delivered.²³ This would not be the case unless they believed quite strongly that it would meet their expectations.

Havco is conventional laminated oak boards bonded to Fiber Reinforced Plastic (FRP) that provides high strength fibers that run in both directions. This bonding process provides a 50% strength increase over conventional oak flooring. Havco reduces floor weight up to 325 pounds for a 53-foot trailer, which translates to a cost savings for cargo hauling. The continuous glue bond between the oak and FRP provides exceptional protection of the complete underside surface from road and weather debris. End-users also indicated satisfaction with the company that provides Havco, Havco Wood Products, Inc.

The properties that make Havco an excellent recommendation are the weight savings, superior waterproofing, strength, durability, rigid testing requirements and end-user recommendations.

5.6.2 HPA Monon

HPA Monon is the laminated oak flooring produced by HPA Monon Construction, a manufacturer of dry freight vans, container chassis and domestic containers. HPA Monon manufactures 100% of their laminated hardwood flooring and until recently, did not offer their Monon flooring outside of their purchased trailers. However, the company is now developing their flooring for purchase separate from a trailer system.

HPA Monon installs their floors directly onto floor cross members with a flat top surface with both sides of the boards planed smooth. A high melamine content glue laminates the boards, which are then sealed top and bottom. Each board is pre-undercoated with a premium waterborne acrylic emulsion for 100% coverage and adhesion. The also caulk full length between boards to prevent moisture penetration from beneath the floor. The main consideration in the design of Monon flooring is to prevent moisture from penetrating the cargo space and coatings are applied to the steel cross members for corrosion prevention. HPA Monon also offers the industry's only five year, non-pro rated floor warranty.²⁴ Maintenance Manger Ernest Williams, of Roehl Transport, has 27 years experience with Roehl and recommends HPA Monon and Havco as high quality flooring products for interior trailers. Mr. Williams also recommended the HPA Monon trailers as “the best dry freight trailer on the market.”²⁵

5.6.3 Composite Lumber/Engineered Wood

Composite lumber/engineered wood is an approved replacement for natural domestic and tropical hardwoods in structural construction. Composite lumber is formed by combining polymer

plastic with reclaimed waste wood to give the lumber added strength, durability and slip resistance. It resists insects, fungus, splitting, cracking, warping and exposure to outside elements. The lumber can be nailed, drilled and cut like wood. Composite wood was also recommended as a possible decking source by the Canadian Wood Council (CWC).²⁶ The type of base wood used (i.e. Douglas Fir, Southern Yellow Pine, Western Red Cedar) determines the specific woods best suited for specific uses. There is no doubt that these materials are excellent alternatives to natural lumber and provide significant advantages. The ecological advantages alone make it a viable product. The concern with these types of woods is their lack of use in semi trailer flooring. Most of these products carry an excellent warranty but vendors are most forthright in stating they may not uphold warranties for use in semi trailer decking because it simply has not been significantly used in this application. While these products are superior to wood, they still possess some of the inherent disadvantages of wood, particularly when exposed to the elements. Some of these products are easily treated and quite conducive to that process but they still possess some of the qualities of wood that allows the surface to be “chewed” by loading equipment and vehicles. There is research and development of engineered woods being conducted to provide a glulam or LVL with an overlay of fiberglass for protective purposes. A review of the potential products was conducted and the following products provide potential for use in covered semi trailers. However, the previous covered deck recommendations (Havco, HPA Monon) remain the first choice for covered semi trailer decks and additional testing of engineered lumbers is only recommended as a last alternative.

5.6.3.1 Glulam (glued-laminated timber)

Glulam is wood laminations bonded together with adhesives. Typical lams are 1 3/8 inches thick for southern pine and 1 1/2 inches for western species. Custom specifications, very common with these various materials, can be produced. Glulam has excellent strength and stiffness and pound for pound, it is stronger than steel.²⁷ The use of water resistant phenol-resorcinol adhesives, if properly pressure-preservative treated, allows use of glulam in exposed exterior environment for construction purposes without glue line degradation. Because glulam is manufactured from kiln-dried lumber, shrinkage and warping are minimal. However, as with all natural wood products, moisture is a concern and proper sealants must be applied for specific applications. The majority of applications using glulam are interior. Again, this characteristic indicates glulam would only be suited for covered

Floor applications that do not necessitate vehicle loading in semitrailers.²⁸

5.6.3.2 Veneer Lumber (LVL) Laminated

LVL is a layered composite of wood veneers and adhesive. Once fabricated into billet of various thickness and widths, it can be cut at the factory into stock for headers and beams, flanges for prefabricated wood I-joists and floor beams. The most common applications for LVL are roofs and interior floors. LVL lumber is stronger and straighter than solid sawn lumber and natural defects and concentrated weak areas are virtually eliminated.²⁹ Again, these types of engineered woods are quite open to specific engineering designs for specific applications. A Greenwood Forest Products Wood Scientist discussed the options of using LVL, with a fiberglass overlay, for wood decking and he indicated there is great potential in this area.³⁰ Greenwood specialized in product development for specific customer performance criteria. They believe the base decking products they currently produce could be modified to create an excellent trailer decking product. They produce bus flooring, mezzanine decking and recreational vehicle flooring. Development of an LVL for semi trailer decking is underway. Contact information is included for post development follow-up. Currently, Greenwood provides LVL lumber to a number of boat manufacturers for use as boat panels used throughout the construction of vessels. These panels do carry lifetime warranties.

5.6.3.3 Microlam, Paralam

Microlams and paralams are another example of the engineered woods on the market today. As with all engineered woods, these benefits and detriments remain the same. Recommendations agree that there is a variety of excellent products on the market but none used as semi trailer decking materials. Due to the superior performance of and recommendations for the Havco and HPA Monon flooring as well the recommendations for open decks, engineered wood shows the least potential as a decking source.

5.7 Aluminum

The only common metal semi trailer flooring identified was aluminum. Steel flooring is considered too heavy unless specifically mandated. The use of aluminum has expanded in recent years with demands from the automotive and construction industry for materials that are lighter yet durable and corrosion resistant. In similar applications aluminum can out

perform steel, however, the cost for the product per pound is twice that of steel. Aluminum is used on truck trailers when the overall weight of the vehicle must be kept to a minimum while maintaining structural integrity. Aluminum deck flooring can be found on trailers needing side access for loading and unloading. The product can be easily recycled in its entirety so the price for salvage is high.

Cost is not the only issue in producing and delivering aluminum; it is a very sensitive metal. It cannot be formed in the same way as steel. There cannot be any sharp flanges or edges when stamping or it will split and any contaminants in the casting will leave small impressions. Because aluminum has a higher springback than steel, this must be compensated in die development. Aluminum is harder to weld than steel so repairing damage to components is more difficult. It conducts heat so well that higher weld point temperatures are needed. It must be heated close to molten temperatures in order to achieve a strong weld. Even after the weld is completed, aluminum contracts and expands to its surroundings, leading to micro cracks and ultimately weld fatigue. A more expensive, new method combines welding with adhesive bonding.³¹

Although some commercial trailer companies install aluminum flooring, most surveyed indicated it is not a recommended alternative to Apitong except for specific purposes. Aluminum flooring can react when it contacts the steel frame of the trailer, causing galvanic corrosion. The most common way to eliminate galvanic corrosion is to insulate the materials. Aluminum flooring also can be expensive, break when overloaded and often shows metal fatigue within two years.³² Aluminum appeared to be a very subjective alternative, with only one trailer manufacturer recommending it while others advised avoiding widespread use. Certainly, there is a variety of configurations available and often Apitong or other hardwoods are laid within the aluminum as nailing strips or to provide extra gripping characteristics. Specific manufacturers configure their aluminum decks for their needs and aluminum would only be recommended for specific semi trailers, perhaps in an aluminum and wood configuration.

6.0 Conclusion

In conclusion, alternate decking material recommendations look very promising but they must address a variety of issues with regard to specific trailer systems, especially covered versus exposed decks. The trailer industry is slowly coming to terms with the facts regarding use of tropical hardwoods. Everyone agrees that Apitong is an excellent wood and by far the best natural wood product for decking. Unfortunately, in today's world, continued massive harvesting of tropical rainforest is neither advisable nor warranted. The tremendous proliferation of recycled rubber and plastics, plastic/fiberglass, plastic lumber and

engineered wood products many alternatives for the trailer industry. The key to using these new, exciting products appears to be proper understanding and use, and adjusting the trailer systems to take advantage of these durable, long lasting alternatives. **MTS** recommends testing with the various recommendations listed above and dealing with the recommended companies who have the experience and technical experience to devise the right material for each system. The industry does possess some “fly by night” companies and products. Using companies with good reputations and recommended by trailer manufacturers and end users will ensure the technical expertise necessary to utilize the various new products and take full advantage of their excellent properties. In order to view the specific testing recommendations made by **MTS**, please see *Table 1 Semi trailer Decking Recommendations Matrix*.

Table 1 Semi Trailer Decking Recommendations Matrix

Trailer		Enclosed Deck	NSN	Manufacturer	Decking/Material Recommendations for Testing
M127 Stake semi trailer, 12 ton – Hauls up to 24,000 # NSN: 2330-00-797-9207	A1	NO	2330-00-048-7743	Stevens Manufacturing	>> Rumber >> Plastic Lumbers >>Transdeck >>SAFPLATE with DURAGRID >> PepCore
	A1C	NO	2330-00-752-9750	Stevens Manufacturing	
	A2C	NO	2330-00-788-6299	Stevens Manufacturing	
M128 Semi trailer Cargo Van, 12 ton – hauls up to 24,000 # NSN: 2330-00-528-9789	A1C	YES	2330-00-752-9751	Dorsey Trailers	>> Laminated Hardwood Flooring - Havco - HPA Monon >> Rumber >>Plastic Lumbers >> SAFPLATE with DURAGRID >> PepCore
	A2C	YES	2330-00-788-6296	Dorsey Trailers	
M129 Semi trailer Van: Supply, 12 ton – hauls up to 24,000 #; transports and stores military supplies, and houses parts/tools for field repair. NSN: 2330-00-542-4654	A1	YES	2330-00-629-1673	Dorsey Trailers	>> Laminated Hardwood Flooring - Havco - HPA Monon >> Rumber >> Plastic Lumbers >> SAFPLATE with DURAGRID >> PepCore
	A1C	YES	2330-00-752-9752	Dorsey Trailers	
	A2C	YES	2330-00-788-6289	Dorsey Trailers	
	A3	YES	2330-01-175-7379	Dorsey Trailers	
	A4	YES	2330-01-372-5642	Dorsey Trailers	

Trailer		Enclosed Deck	NSN	Manufacturer	Decking/Material Recommendations for Testing
M172 Lowbed semi trailer, 15-25 ton, hauls up to 50,000# NSN: 2330-00-735-9326	A1	NO	2330-00-317-6448	Fontaine Truck Equipment Co., Inc. Consolidated Welding and Engineering Co.	>> Rumber >> Plastic Lumbers >> Transdeck >> SAFPLATE with DURAGRID >> PepCore
M870 40 ton low bed semi trailer – hauls up to 80,000 #; heavy engineer construction equipment NSN 2330-00-133-1731	A1	NO	2330-01-244-9245	Shoals American Industries, Inc.	>> Rumber >> Plastic Lumbers >> Transdeck >> SAFPLATE with DURAGRID >> PepCore
M871 22 1/2 ton platform semi trailer – haul up to 45,000 #; line haul missions transporting containerized and bulk cargo NSN: 2330-00-122-6779	A1	NO	2330-01-226-0701	Dynaweld	>> Rumber >> Plastic Lumbers >> Transdeck >> SAFPLATE with DURAGRID >> PepCore
	A2	NO	2330-01-294-3367	Dynaweld	

Trailer		Enclosed Deck	NSN	Manufacturer	Decking/Material Recommendations for Testing
M872 34 ton flatbed semi trailer – hauls up to 67,200 #; transports containerized and bulk cargo NSN: 2330-01-039-8095	A1	NO	2330-01-109-8006	Theurer Greenville Corp. and Heller Corp.	>> Rumber >> Plastic Lumbers >> Transdeck >> SAFPLATE with DURAGRID >> PepCore
	A2	NO	2330-01-119-5837	Theurer Greenville Corp. and Heller Corp.	
	A3	NO	2330-01-142-1385	Southwest Truck Body Co.	
M989 11 TON Flatbed Trailer (HEMAT) – hauls up to 22,000 #; Heavy Expanded Mobility Ammunition Trailer (HEMAT) NSN: 2330-01-109-4258	A1	NO	2330-01-275-7474	SEI, Inc.	>> Rumber >> Plastic Lumbers >> Transdeck >> SAFPLATE with DURAGRID >> PepCore

Table 2 – Contact List

Company	Contact	Job Title	Business Address	Business Phone	Business Phone 2	Business FAX	Email Address	Web Page
99 th Transportation Squad	Anderson, Cindy	Maintenance Control & Analysis	Vehicle Maintenance Transportation Squad Nellis AFB, Nevada	(702) 652- 1110				
Abilene District, Texas DOT	Brooks, James	Equipment Supervisor	Abilene, TX	(915) 676- 6880			Jbrook1@dot.state.tx.us	
American Ecoboard, Inc.			200-T Finn Ct. Farmington, NY 11735	(800) 567- 9851	(631) 753- 5165			
Angelina Hardwood	Henderson, Trey or George			(936) 634- 4415		(936) 634- 8207	Thenderson@inu.net	www.angelinahardwood.com
Argone Distributing, Inc.	Wariam. Steve		118 Front St. Spooner, WI 54801	(800) 521- 6790	(715) 635- 5007	(715) 635- 5024	Spwarian@aol.com	www.ainsworth.com
Aztec International	Xochihua, David	Importer		(360) 690- 8532				
Babcock Lumber	Heil, Robert Jr.	Sales	Pittsburgh, PA	(800) 252- 3780				
Bedford Technology, LLC	Aanenson, Rachel	Sales Manager	PO Box 609 2424 Armour Road Worthington, MN 56187	(507) 372- 5558				www.plasticsboards.com
Black Rhino Recycling, Inc.	Brody, Keith		4503 Lebanon Church Rd. West Mifflin, PA 15122	(412) 460- 0160			arhino@nauticom.com	www.nauticom.net/ www.arhino

Company	Contact	Job Title	Business Address	Business Phone	Business Phone 2	Business FAX	Email Address	Web Page
Canadian Wood Council (CWC)	Griffith, Don	Communications Manager	1400 Blair Place; Suite 210 Ottawa, Ontario K1J 9B8 Canada	(800) 463-5091		(613) 747-6264	dgriffith@cw.ca	www.cwc.ca
Carlville Truck Equipment Mfg., Inc.			North University PO Box 512 Carlville, IL 62626	(800) 252-9631	(217) 854-6706	(217) 854-3384	info@ctemi.co	www.ctemi.com
Caulfield Associated	Caulfield, Anthony		Box 1448 Doylestown, PA 18901	(800) 382-3814	(215) 348-5565	(215) 340-0177	caufield@pil.net	
Combined Support Maintenance (CSMS) Shop #1, Alabama National Guard	Myers, MSGT William,		Alabama Army National Guard, PO Box 3711 Montgomery, AL 36109-0711	(334) 213-7531		(334) 213-7622	william.myers@al.ngb.army.mil	
Dorsey Trailers, Inc.			2727 Paces Ferry Road, One Paces W., No. 1700 Atlanta, GA 30339	(770) 438-9595		(770) 438-8190		
Dynaweld				(708) 896-0009				
Eby Trailers	Alderfer, Corey	Customer Service Rep.		(717) 354-4971				
Everlast Plastic Lumber	Cougel, Tiffany	Sales Manager	Hamberg, PA	(610) 562-8336			tleepl@aol.com	www.everlastlumber.com
Fontaine Trailer Co.	Hutchinson Gary	Sales	Old Delmar Rd. PO Box 619 Haleyville, AL 35565	(205) 486-5251 Ext.361			ghutch@fontainesales.com	

Company	Contact	Job Title	Business Address	Business Phone	Business Phone 2	Business FAX	Email Address	Web Page
Fort Campbell, KY	Powell, WG9 Carland	Carpentry Shop		(270) 798-2672				
Fort Eustis, VA	Rivera, Herbie	General Foreman		(757) 878-2579				
Fort Polk, LA	Mango, Bill	Chief of Maintenance Operations		(337) 531-1933				
Great Dane Trailers	McCormack Dan	Testing Manager	PO Box 67 Savannah, GA 31402	(912) 232-4471 Ext. 2414				www.greatdanetrailers.com
Greenwood Forest Products	Reed, Dave	Wood Scientist	Portland, Oregon	(503) 598-3335	(800) 333-3898	(503) 670-7755	dreed@greenwoodproducts.com	www.greenwoodproducts.com
Havco Wood Products, Inc.	Padmanabhan, Gopal	Engineer					Gopal@havcowp.com	
Havco Wood Products, Inc.	Wiggs, Larry	Sales Manager	PO Box 1342 Cape Girardeau, MO 63702-1342	(800) 792-4040	(573) 332-2535	(573) 334-9415	lwiggs@havcowp.com	www.havcoinc.com
Heller Truck Body Corp.			Hillside, NJ	(800) 229-4148			Info@hellertruck.com	www.hellertruck.com
HPA Monon Corporation	Harney, Glenn	VP, Sales & Marketing	One Water Tower Drive PO Box 655 Monon, IN 47950-0655	(800) 231-6413		(219) 253-8033	gharney@hpamonon.com	www.hpamonon.com
J&J Body Company	Weir Jim	Superintendent	Somerset, PA	(814) 443-2671				
Legend Vans, Inc.	Les Trudale			(513) 563-8280		(513) 563-0038		

Company	Contact	Job Title	Business Address	Business Phone	Business Phone 2	Business FAX	Email Address	Web Page
Lufkin Trailers	Harris, Matt	Branch Materials Manager	PO Box 849 Lufkin, TX 79902	(936) 637-5545	(936) 634-2211	(936) 637-5244	Matt-harris@lufkin.com	www.lufkin.com
Lyncoach Industries	Phelps, David		810 Hwy. 231 South PO Box 887 Troy, AL 36081	(334) 566-4330		(334) 566-0589	Lycoach@mindspring.com	
Mead Clark Lumber Co	Orslini, Mario			(800) 585-9663				www.meadclark.com
MS Carrier, Inc.			PO Box 30788 Memphis, TN 38130	(901) 332-2500				
Mullen Equipment Corporation	Kmit, Edward	Manufacturer Representative	Strongwell Manufacturing Reps./Distributors Troy, MI	(248) 643-8120			Mulleneq@aol.com	www.strongwell.com
Oshkosh Truck Corporation	Van Sistine, Jim	Director PLS/HET Programs	Oshkosh, WI	(920) 233-9691		(920) 233-9540	Jvansistine@oshtruck.com	www.oshkoshtruck.com
Outwater Plastics Industries, Inc.	Sardoski, Peter	Sales Manager & Technical Advisor	4 Passaic Street Wood-Ridge, New Jersey 07075	(888) 688-9283	(800) 526-0462	(201) 916-1640		
PA Army National Guard Ft. Indiantown Gap	Shaffer, Dick	Supply Systems Officer	State Area Command, STARC	(717) 861-8669		(717) 861-8680		
PA Army National Guard OMS #17	Cory, Sgt.		Lockhaven, PA	(814) 765-1119				

Company	Contact	Job Title	Business Address	Business Phone	Business Phone 2	Business FAX	Email Address	Web Page
PA Army National Guard OMS #17A	Noll, Chief Jack	Chief Warrant Officer	Clearfield, PA	(570) 893-2373				
PA Army National Guard OMS #12	Johnston, Chief Warrant Officer,			(814) 533-2406				
Penn Metals Fabricators, Inc.	Robert Senft, Engineer	Formerly Stevens Manufacturing	New Germany Road Ebensburg, PA 15931	(814) 472-6000		(814) 472-7670		
Pharr District, Texas DOT	Barker, Bob	District Equipment Manager	Pharr, TX	(956) 702-6206			Jbaker3@dot.state.tx.us	
Phelps Engineered Plastics	Coslovich, Owen		36 Kenosia Avenue Danbury, CT 06810	(203) 792-5110-Ext. 109	(877) 258-5424	(203) 797-0390		www.pepcore.com
Phelps Engineered Plastics, Inc.	Karamanis, Gabe	VP of Engineering		(203) 792-5110				
Powledge Unit, Texas Dept. of Criminal Justice	Poe, Johnny	Metal Fab Shop		(903) 723-5074 Ext.6300				
R.L. Garret	Wollman, Mike		PO Box 466 Fort Madison, IA 52627	(319) 463-5434		(319) 463-7210		
Reineke, Mfg.			101 Reinke Road Deshler, NE 68340	(402) 365-7251		(402) 365-4370		www.reinke.com

Company	Contact	Job Title	Business Address	Business Phone	Business Phone 2	Business FAX	Email Address	Web Page
ReNEW Plastics, A division of N.E.W. Plastics Corporation	Neville, Christopher	Customer Service	112-4 th Street PO Box 480, Dept. I Luxemburg, WI	(800) 666-5207 Ext. 104			Chris@renewplastics.com	www.renewplastics.com
ReNEW Plastics, A division of N.E.W. Plastics Corporation	Vincent, Lonnie or Vern	Account Executive	112 4 th Street PO Box 480, Dept. I Luxemburg, WI	(800) 666-5207 Ext.107				www.renewplastics.com
Roehl Transport Inc.	Williams, Ernest	Maintenance Manager	1916 E. 29 th Street PO Box 750 Marshfield, WI 54449	(715) 387-3795 Ext. 2229			Ebww@txnet.com	www.roehl.net
Rumber Materials, Inc.	Hare, J'Lynn	General Manager	621 W. Division Street Muenster, TX 76252	(940) 759-4181			Rumber@cooke.net	www.rumber.com
Rumber Materials, Inc.	Reinhardt. Bill	Vice President	621 W. Division Street Muenster, TX 76252	(512) 794-8473	(940) 759-4181	(940) 759-4011		www.rumber.com
SEI, Inc.	Russell, Gerard		St. Louis, Missouri	(314) 553-4195			Grussell@seistl.com	www.seistl.com
SEI, Inc	Walker, Pate	Manager of Contracts	St. Louis, Missouri	(314) 553-4910			Pwalker@seistl.com	www.seistl.com
Strongwell Corporation	Christian, Mark	Engineering, Marketing	400 Commonwealth Ave. PO Box 580 Bristol, VA 24203	(540) 645-8000		(540) 645-8132		www.strongwell.com

Company	Contact	Job Title	Business Address	Business Phone	Business Phone 2	Business FAX	Email Address	Web Page
Strongwell Corporation ISO-9001 Certified Manuf. Plant	Division, Chatfield		1610 Highway 52 South Chatfield, MN 55923-9799	(507) 867-3479		(507) 867-4031		www.strongwell.com
Talbert Manufacturing	Beavers, Dave		1628 W. State Rd. 114 Rensselaer, IN 47978	(219) 866-7141		(219) 866-5437		www.talbertmfg.com
Texas Department of Criminal Justice	Loretta			(936) 437-8774				
Trail King Industries, Inc.	Fenwick, George		2200 N. Ohlman Street Mitchell, SD 57301	(605) 995-3700				
Trailmobile	Robinson, Colin		PO Box 5045 1000 N. 14 th Street Charleston, IL 61920	(217) 348-8181		(217) 348-0421		
Trailmobile Trailer LLC	Hawkins, Robert	VP Southwest Region	Dallas, Texas	(214) 637-0290				
Trailmobile Trailer LLC	Huddle, Tom		Charleston, IL	(217) 348-8181				
Transcraft Corporation			PO Box 500 Anna, IL 62906	(606) 498-2382		(606) 498-0161		
Trex Company			245 Capitol Lane Winchester, VA 22602	(540) 678-8128				www.trex.com
Tyler District, Texas DOT	Clark, Larry	Equipment Manager	Tyler, Texas	(903) 510-9219			Lclark2@dot.state.tx.us	

Company	Contact	Job Title	Business Address	Business Phone	Business Phone 2	Business FAX	Email Address	Web Page
USDA Forest Service-Forest Products Laboratory	LeVan-Green, Susan	PM-S&PF Technology Marketing Unit	One Gifford Pinchot Dr. Madison, WI 53705-2398	(608) 231-9518			Slevan@fs.fed.us	www.fpl.fs.fed.us
Utility Trailer Mfg. Corporation	Division, After Market,		17295 E. Railroad Street City of Industry, CA 91749	(626) 964-7319		(626) 964-7319		
Waco District, Texas DOT	Johnson, Clarence	Equipment Superintendent	Waco, TX	(254) 867-2810			Ljohnso@dot.state.tx.us	
Willamette Industries, Inc.			1300 SW Fifth Ave., Suite 3800 Portland, OR 97201	(800) 942-9927	(877) 303-7263			www.wii.com
Wilson Trailer Company			PO Box 2616 Sioux City, IA 51106	(712) 252-6550		(712) 252-6461		www.wilsontrailer.com
Yards of Plastic	Hormeck, Mike	Owner		(334) 965-7239				
YVR Forestry Ltd.	Hui, Philip	Sales	Vancouver, BC, Canada	(604) 329-2766			Phil@yvrforestry.com	www.yvrforestry.com

Appendix A-CID A-A-52520

[METRIC]
A-A-52520
September 26, 1995
SUPERSEDING
MIL-H-3912G
11 March 1991

COMMERCIAL ITEM DESCRIPTION

HARDWOOD; FLOORBOARDS AND PLATFORMS: FOR MILITARY VEHICLES (METRIC)

The General Services Administration has authorized the use of this commercial item description (CLD) for all federal agencies.

1. SCOPE. This CID covers hardwood floorboards and platforms fabricated for military vehicles.

2. SALIENT CHARACTERISTICS

2.1 Materials. Unless otherwise specified herein, the materials used shall be in accordance with the manufacturer's materials specification for hardwood. The use of recovered materials made in compliance with regulatory requirements is acceptable providing all requirements of the CID are met (see 5.5).

2.1.1 Hardwood. Floorboards and Platforms shall be fabricated from species of domestic hardwoods, unless otherwise specified (see 6.2). Domestic hardwoods include species of maple, red or white oak, and American white ash (see table I). The use of species grown in lowlands or swamps is unacceptable. Hardwoods shall conform to NHLA Rules for the Measurement and inspection of hardwood and cypress lumber. Wood shall be free of defects that render it unsuitable for the intended use.

Beneficial comments, recommendations, additions, deletions, clarifications, etc. And any other data which may improve this document should be sent by letter to: U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E, Warren, MI 48397-5000.

FSC 2510

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

TABLE I Domestic hardwoods**A-A-52520 Table I**

Common Name	Species	Genus
Maple	Red Maple Sugar or Hard Maple Black Maple Silver Maple	Acer, Rubrem Acer, Saccarum Acer, Nigrum Acer, Saccarinum
Red Oak	Northern Red Black Oak	Quercus, Rubba Quercus, Velutina
White Oak	White Oak Bur Oak Chestnut Oak	Quercus, Alba Quercus, Macrocarpa Quercus, Prinus
Ash	White Ash	Fraxinus, Americana

2.2 Moisture Content. Unless otherwise specified (see 6.2) material used shall be air dried or kiln dried to a maximum moisture content of 15 percent or less at time of treatment. This shall be verified when tested to ASTM 4444.

2.3 Preservative treatment. Treatment shall be accomplished after all cutting, machining, or trimming has been accomplished. At the time of treatment, the moisture content shall be in accordance with the requirements noted in 2.2. Hardwood preservative treatment shall be a pressure treatment of light solvent solution of copper naphthenate, to a net minimum retention of .64 kilograms per cubic meter (Kg/m³)[0.040 pound per cubic foot (pcf)] of copper as measured by gauge or assay method for the zone of 0 to 15 millimeters (mm)(0 to 0.6 inch). The copper naphthenate used in the treating solution shall comply with AWWA P8. The solution shall contain 1 percent copper but not less than 34 grams of copper per gallon at 16 degrees Celsius (°C)[60 degrees Fahrenheit (°F)]. Hardwood preservative treatment shall be monitored, tested, and checked using the appropriate procedures of AWWA C2.

- a. For white oak hardwood, treatment to refusal is allowable (see 6.3). The pressure and treatment during the pressure period shall be maintained constant or increased within a range consistence for the material being treated until the quantity of preservative during each of two consecutive half-hour periods is more than 2 percent of the amount already injected.

b. For domestic hardwood species an alternate non-pressure treatment is acceptable, if a high solvent solution of copper naphthenate is used, with a minimum net retention of .64 Kg/m³ (0.040 pcf) of copper as measured by the assay method for the zone of 0 to 15mm (0 to 0.6 inches). The copper Naphthenate used in the treating solution shall comply with AWWA P8. The solution shall contain 2 percent copper but not less than 68 grams of copper per gallon at 16°C (60°F).

c. If further modification is required after treatment, any new exposed surfaces from machining, cutting or trimming shall be treated with preservative.

d. After treatment, the wood shall be free of tack and shall provide a paintable surface following 72 hours of drying. The surface of the treated-dried wood shall be free from waxy, greasy, or oily deposit removable by rubbing with the finger and free from any glossy film resembling that of varnish. The paintable surface shall be compatible with Chemical Agent Resistant coatings used by the military.

2.4 Hardwood defects. Material used in the fabrication of floorboard components shall conform to the requirements of 2.4.2 through 2.4.6.

2.4.1 Knots. No unsound knot or hole shall be permitted. Sound knots will be permitted, up to and including 25.4mm (1.0 inch) in diameter. The sum of the diameters of all sound knots in any one-fourth length of a piece shall not exceed the width of the piece, nor shall any two knots of 25.4mm (1.0 inch) or more in diameter be closer to each other than 20 centimeters (cm) (8 inches).

2.4.2 End splits. End splits, exceeding the width of the piece in length, shall not be permitted. End splits shall only be allowed in one end of board.

2.4.3 Warping. Maximum warping shall not exceed 12.7 mm (0.5 inch) per 30.5cm (12 inches) length as defined in NHLA Rules for the Measurement of Hardwood and Cypress.

2.4.4 Hit-or-miss surfacing. Hit-or-miss surfacing, with skips not over 1.6 mm (0.06 inch) deep between them, shall be permitted on the underside of the floorboards, but all floorboards shall be full thickness at the ends and over the cross bolsters.

2.4.5 Wood destroying organism defects. Open channels not more than 3mm (0.13 inch) deep and 12.7 cm (5 inches) long will be permitted on the face of the board. On the underside of the board, channels shall be not greater than 6mm (.25 inch) wide and 20 cm (8 inches) long. No defects shall extend through the thickness of the piece.

2.4.6 Secondary hardwood. Fabricated wood components shall be free from the following characteristics or imperfections to the extent that they shall not decrease the strength or serviceability or be other wise detrimental to the required service of the component.

Burls.

Season checks.

Sound stain or discoloration.

Sound streaks.

Small, sound, tight knots or small open knots.

Short splits.

Bark streaks and pockets.

Wormholes, except buckshot wormholes in clusters.

Bird peck.

Bird's-eye.

Slight vane on small pieces and medium vane on large pieces.

Slight variation in thickness.

Small end checks.

Slight honeycomb.

Occasional torn grain.

Occasional rough or hit-and-miss surfacing.

Other definitely minor imperfections.

2.5 Design and construction. Design and construction of floorboards and platforms shall conform to the applicable drawings and data supplied by the procuring activity (see 6.2).

2.5.1 Joints. Joints shall be of approved scarf or finger type, and shall be located only where adequately supported by cross-member (bolsters), and shall be so staggered as to assure maximum floor strength. Jointed construction of floorboard components, normally cut from one solid piece of lumber, shall be subjected to specific approval.

2.5.2 Gluing. Gluing of floorboards shall be conducted using a phenol and resorcinol base adhesive of long time durability and suitable for marine use. The adhesive bond shall be of high strength and resistant to salt water, extreme shrinking and swelling. The adhesive shall be applied uniformly to both contact faces. The amount of adhesive spread shall be sufficient to ensure a permanent bonding. At time of gluing, the temperature of lumber materials and ambient air temperatures shall be $24 \pm 8^{\circ}\text{C}$ ($75 \pm 15^{\circ}\text{F}$). The surfaces to be bonded shall be free of oil, dirt, crayon marks, and other foreign material which may interfere with bonding of the adhesive. Application of pressure to the glue lines shall be adequate so as to uniformly apply and hold a glue line pressure of 1207 ± 172 kilopascals (kPa) [175 ± 25 pounds per square inch (psi)] throughout the cure.

2.5.3 Dimensional lumber. Dimensional lumber, used in the fabrication of any one glued piece or component, shall be of the same species of hardwood. It shall be matched for density and for direction of grain in each piece of wood.

2.5.4 Quality impairment. Defects in wood components (see 2.4) shall not impair the quality of the joint or the fitting of hardware, and when practicable shall not be located on the normally visible surface of the assembled body. No knot split or similar defect shall be permitted at a bolt, nail, screw, glued joint, machined joint, mortise, or notch; where it may impair the strength and serviceability of the component.

2.6 Identification and marking. Unless otherwise specified in applicable engineering drawings (AEDs), identification and marking of the lumber shall be permanent and legible and shall include, as a minimum the AED part number, the manufacturer's CAGE code and date of manufacture (month and year) so that after assembly their identification marks shall be located on the top surface and 15.2cm (6 inches) from the front end of the component.

3. REGULATORY REQUIREMENTS. The offeror/contractor is encouraged to use recovered materials in accordance with Public Law 94-580 to the maximum extent practicable.

4. QUALITY ASSURANCE PROVISIONS.

4.1 Responsibility for inspections. The contractor is responsible for the performance of all inspections (examinations and tests).

4.2 Contractor certification. The contractor shall certify and maintain substantiating evidence that the product offered meets the salient characteristics of this commercial item description and that the product conforms to the producer's own drawings, specifications, workmanship standards, and quality assurance practices. Items with know defects shall not be submitted for Government acceptance. The Government reserves the right to perform or witness any of the inspections it deems necessary to insure supplies and services conform to prescribed requirements.

5. PACKAGING. Preservation, packing, and marking shall be as specified in the contractor order (see 6.2)

6. NOTES

(This section contains information of a general or explanatory nature that maybe helpful, but is not mandatory.)

6.1 Addresses for obtaining copies of referenced documents.

6.1.1 Industry documents. Copies of ASTM D4444 "Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters" can be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103. Copies of AWPAC2 "Lumber, Timbers, Bridge Ties and Mine Ties, Pressure Treatment" and AWPAC8 "Standards for Oil-Borne Preservatives" can be obtained from the American Wood Preserves Association, P.O. Box 286 Woodstock, MD 21163-0286. Copies of "NHLA Rules for the Measurement and Inspections of Hardwood and Cypress Lumber" can be obtained from the National Lumber Association, P. O. Box 34518, Memphis, TN 38134.

6.2 Ordering data. Acquisition document must specify the following:

- a. Title, Number and date of this CID.
- b. Issue of DODISS to be cited in the solicitation and, if required, the specific issue of the individual document referenced.
- c. Selection of applicable levels of packaging requirements.
- d. If moisture content is other than as specified.
- e. Applicable drawings and data.
- f. If wood species are other than as specified.

6.3 Definitions.

- a. Refusal treatment. Treatment of wood under specified conditions until the quantity of preservatives absorbed in a given time is not more than a prescribed percentage of the amount already injected.
- b. Sound knot. A knot that is solid across its face, at least as hard as the surrounding wood and shows no indication of decay.

6.4 Cross reference data. Hardwood; floorboards and platforms conforming to this CID are interchangeable/substitutable with hardwood, floorboards and platforms conforming to MIL-H-3912G.

MILITARY INTERESTS:

Custodians:

Army – AT
Air Force – 99

Review Activities:

Army – MD, MI
Navy – MC
Air Force – 85
DLA - CS

CIVIL AGENCY COORDINATING ACTIVITY:

GSA-FSS

Preparing Activity
Army – AT

(Project 2510-0127)

Appendix B – List of Citations

- ¹ *Commercial Item Description Hardwood: Floorboards and Platforms: For Military Vehicles (Metric)*. U.S. Army Tank-automotive and Armaments Command (TACOM). A-A-52520, September 26, 1995.
- ² *Military Specification Hardwood: Floorboards and Platforms: For Military Vehicles*. U.S. Army Tank-automotive and Armaments Command (TACOM). MIL-H-3912G, March 11, 1991.
- ³ *MTS Technologies, Inc., Alternatives to Apitong Hardwood for Flooring on the United States Army Trailer Fleet*. Contract #DAAE07-95-C-X110, November 1996.
- ⁴ VSE Corporation. *Letter Report Wood Products for Semi Trailer Floorboards: Alternatives to Apitong*. Contract #DAAE07-91-C-R065, Work Directive E-4DA-7, September 1995.
- ⁵ Discussions with David Xochihua of Aztec International; Trey Henderson of Angelina Hardwood; Philip Hui of YVR Forestry, Ltd; Robert Heil, Jr. of Babcock Lumber.
- ⁶ Martin Chudnoff, Forest Products Laboratory. *Agriculture Handbook Number 607 Tropical Timbers of the World*. United States Department of Agriculture Forest Service, Washington, DC; 1984.
- ⁷ Results obtained during completion of Contract No. DAAE07-99-C-S016, Work Directive Number PM-Inv-01, commonly referred to as *Trailer Inventory*. *MTS Technologies, Inc.*, Troy, Michigan. November 2000.
- ⁸ *Fielded System Review of the Semi Trailer, Flatbed, Transporter M872/A1/A2/A3*. Readiness Directorate, Logistics Intelligence and Assessments Division, under MOA with TACOM, March 1993.
- ⁹ Discussions with J'Lynn Hare, General Manager of Rumber Materials, Inc., Muenster, Texas, November 2000.
- ¹⁰ Discussions with Bob Barker, Pharr District; Larry Clark, Tyler District; Clarence Johnson, Waco District; Texas DOT and MSG Billy Myers, AL ARNG and John Poe, Powledge Unit, Texas Department of Criminal Justice, October – November 2000.
- ¹¹ Ibid.
- ¹² Discussion with John Poe, Powledge Unit, Metal Fab Shop, Texas Department of Criminal Justice, October 2000.

-
- ¹³ Discussions with Bill Reinhardt, VP of Rumber Materials, Inc., Muenster, Texas, November 2000.
- ¹⁴ Discussions with Anthony Caulfield, owner of Caulfield Associates, October 2000.
- ¹⁵ *Perma-Poly Decking Lumber*, ReNEW Plastics, a division of N.E.W. Plastics Corp., Luxemburg, WI.
- ¹⁶ *ReNEW Plastics, Turning An Environmental Problem into a Useful Product*, ReNEW Plastics, a division of N.E.W. Plastics Corp., Luxemburg, WI, 1998.
- ¹⁷ *Trucking Industry Finds Plastic Lumber a Better Solution*, Modern Bulk Transporter, 2000.
- ¹⁸ Uray, Craig. *Plastic Boards Perform for Ohio Project*, Plastic News, October 12, 1998.
- ¹⁹ *Outwater Plastic Lumber Information Sheet*, Outwater Plastic Industries, Inc., Wood-Ridge, NJ.
- ²⁰ Memo from Dr. Herman F. Nied, Lehigh University, *Testing Data*, March 1997.
- ²¹ Discussions with Gabe Karamanis, VP of Engineering, Phelps Engineered Plastics, November 2000.
- ²² Discussions with Ernest Williams, Maintenance Manager for Roehl Transport; Tom Huddle of Trailmobile Trailers; Matt Harris, Parts Manager for Lufkin Trailers; Dan McCormack of Great Dane Trailers, October – November 2000.
- ²³ Discussion with Robert Hawkins, VP Southwest Region for Trailmobile Trailer, Dallas, Texas, November 6, 2000.
- ²⁴ Discussions and correspondence with Glen Harney, VP Sales & Marketing, HPA Monon Corporation, Monon, Indiana, November 2000.
- ²⁵ Discussions with Ernest Williams, Roehl Transport, November 2000.
- ²⁶ Canadian Wood Council (CWC) website. www.cwc.ca/english, October 2000.
- ²⁷ APA EWS, *Product Guide Glulam*. Engineered Wood Systems, Tacoma, Washington, March 1998.
- ²⁸ Willamette Industries, Inc., *Glulam*. Columbus, Ohio, July 1998.

²⁹ Willamette Industries, Inc., *StrucLam LVL Design Guide*. Technical Services, Columbus, Ohio, 1999.

³⁰ Discussions with David Reed of Greenwood Forest Products, October 2000.

³¹ Transcraft Corporation, www.transcraft.com, November 2000.

³² Discussions with Robert Jarrett of Transcraft Corporation, November 2000.