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Evaluating A Shippers Cargo Securement Needs and Regulatory Requirements

By Matthew Bullock, Walnut Industries

Very few methods of securement exist which are harmonized to satisfy all the pertinent regulations which may apply to a shipment being offered for an intermodal transport. Many of the regulations, as you will see detailed below, are performance based however the railroad regulations are more prescriptive and require specific testing and approval of a securement method. A shipper's options are then further limited by the implementation of the International Soft Packaging Material (ISPM-15) mandatory requirement to use heat treated or manufactured wood dunnage exhibiting the IPPC seal.

Rail Transportation

Neither The Association of American Railroads (AAR) nor its individual railroad members take securement standards lightly. The railroad industry publishes standards in the Intermodal Loading Guide only after carefully considering all relevant facts and circumstances, and following appropriate testing. In fact, railroads tend to be conservative in their assessment of securement devices. This is done to increase safety and minimize liability risks that they might confront in the event that cargo, containers or other property were damaged as a consequence of inadequate securement.

The Federal Railroad Administration, which is the rail safety arm of the U.S. Department of Transportation (DOT), does not maintain any regulations regarding cargo securement devices or methods. The only such government regulations that do exist apply to the transportation of hazardous materials. A unit of DOT known as the Pipeline and Hazardous Materials Administration maintains (at 49 CFR § 174.55(a)) a general, performance-based requirement for securement of hazardous materials as follows:

> Each package containing a hazardous material being transported by rail in a freight container or transport vehicle must be loaded so that it cannot fall or slide and must be safeguarded in such a manner that other freight cannot fall onto or slide into it under conditions normally incident to transportation. When this protection cannot be provided by using other freight, it must be provided by blocking and bracing. For examples of blocking and bracing in freight containers and transport vehicles, see Bureau of Explosives Pamphlet Nos. 6 and 6C.

The "examples" of blocking and bracing referenced in the above regulation are those published in the Intermodal Loading Guide (ILG), which is also designated Bureau of Explosives Pamphlet No. 6C. Furthermore, not all securement methods which pass impact tests are approved for hazardous materials by the Bureau of Explosives committee. Most referenced ILG methods are limited to general cargo.

The Intermodal Loading Guide is issued by AAR, a private (non-governmental) trade association composed of each of the nation's major (Class 1) railroads, as well as regional, smaller railroads and associate members.

The above regulation makes clear that a securement method that prevents packages of hazardous materials in a container from falling or sliding under normal transportation conditions is sufficient under the regulation. Railroad Carriers, however, require adherence to the ILG methods.

Ocean Transportation

The securement of dangerous goods during international ocean transportation is subject to the International Maritime Dangerous Goods (IMDG) Code. That Code sets forth performance-based standards. It does not address specific securement methods or materials. Thus, section 7.5.2.2 of the IMDG Code provides that, "Packaged dangerous goods and any other goods within the same cargo transport unit shall be tightly packed and adequately braced and secured for the voyage. The packages shall be packed in such a way that there will be a minimum likelihood of damage to fittings during transport. Such fittings on packages shall be adequately protected."

It is also worth some discussion of the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) as they pertain to sea transportation under the International Maritime Dangerous Goods (IMDG) Code for international cargo vessel transportation. As provided by Part 171.12 a hazardous material that is packaged, marked, classed, labeled, placarded, described, stowed, segregated and certified in accordance with the IMDG code may be offered and accepted for transportation and transported within the United States subject to certain conditions and limitations. Since none of these conditions and limitations includes specific compliance with § 176.76(a), a containerized shipment that is transported by vessel may be prepared with the IMDG code instead of the specific provisions of § 176.76(a). See DOT RSPA (PHMSA) Interpretation Letters Ref. Nos: 00-0317 and 03-0095.

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This clearly permits a shipper to use securement methods other than wood dunnage which requires ISPM-15 compliance and the IPPC seal. Under the performance-based standard incorporated into section 7.5.2.2 of the IMDG code, a restraint system, including a fabric restraint system, that can achieve the specified performance, is acceptable.

Highway Transportation

Regarding ground transportation, the Federal Motor Carrier Safety Administration (FMCSA) has adopted a revised cargo securement standard. Again this is a performance criterion under section 393.102, and the working load limit criteria are codified under section 393.108. This takes into account acceleration forces inherent to ground transportation and the Safe Working Load of the securement method satisfies the acceleration requirements.

Care and Evaluation in Choosing Securement

When selecting a securement method, which fits one's supply chain strategy, it is important to remember that no method of securing can adequately compensate for improper stowage. This would include such matters as weight distribution and tight packing of the cargo. The IMO/ILO/UN ECE 'Guidelines for Packing of Cargo Transport Units (CTUs)' provides a good source of general information.

In general terms, individual securement components are put together in sequence to create a securement system. Each component will have it own strength rating, and should be designated with a Maximum Securing Load (MSL). This is a percentage of the Breaking Strength of the material and, as the name implies, represents the maximum load that can be safely secured by the component. The manufacturer of the lashing material usually provides this figure. If it is not provided, there are some 'Rule of Thumb' methods of determining MSL available. The IMO 'Code of Safe Practice for Cargo Stowage and Securing' provides relevant information in this regard, particularly in Annex 13 of the publication.

The MSL of the securement system will be that of the weakest component or part of that system. With respect to lashing inside containers with strapping, the weakest component is often the internal anchor or lashing point (sometimes known as the D-ring) on the container itself. ISO standard 1496-1 contains detail specification and testing requirements for general cargo containers. Annex F of this standard relates to Cargo Securing Systems and specifies the strength requirements for the anchor and lashing points. For anchor points, this is given as only 1000 kg. Some containers may be manufactured with anchor points stronger than these. If no specific information is provided, then the anchor and lashing points should be assumed to comply with the minimum rated load requirements as detailed above, provided they are in sound condition and have not been weakened by damage or wastage.

Acceleration Values

One must take accelerations into account and consider the effect of the G forces to which the container will be subjected during its intermodal voyage. These forces need to be compensated for in order to immobilize freight. The accelerations can vary considerably with the different modes of transportation.

Assumed values are shown in the IMO/ILO/UN ECE 'Guidelines for Packing of Cargo Transport Units (CTUs)'.

Longitudinal. The highest values in the longitudinal direction are likely to be found in the rail mode, particularly if the rail cars are subjected to shunting (humping). In that event, longitudinal accelerations up to about 4 g (approximately 40 m/sec2) can be experienced.

Transverse. The highest values in the transverse direction are likely to be found in the sea mode, particularly if the ship is rolling heavily. Generally, the ship's officers will attempt to minimize severe movement and so transverse accelerations should not usually exceed approximately 0. 8 g (8 m/sec2).

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HAZMATIP

DOT gives entry information that appears in italics within a number of shipping names in the Hazardous Materials Table, § 172.101. When entering shipping names on a shipping paper, may italicized information from the Table be used in addition to the "proper shipping name", (§172.101(c)(2)). If allowed, in what order should it appear?

DOT says that italicized information from §172,101 may appear on the shipping paper in addition to the essential elements of the proper shipping name. The placement or sequence of this information is optional, however. It gives the examples of "Adhesives, *containing a flammable liquid,* 3, UN 1133, PG I" and "Adhesives, 3, UN 1133, PG I, *containing a flammable liquid*" as both being acceptable. But DOT notes that the first description above, which is the sequence found in the Table, is preferred. NOTE: *HAZMAT Packager & Shipper* wishes to observe, however, that in some instances the use of the italicized information can prevent confusion during shipment when a compliance question may arise about the contents of a package.

Ed. Note: *See DOT's letter to Onyx Environmental Services, LLC, dated December 5, 2005, on page 36 of this issue, referencing § 172.101.*

Complex Movement Potentials. It should also be borne in mind that a ship has six degrees of freedom (i.e. is capable of moving in six different directions) and will often be moving in two or three different directions, each with associated acceleration forces, at the same time. Nonetheless during north Atlantic maritime winters rough swells can be unavoidable. Additionally the specific

location and placement of the container on board the vessel will determine the degree of force to which the container and cargo will be subjected. For example if a container unit is loaded on deck, off the center line, in the forecastle row (front) at the top of the stack, it will be subjected to the most severe effects of Roll and Pitch. The carriers planning department takes this into account and attempts to load less hazardous and less dense units high. However, this is not always possible as the vessel needs to be balanced. Additionally small feeder vessels subject the containers to higher degrees of force than the large panamax mega vessels which generally pitch and roll to a lesser degree.

Intermodal Securement

In order for cargo to be considered properly secured for an intermodal move, the securing arrangement must be capable of providing a measure of restraint at least equal to the upsetting forces created due to the maximum accelerations anticipated at any stage of the move. As indicated above, if this includes a rail stage in which humping may take place, total securing in the longitudinal direction should take account of acceleration forces in the order of 4 g (g = approx. 10 m/sec2). Transverse securing, for the sea mode, should take account of acceleration forces in the order of 0.8 g. Anticipated forces can be readily calculated using the simple formula,;

Force (kN) = Mass of cargo (tonnes) xAcceleration (m/sec2) or F = ma.

Methods of Restraint

Restraint is not provided by the securement system alone. Different packaging types will possess different frictional properties. Friction can justifiably be included as providing a portion of the required restraining force under most circumstances. In addition, IIPC stamped lumber blocking and/or bracing can be used to provide a measure of restraint. Annex 13 of the IMO 'Code of Safe Practice for Cargo Stowage and Securing' provides a detailed methodology for calculating frictional forces and adequacy of securing in general using the 'balance of forces approach'. Although this specifically applies to the securing of non-standardized cargo on board ships, the principles are the same.

Summary

With consideration given to each of the elements touched upon above, effective securement can be achieved to sufficiently secure dangerous cargo across all modes of transportation, leading to safe transportation and customer satisfaction.

Author's note: *There are rumors that IMO will soon adopt guidelines limiting any load to be placed on the front bulkhead of an ISO container and that their will be a requirement to secure against vertical movement for ocean carriage. This seems somewhat draconian and I doubt shippers will want to readily adopt.*