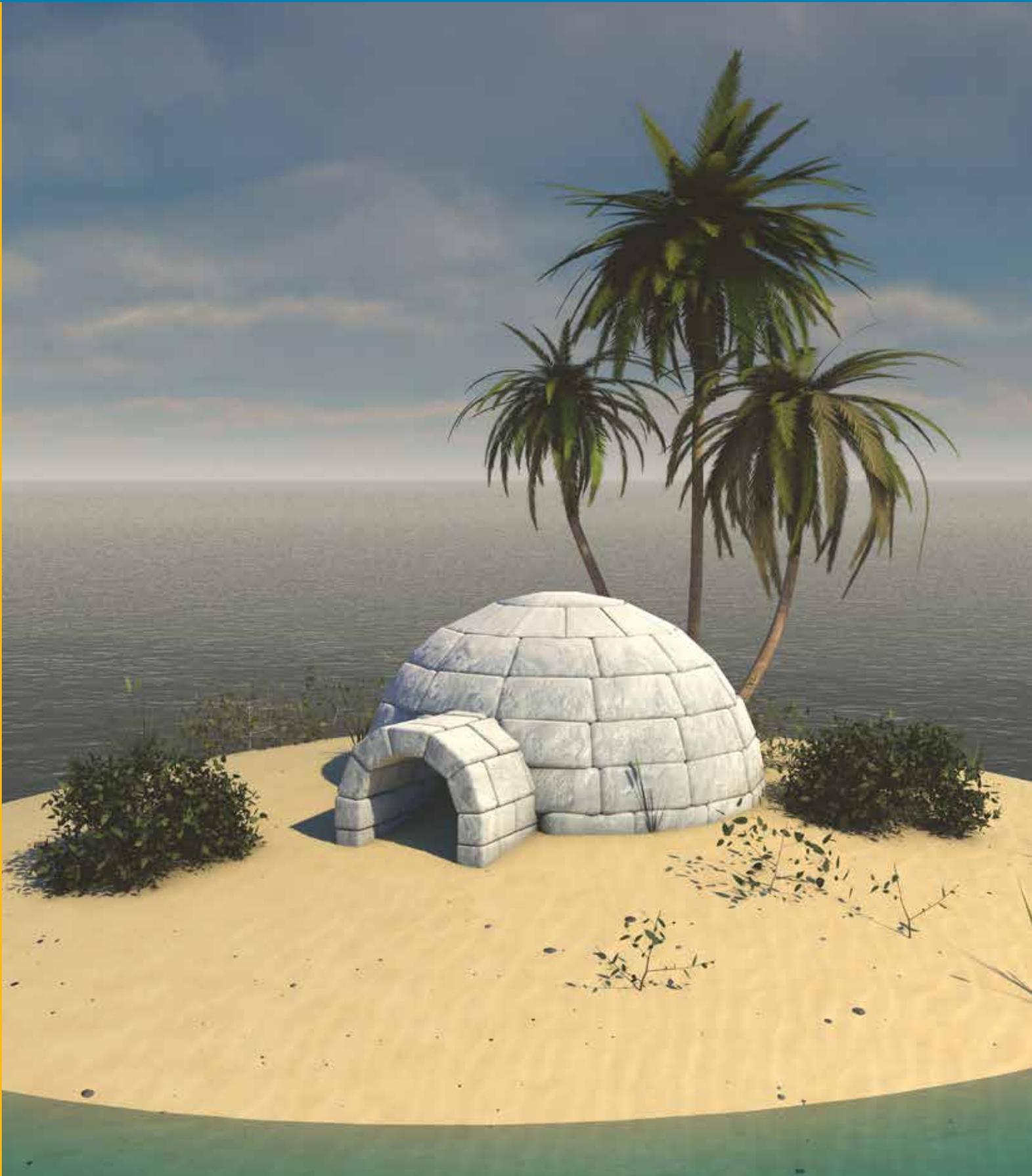


Protecting Goods From Temperature and Impact Excursions



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When the Mona Lisa, Leonardo da Vinci's masterpiece painting, left the Louvre to be exhibited in the United States in 1962, it was shipped in a special, temperature-controlled, fire-proof, watertight container and affixed to a bed frame in an ocean liner's deluxe cabin. French officials

were rightly concerned about the rigors of transportation.

Transportation has improved since then, but packages — whether priceless objects of art, industrial goods, or consumer items — still must be protected from temperature changes and impacts as they move across the country and throughout the world.

Wine shipments, which may be harmed by temperature differentials and physical drops, are a good example. Discoloration and changes in the aroma and flavor can begin at temperatures above 16°C and become more significant as temperatures rise. Yet, eProvenance, which tracks data from actual wine shipments, reveals that about 15 percent of global wine shipments experience temperatures above 30°C. Importantly, the data indicated the greatest risks occurred during local storage and transportation, where monitoring could enable quick intervention, before damage occurred. Breakage wasn't tracked, but can range from broken bottles to smaller cracks and seepage over time that, without impact loggers, are difficult to link to any specific incident or location.

A study published by the International Society for Horticultural Science found that strawberries that experienced fluctuating temperatures during handling often resulted in the loss of entire loads of berries. Those exposed to "semi-constant" temperatures, however, remained in good condition even one day after being displayed for retail sale.

The First Line of Defense

For many products, packaging is the first line of defense. Designed to protect goods from impacts and extreme temperatures, packaging is matched to the item being shipped and the shipping environment. Padding and thermal protections are designed to defend packages from

normal mishaps. But, shipping environments change, things go awry, and finding the right packaging design may take time. And, sometimes, packaging fails.

Consider the pharmaceutical manufacturer that used one type of packaging for summer conditions and another type for winter. It worked as long as the weather pattern matched the calendar, but unseasonably warm temperatures a few Springs past left the product inadequately protected. This approach to packaging also makes it difficult to ship between the northern and southern hemispheres, in which packages can exchange Boston winters for Sao Paulo summers.

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Other shippers have used the best packaging for the product, season, and route but still had damages products because those packages were affected by the thermal conditions of adjacent products. Imagine, for example, what happens when pharmaceuticals that must stay within the 2°C - 8°C range are surrounded by packages that have been in the sun on a hot tarmac for hours before being loaded, or when they are left inside mailboxes. (A 1995 FDA study of black mailboxes in St. Louis between June 9 and October 28 found that internal temperatures varied from ambient temperatures by -6°F to 41°F (-3°C to +25°C), depending on cloud cover, wind and precipitation.)

Routine bumps and vibrations, as well as accidents and willful negligence, pose additional threats. These risks change as the transportation mode changes. Therefore, shippers must be aware of the differences and plan for them.



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Establish Baselines

To minimize these risks, shippers need to know the conditions their products experience throughout transit. Immediate information helps companies identify the conditions specific packages encountered, so those with excursions can be examined more closely for damage before being sent to the end user, thus reducing replacement and repair costs and salvaging corporate reputations.

Long term, the data provides a baseline that establishes existing conditions by carrier, transportation mode, lane, and time of year. With this information, managers can begin a process of continuous improvement and know whether outcomes are the result of specific changes or other unexpected variables. By monitoring shipments for impacts and temperature excursions, shippers can learn exactly what to expect and adjust their supply chain accordingly.

Shippers may want to measure temperature and vibration at multiple locations throughout the shipping container or cargo hold. For example, in airplane cargo holds, temperatures vary between the nose and tail sections, and by proximity to the heating equipment or to the cargo door, which has less insulation than other areas of the plane. Cargo hold temperature variations also have been recorded among different planes of the same model, as well as by different types of planes.

Some airlines have installed special controlled temperature sections. In March 2014, for example, IAG Cargo (formerly British Airways and Iberia) introduced the B787 passenger jet for flights between Heathrow and Hyderabad. It features a controlled temperature section in its nose, helping IAG tap into India's lucrative pharmaceuticals market. However, planes tend not to control their cargo compartment temperatures while sitting at the ramp or at freight depots. If airlines aren't using the equipment to control temperature at the ramp, what happens if the flight is delayed?

For over-the-road or rail transportation, the route and mode matter, too. Cargo being shipped overland from Port Miami, for example, experiences different conditions than cargo shipped from the Port of SeaTac, because of differences in port facilities, customs inspection, number of subsequent transfers, and environmental temperatures along their routes.

Because of such differences, it's a good idea to routinely monitor products that may be damaged by impacts or temperature excursions. This not only provides information for particular shipments but, when combined with



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additional data, provides insights into conditions throughout shippers' entire supply chain.

Monitor New Transportation Modes

Monitoring is particularly important as shippers change transportation modes. Technological advances combined with cost concerns are causing many shippers to consider transportation modes that were practically impossible before. For example, some fresh produce now ships by rail, thanks to improved delivery times and reliable reefers designed to go from rail to road. Pharmaceutical shippers even are beginning to consider ocean freight for certain products with long shelf lives.

Fuel charges and line haul expenses for intermodal are less than for alternative transportation methods, congestion and environmental impact are reduced, and the capacity is available. Consequently, some of the larger over-the-road carriers are beginning to offer cold chain services. BNSF and some regional rail providers are investing significantly in their cold chain capabilities as well.

Shippers switching transportation modes must be aware that the temperature and humidity, as well as the type of impacts and vibrations change. Therefore, as companies consider alternative transportation options, they must monitor conditions so they are aware of how a new transportation mode affects their products. Recording the normal vibrations of the rails or roads, the impacts as freight cars are coupled and as reefers are lifted onto rail chassis, as well as temperatures along these new routes, with new carriers or different equipment should be included in the transportation analysis.

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Develop Written Protocols

Written protocols are important for any organization, but are particularly important when shipping modes change. That's because the mindset that comes with each form of transportation is different in terms of services and delivery expectations. Air freight carriers may be aware of same day service and cold chain requirements, but for other providers new to the cold chain that understanding may not extend far beyond the main office.

Before committing to a new transportation mode or a new carrier, shippers should know the temperature parameters and the level of impact and vibration that each product can withstand, and those thresholds should be incorporated into written transportation protocols. The carriers may have the temperature parameters and vibration data for their equipment. If not, they may agree to have data loggers placed on their trucks, planes or other equipment. At least, they may agree to ship test packages with impact and/or temperature loggers attached so shippers can adapt packaging to actual conditions.

Carriers may present their equipment specifications, but shippers may also need to validate that equipment to ensure it actually meets those specifications and can maintain them throughout the duration of the shipment. To do this, shippers should develop a scientific, standards-based approach to equipment qualification.

Written SOP's are particularly important because products are handled by multiple parties. For example, a pharmaceutical company sources ingredients globally, which may be shipped to contract manufacturers in different regions where they are produced and packaged before being shipped using third party logistics companies to tiers of distributors that supply pharmacies ranging from large teaching hospitals to large retail operations and individual shops. Electronics also have a far-flung supply chain, with components manufactured in many countries and shipped to a site for assembly, and sometimes shipped again before being installed in a plane. Written procedures distributed throughout the supply chain help ensure that each handler knows what is expected and puts the necessary safeguards in place.

Write Standard Operating Procedures for Specific Products

When developing procedures, understand that different products have different thresholds. For example, not all



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vaccines have the same temperature requirements. The Centers for Disease Control and Prevention recommend storing many vaccines between 2° and 8° C. For many vaccines, freezing is a concern, as well as overheating. Other vaccines, like those for measles, mumps and rubella, require temperatures between -50°C and -15°C. New technologies are eliminating the need for the cold chain entirely for certain other vaccines. Therefore, handlers must not assume similar products can be treated the same.

Likewise, ruggedized electronics may withstand substantial impacts but their individual components may be relatively fragile before they are mounted into their carriage systems. Although breakage is the most obvious outcome, punctures and ruptures of seals and plastic materials can be caused by vibrations during shipping. Some components, like electrolytic caps, also may be susceptible to heat.

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Realize that what a product actually can withstand and what it is certified to withstand may be different. When writing SOP's, adjust protocols accordingly to ensure that good products aren't discarded because of events that are within the product's specifications – but not necessarily those stated on the package. Alignment between the laboratory and the supply chain is important.

With such threshold difference in mind, logistics experts advise shippers to establish standards and qualification procedures for transportation. Write protocols for each threshold, and include the scientific rationale for each requirement. Therefore, shippers can justify the use and placement of specific types of shock and temperature monitors for each type of shipment.

When working with carriers, remember to include a quality agreement as part of the standard contract. This clearly signals the expectation that packages will be handled within certain guidelines, and outlines remedies for improper handling.

Shippers also should consider their own internal procedures for warehousing and shipping (including trailer loading) to ensure that their standard operating procedures are up-to-date and reflect any new requirements caused by changes in products or formulations.



Plan for the Worst

To quote Scottish poet Robert Burns, “The best laid plans of mice and men often go awry.” A quick survey of YouTube proves it. Multiple videos uploaded from cell phones and security cameras show packages being hurled by airport cargo handlers and delivery personnel – even those working (briefly) for the leaders in package delivery.

Those videos underscore one point: the most dangerous time for packages is during handoffs. This is when they risk being jostled, tossed, clipped by forklifts, dropped by cranes or otherwise damaged. This is also when temperature sensitive packages are most likely to be unprotected, sitting on hot tarmacs or loading docks, for example, or being off-loaded for transshipment. While one newly-introduced reefer for ocean carriers claims it can maintain temperatures for 24 to 48 hours without power, most reefers used for marine transport can maintain temperature only for about four hours once they are unplugged. Carriers are beginning to address the issues, but without independent monitoring, there's no immediate way to know whether their approaches actually work.

While data loggers, and indicators can't prevent every adverse event, their presence on packages can dissuade careless handling, and can document unacceptable impacts and temperature excursions. Solutions with realtime alerts offer the possibility of intervention in time to save the shipment.

Monitoring Options

A variety of monitoring solutions are available which indicate the extent and duration of the excursion, and some versions also indicate when and where the event or multiple events occurred. Simple, low-cost indicators also are available that indicate whether impact or temperature thresholds were exceeded.

When these solutions are paired with analytics, shippers can access thousands of data points throughout their supply chains, using them to determine the safest or most damage-fraught routes and carriers, and to understand the variations by season and mode.

Monitoring temperature and impacts is part of a comprehensive approach to damage reduction and is a vital part of any supply chain improvement effort. To learn more about ways impact and temperature monitors can improve your supply chain, contact ShockWatch.

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