

Protecting the Supply Chain from Temperature and Impact Damage



Protecting the Supply Chain from Temperature and Impact Damage



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.

Shipping 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. Nearly 5.8 million cases worth \$2.7 billion were shipped directly to consumers in 2017. When eProvenance tracked 4,800 direct to consumer wine shipments from Napa Valley to customers throughout the world, it found that one-third experienced potentially damaging temperatures

during transport and storage. (Discoloration and changes in the aroma and flavor can begin at temperatures above 16°C and become more significant as temperatures rise.) Therefore, many wineries only ship during the temperate fall and spring months.

The challenge isn't only with climate extremes. For example, eProvenance cites one London wine merchant's detailed cold chain processes, which were thwarted during last-mile delivery in Tokyo when the driver failed to turn on a refrigeration unit. That story isn't all that uncommon. Studies indicate that the greatest risks occur during local storage and transportation, when monitoring could alert shippers to intervene and prevent damage.

Breakage is another risk. Damage 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 and, if unnoticed, spoil the wine.

Perhaps as importantly as preventing damage, monitoring goods' conditions during shipping strongly suggests that shippers care about the quality of their products. As eProvenance reports, one case of Bordeaux sold at auction for prices that were 14 percent higher than comparable cases simply because bidders could see the wine storage history for the case.

The benefits of monitoring provides valuable insights into the supply chain, too. A study published in HortTechnology tracked the appearance and shelf life of five pallets of strawberries shipped by truck from California to Florida. It found that the refrigerated trailer could not maintain the temperatures for any of the strawberry pallets during shipping. Furthermore, fruits that were precooled to 1.7°C immediately after they were picked had the best visual quality and longest shelf life (three days).

The Cargo Handbook recommends shipping strawberries at temperatures "as cold as possible without freezing."

Protecting the Supply Chain from Temperature and Impact Damage

The First Line of Defense

For products that don't require pre-chilling, 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 multiple attempts. And, sometimes, packaging or packagers simply fail.

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 one Spring left the product inadequately protected. This approach to packaging also makes it difficult to ship between the northern and southern hemispheres, when packages can exchange Boston winters for Sao Paulo summers.

Other shippers have used the best packaging for the product, season, and route, but still had damaged 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. To hone the

point, 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.



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, environmental and handling data provides a baseline for existing conditions by carrier, transportation mode, lane, route, and time of year. Subsequent monitoring helps logistics managers identify trends. With this information, they can begin a process of continuous improvement that links outcomes to specific changes or unexpected variables. By monitoring shipments for impacts and temperature excursions, shippers can learn exactly what to expect and adjust their logistics practices accordingly.

When monitoring shipments, be sure to measure temperature and vibration at multiple locations throughout the

Protecting the Supply Chain from Temperature and Impact Damage

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 temperatures also vary 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. While this is a notable advancement, know that planes tend not to control their cargo compartment temperatures while sitting on the tarmac or at freight depots. If airlines aren't using the equipment to control temperature at the loading ramp, what happens to the cargo when 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, road and rail conditions, 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 additional data, provides insights into conditions throughout shippers' entire supply chain.

Monitor New Transportation Modes

Monitoring is particularly important when 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, the National Center for Cold Chain Development now cites advantages to using rail transportation for the long-haul transport of fresh fruits and vegetables. This is driven by improved delivery times and reliable reefers designed to go from rail to road. And even marine carriers now attract high value pharmaceutical shipments. This interest in intermodal shipping continues to grow, driven by lower fuel charges and line haul expenses that are less than those of alternative transportation methods. Additionally, intermodal shipping reduces congestion and environmental impacts, and the capacity is available. To attract new types of clients, some of the larger now offer cold chain services. For example, BNSF and other rail lines are investing significantly in their cold chain capabilities.

Shippers switching transportation modes must be aware that the temperature and humidity, as well as the type of impacts and vibrations, vary by mode of transport. 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, the temperatures along these new routes, and handling by new carriers or different equipment should be included in the transportation analysis.



Protecting the Supply Chain from Temperature and Impact Damage

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.

Some carriers will have the temperature parameters and vibration data for their own equipment. If not, they may agree to have <u>data loggers</u> placed on their trucks, planes, or other equipment to provide a quantitative look at their shipping environment. The alternative is for shippers to ship test packages with impact and/or temperature loggers attached, to the actual shipments can be properly protected and monitored, based upon actual conditions. While carriers may present their equipment specifications, shippers may also need to qualify that equipment – reefers, for instance – to ensure it actually meets the 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 standard operating procedures (SOPs) 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 (3PL) companies to tiers of distributors that supply pharmacies ranging from large teaching hospitals to large retail chains and small 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 vaccines have the same temperature requirements. The Centers for Disease Control and Prevention recommend storing many – but not all – vaccines between 2° and 8° C. 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.

Protecting the Supply Chain from Temperature and Impact Damage

When writing SOPs, realize that what a product actually can withstand and what it is certified to withstand may be different. 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 R&D and the supply chain is important.

With such threshold differences 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 SOPs 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 temperaturesensitive packages are most likely to be unprotected, sitting on hot tarmacs or loading docks, for example, or being off loaded for tarmaching ant

off-loaded for transshipment. While some newer reefers for ocean carriers claim to maintain temperatures for 24 to 48 hours without power, many of the reefers used for marine transport can maintain temperature only for about four hours once they are unplugged, leaving shipments vulnerable. Carriers are beginning to address such issues. But, without independent monitoring, there's no immediate way to know whether their approaches actually work.



Protecting the Supply Chain from Temperature and Impact Damage

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 real-time alerts offer the possibility of intervention in time to save the shipment.

Monitoring Options

A variety of monitoring solutions is available to indicate the extent and duration of temperature or impact excursions. Sophisticated versions indicate when and where the event or multiple events occurred. <u>Simple, low-cost indicators</u> 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 SpotSee.



Protecting the Supply Chain from Temperature and Impact Damage





۷	VarmMark Time - Temp Tag	
	RED INDICATES	
MFD by ShockWatch®	BRIEF	0
	MODERATE	spotsee.i
	PROLONGED	www.
	EXPOSURE ABOVE 5°C/41°F	

ShockLog[®] Cellular

ShockLog Cellular shock recorder, adding cellular connectivity to the ShockLog 298 impact recorder, sends you a text or email whenever an impact exceeds your pre-set thresholds, anywhere there is cell service. The ShockLog Cellular combines the powerful monitoring capabilities of the ShockLog 298 impact recorder with a cellular communication module to deliver real-time notifications of unacceptable handling in the supply chain.

ShockLog® 298

ShockLog 298 monitors and records shock, vibration, and environmental conditions experienced by any type of structure or equipment, whether in use, in transit, or in storage. With the capacity to record data for 870 events and 262,000-time slots, the device alerts you whenever damage may have occurred so you can respond promptly. Optional sensors extend the value of your ShockLog by providing more intelligence about your environmental journey by adding temperature/humidity sensor into unit, or adding a temperature/ pressure/humidity accessory sensor.

WarmMark[®]

WarmMark, a time-temperature indicator sticker, provides insights into your cold chain logistics so you will know which packages may have experienced thermal damage and which were handled properly. This single-use temperature recorder for shipping turns red when it reaches the temperature threshold you selected. Then, unlike many temperature indicator stickers, WarmMark starts a countdown, with its three individual indicator dots changing color for brief, moderate, and prolonged exposure.

Contact Spotsee about your supply chain and explore our best-in-class logistics devices. www.spotsee.io/contact