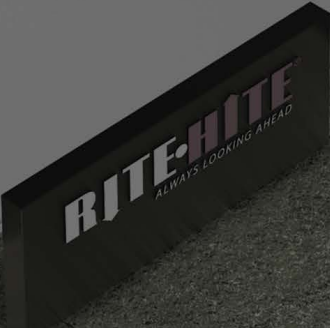


An aerial, cutaway-style rendering of a cold storage warehouse. The interior is divided into several sections. On the left, there are large roll-up doors and a white pickup truck parked. In the center, there are shelving units and a forklift. On the right, there are more shelving units and a large white trailer parked. A sign in the top left corner reads "SHIPPING & RECEIVING". The overall scene is dimly lit, emphasizing the industrial and cold storage environment.

**THE ESSENTIAL GUIDE:**  
**COLD STORAGE**



**RITE·HITE**<sup>®</sup>  
ALWAYS LOOKING AHEAD

## A HOT CATEGORY

Cold storage facilities play a critical role in many industries, from food and beverage to pharmaceutical, electronics and more. With regulatory changes, technological advances, macro-economic trends and other factors, best practices for cold storage facility operation and design have undergone a number of changes recently. This guide is designed to give facility managers an overview of those changes, the trends behind them and potential solutions for ensuring efficiency and compliance.

While the numerous studies done on this category don't always agree, one thing is clear in all of them: the cold storage industry is growing steadily. According to sources such as Global Cold Chain Alliance (GCCA) and DatexCorp, the total capacity of cold storage warehouses has been increasing at roughly 4% annually since 2013 and is expected to continue.

This expansion has been driven by a variety of factors, including the boom in global frozen food consumption. The global frozen food market is expected to grow from €137.4 billion in 2020 to €143.5 billion in 2021 at a compound annual growth rate (CAGR) of 4.2%. There are other factors, as well, not the least of which is the world's ever-increasing population, which ensures increasing demand. But also the ongoing global Corona-pandemic. Post the COVID-19 pandemic and subsequent lockdown, consumers have been more reluctant to shop at physical stores. Since the virus outbreak a steadily increasing number of consumers are leveraging the safety and convenience offered by e-commerce, causing online orders to skyrocket to new highs.



## BIGGER, TALLER FACILITIES

A trend across all cold storage subsectors is a shift toward larger, multi-storey facilities. According to the Global Cold Chain Alliance and DatexCorp, the total capacity of cold storage warehouses has been increasing at roughly 4% annually since 2013. Industrial real estate firm CBRE estimates that average warehouse heights have increased by more than one-third since the 1960s.

This is partially due to an increased need for warehouses in urban areas, where real estate is more expensive,

and partially due to the high cost of building and operating a cold storage facility. Because of their sophisticated freezer and cooler needs and comparatively high energy usage, the cost of operating cold storage facilities can be as much as three times that of operating conventional warehouse space.

Nine storey high facilities capable of keeping foods at temperatures from 0 to -25 degrees Celsius are already a reality. Even larger facilities of 50,000-square-metres or more are also being built.

# Common Problems Facing Cold Storage Facilities

Regardless of their size or inventory, all cold storage facilities (and supply chains) share some universal challenges, with the first and foremost being **cold chain integrity**. A cold chain can break down at many different points from point of origin to the consumer. Inconsistent temperature control during shipment, poor temperature control inside the warehouse, and product sitting on an open dock (or in an open trailer) too long are all common scenarios for cold chain disruption. Considering the value of a standard OTR food shipment is between €50,000 and €100,000, with reefer loads going up to €1 million (and pharmaceutical loads up to €50 million) any glitch in a cold chain's integrity can become an immensely expensive mistake.

**Employee safety** is a concern at all warehouses, whether they are cold storage or dry goods. Loading dock areas are particularly dangerous, accounting for nearly a quarter of all industrial injuries. This isn't surprising, considering the number of forklifts manoeuvring around towers of pallets and product with a fair amount of foot traffic mixed into such a small area. Dock exteriors are also a dangerous area. There are hundreds of forklift accidents annually due to trailer creep, trailer tip-over or trailers pulling away from the dock prematurely. Tractor trailers are also a major cause of back-over deaths, and the risk isn't isolated; many international governments are recommending aggressive solutions to address this danger at the dock.

Inside cold storage facilities, large blast freezer doors can be notoriously difficult to open without multiple people. Workers who attempt to open them with unsafe methods – like using a forklift – can damage the door or cause an injury to themselves or others. Multi-storey workspace and storage areas also create risk for fall-related injuries or injuries due to falling product.

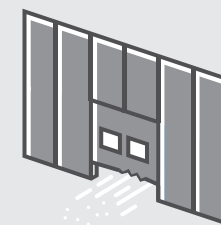
**Regulatory compliance** is another common challenge for cold storage facilities, particularly in the food sector. Cold chain integrity plays a vital role in meeting food safety standards, defined by organisations like the European Food Safety Authority (EFSA).

**Reputation is a further challenge**, linking to all three common problems: cold chain integrity; employee safety; and regulatory compliance. GCCA research has consistently shown the extent to which Cold Chain providers play an integral part in their customers' food safety regimes and need to see themselves as 'Brand extenders'. In a table entitled 'Top Business Trends that will impact the Company', highest on the list was 'food safety' and 'protecting the brand'. The challenge of regulation and compliance was not far behind.

## Other Cold Chain Challenges



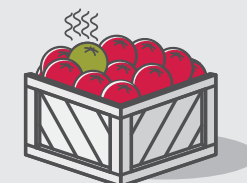
Condensation



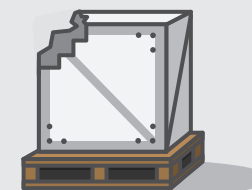
Damage to cooler/  
freezer doors



Mould/mildew/  
microbial growth



Heat exposure  
at loading dock



Damaged/  
compromised  
shipments getting  
delivered

# Best Practices: New Design and Technology

A number of new technologies and facility designs have been developed recently to help cold storage warehouses and distribution centres become more energy efficient and productive in the process.

## DRIVE-THROUGH DOCK DESIGN

The loading dock is the gateway for products in and out of any cold storage facility. A traditional loading dock requires truck drivers to break the security seal and open the truck doors before finishing backing in and docking. If this process isn't completed in a timely manner, it could damage temperature-sensitive products. It also creates opportunities for theft, tampering and drive approach accidents.



The gold standard for any industry that depends on a strong cold chain is to implement a “drive-through” application at the loading dock. In addition to securing the cold chain, this loading dock solution can prevent product from being tampered with or stolen and helps maintain cold chain integrity, environmental control and security.

A drive-through set-up requires more than just one product; it entails a system of equipment that works together. The core component is a load house which is a modular housing system that combined with a dock shelter, a dock door and a dock leveller forms a stand-alone docking system that can be attached to the building. This allows the trailer to back all the way into the loading dock before the security seals are broken and trailer doors can be opened into the load house – meaning loads are never exposed to outside weather or contaminants and people are kept out of harm's way on the drive approach.

The other key to a drive-through application is creating a complete environmental seal between the back end of the semi-trailer and the inside of the loading dock. This can be done with loading dock shelters specifically designed for drive-through docks.

Through special design features, these shelters provide tight sealing against trailer sides, across the full width of the trailer top and at the corners, without interfering with trailer doors being opened and closed after the trailer has been parked at the dock and secured.

*Placing a load house in front of a building is the key for a drive-through-operation and saves costly interior space on the inside.*



*The stepped steel plateau of the load house allows trailer doors to be opened inside the isolated environment of the load house.*

## AGVS AND AS/RS

High-tech, automated and robotic technologies, including automated guided vehicles (AGVs) and automated storage/ retrieval systems (AS/RS), have become increasingly commonplace in all types of industrial facilities in the past decade. This is certainly true for cold storage facilities, where AGVs are regularly used to improve throughput speed of products from end-of-line equipment to shipping. AS/RS systems are also widely implemented to improve safety and efficiency throughout cold storage facilities. As distribution centres continue to grow vertically, these automated picking systems can effectively and safely reach product at various levels without putting the human workforce in dangerous situations.



*Special dock shelters are also a key to drive-through dock applications.*

## RADIO FREQUENCY IDENTIFICATION (RFID)

Another important new technology which has become common in cold storage facilities recently is wireless Radio Frequency Identification (RFID). RFID utilises scanned tags to provide tracking information such as product movement, time spent in transit and temperature fluctuation data. At the loading dock, RFID helps manage the flow of goods throughout the warehouse, while drastically reducing labour hours. RFID tags, when integrated with an existing warehouse management system (WMS), will indicate a product's destination, such as cross-dock movement or in-house inventory location, vastly improving throughput speed at the receiving dock. Standard loading dock procedure has always involved cumbersome bills of lading or packing slips. By removing this human element from cold storage monitoring, RFID systems minimise errors and reduce the need to open the product container at all.

Outbound shipments benefit, too. RFID tags share a product's location from source to its final destination, no matter the method of transportation. This smart supply chain boosts product visibility throughout the cold chain improving the management of perishable and temperature-dependent products, enabling suppliers to deliver a fresher, higher quality product for the consumer.



*The Rite-Vu Hazard Recognition System projects a blue light outside of the dock opening when motion is detected inside the trailer.*

## BLOCKCHAIN SMART LEDGERS

Looking forward, an even newer technology is set to become an industry standard: blockchain. This database, which is also the technology at the base of Bitcoin, provides a smart contract ledger for the exchange of goods between two parties. As a product is only represented at one place within the blockchain database, both parties can securely and safely manage the transaction. Walmart for example implemented a blockchain-powered supply chain monitoring system in 2019. This smart contract technology required more than 100 suppliers to input detailed information about their products into a blockchain database upon initial distribution, and allows Walmart to closely monitor for spoilage and other red flags along the supply chain.

## LIGHT COMMUNICATIONS AND MOTION SENSOR SAFETY SYSTEMS

Loading docks and bays are inherently dangerous places. Thankfully, new technologically-advanced dock safety systems – incorporating motion sensors, LED lights, audible/visual alarms and interlocking controls – are now available to make these critical work areas safer than they've been in the past. In some cases, these systems can be added as stand-alone units as budgets allow, provided facilities install upgradeable equipment as the basis for their dock management system.

The newest of these products are motion sensor-based systems designed to protect workers both inside and outside the dock. One such system projects a blue light onto the leveller whenever activity is detected inside a trailer, alerting workers nearby that a forklift, pallet jack or pedestrian could be coming out at any moment. It can be added to any dock or can be integrated with advanced control boxes to keep the vehicle restraint locked until activity in the trailer stops, ensuring the truck doesn't pull away with a forklift operator still inside.

The drive approach outside of the loading dock is equally dangerous, although collisions here typically involve a semi-tractor trailer rather than a forklift. Given the ambient



*Rite-Hite's Approach-Vu sensor triggers a visual and audio alarm when trailers back into a dock.*

noise and the distance between a loading dock and the engine of a semi-tractor trailer, inattentive dockyard workers may not hear a tractor trailer backing toward them until it is too late.

To address this challenge, docks can be equipped with external sensors, which trigger an audible and visual alarm to alert workers outside the dock when a trailer begins backing in and provide them adequate time to remove themselves from danger.

Some vehicle restraints even include these hazard recognition and control features as standard. Both the internal and external warnings can be incorporated into a comprehensive system using red and green LED lights to indicate a docked trailer's status. When the trailer is locked and safe for forklifts to access, green lights will activate inside at the top corners of the dock opening and a red light will come on outside. When the trailer restraint is no longer engaged, the interior dock corner lights change to red while the exterior light turns green (indicating to the driver it is safe to pull away).



*This GUI (Graphic User Interface) door control box eliminates the need for personal protective equipment, provides valuable data and can be integrated into BMS.*

## SMART CONTROLS

Beyond the physical technology upgrades, the growth in “smart” technology is making it possible for cold chain storage workers to glean real-time data, operate equipment remotely, interlock multiple pieces of equipment and to integrate equipment operations into building management systems (BMS) and security systems. From high-speed door controls to loading dock control panels to high-volume, low-speed (HVLS) fan controls, touch screen technology makes it simple to operate and troubleshoot heavy machinery without the need for personal protective equipment.



*HVLS fans help minimise condensation by creating uniform temperature and humidity levels.*

## CONDENSATION AND FROST PROBLEMS

As one might expect, various forms of water can cause some of the biggest problems with cold chain integrity and worker safety. When warm air infiltrates cooler environments, condensation – and in some cases, frost – can develop.

Condensation and frost on the floor can cause safety hazards inside the facility for workers who might slip. Furthermore, condensation can lead to diminished product quality and compromise the safety of food and pharmaceuticals. Cold storage facilities can’t simply cite building defects as an excuse and are expected to comply with legislation and best-practice by finding verifiable and documentable solutions to frost and condensation build-up.

Frequently called “sweating slab syndrome”, condensation forming on the ground is a common problem in facilities with concrete floors. This usually happens due to warmer air entering through open loading dock doors or gaps between trailers and the perimeter of the dock opening during loading and unloading. Because negative pressure is typical of most facilities, warmer outdoor air (especially in refrigerated/cooler dock areas) typically rushes inside.

Extremely harmful condensation can also form on products that have high water content, like fruits and vegetables,

which can cause spoilage. Even products that don’t immediately spoil can be compromised and become harmful to consumers who eat them later. Condensation is a common factor in many listeria cases.

Many facilities combat this problem with environmental seals and shelters at loading dock openings. The most advanced dock shelters can eliminate virtually all gaps along the dock perimeter to minimize air infiltration, as well as any debris or pests.

HVLS fans also play a role in mitigating condensation build-up on and near the floor. Through a process called destratification, HVLS fans unify air temperatures from floor to ceiling. An HVLS fan can transform a tall facility with a 8°C difference from ceiling to floor into a single degree. Instead of cool air settling on the ground where warm air can condense, temperature and humidity levels that become uniform diminish condensation development.

Similar to condensation, frost can develop near especially cold areas. It’s not uncommon to find frost near doors and door openings that separate freezers from warmer working areas. This frost can lead to worker safety issues and also increased risk for air infiltration in instances that affect freezer doors closing.



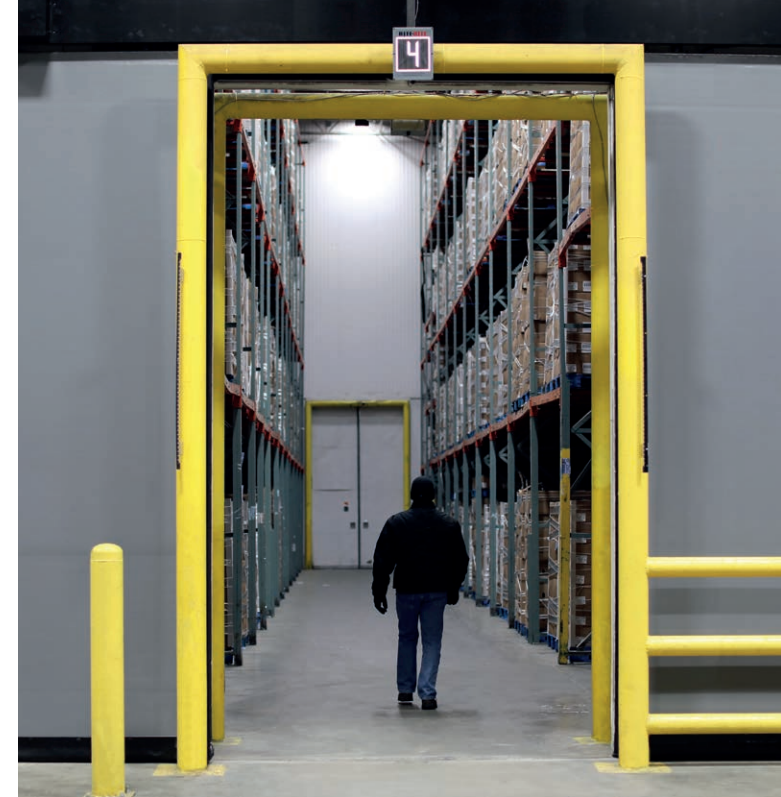
## NEW COOLER AND FREEZER DOOR TECHNOLOGIES

Doors and walls play important roles in facility safety and work zone separation, as well as cold chain integrity. High-speed fabric roll-up doors are becoming more popular across all types of industrial facilities due to their forklift-friendly safety design. A forklift collision with traditional, bi-parting doors can lead to driver injury, product or equipment damage and costly downtime due to repair. Fabric doors allows them to withstand forklift impact and snap right back into their tracks – greatly reducing both downtime and energy loss as compared to traditional doors.



Cold storage facility managers are also becoming increasingly aware of the energy-efficiency benefits of high-speed doors as opposed to slow moving traditional doors. In addition to food, they are highly applicable for keeping pharma product within heavily regulated set temperature levels mandated by government agencies. This awareness shift is taking place globally, with the International Energy Conservation Code (IECC) recognising the importance of high-speed doors. Its 2015 edition includes a revision to Table C402.4.3, which describes the maximum air infiltration rates for fenestration assemblies. As a draft copy of the table notes, their fast cycle times (up to 2.5m per second) minimises air exchange, which is a key part of reducing overall energy losses through a door opening.

*High-speed, roll-up doors are becoming a must for cooler and freezer applications.*



*Rite-Hite's Barrier Glider cold storage door improves on the technology of traditional cold storage doors. Innovative Iso-Tek® panels are combined with a Thermal-Flex Sealing System to help achieve superior environmental separation at the opening with lower energy costs.*

Blast freezers present their own unique set of door challenges. Also known as “shock” freezers, blast freezers are widely used in the food industry to quickly freeze everything from TV dinners to fish to ice cream. Unfortunately, these massive blast freezers present a threat to in-plant safety for employees and equipment. The size, pressure and frost build-up in many blast freezers often makes the insulated panel doors very cumbersome to move. In some cases, these large doors (which can be as large as 7m by 7m) have become so heavy and hard to open that employees have resorted to dangerous methods to open them, such as using a forklift. When left open even a crack, these doors can waste large amounts of energy.

# Takeaways

## KEEPING UP WITH TRENDS IN COLD STORAGE

The cold storage industry is undergoing a massive shift. New regulations are putting an increased emphasis on product integrity and safety. Advanced technologies are allowing for more efficient and transparent operations. Consumer behaviours are driving an Amazon effect of bigger and taller warehouse storage.

As a facility manager, it's vital to stay on top of all these trends and make sure your facility is staying ahead of the curve with the newest technologies and procedures to ensure the stringent standards and increased customer demands are being met. From drive-through loading docks and airtight seals on the exterior of the plant to high-speed doors, smart controls and advanced safety systems on the inside, there are numerous ways to deliver a prosperous future.

# 5 Biggest Changes to Cold Storage

- ▶ AUTOMATION/ROBOTICS
- ▶ DIGITAL RECORD-KEEPING/DATA-COLLECTING CONTROLS
- ▶ SHARED RESPONSIBILITIES ACROSS SUPPLY CHAIN
- ▶ BIGGER AND TALLER WAREHOUSES
- ▶ ENERGY EFFICIENCY INITIATIVES



Improving industrial **safety**, **security**, and **productivity** worldwide through quality and innovation.

- ▶ VEHICLE RESTRAINTS
- ▶ LOADING DOCK LEVELLERS
- ▶ DOCK SEALS AND SHELTERS
- ▶ INDUSTRIAL DOORS
- ▶ HVLS FANS
- ▶ BARRIER SAFETY SYSTEMS
- ▶ SERVICE, REPAIR AND MAINTENANCE
- ▶ INDUSTRIAL CURTAIN WALLS