

INTO THE DEEP FREEZE

New-generation LGVs make breeze of heavy lifting in deep-freeze warehouses and sub-zero distribution centers

By Jim McMahon

Deep-freeze warehouse environments pose significant challenges for food processors, distribution centers and retailers who endeavor to have facilities operating at a high level of efficiency.

The consumption of frozen products has increased dramatically, and rapid replenishment of retailers' shelves is critical.

Every aspect of deep-freeze warehousing is moving faster. Turnover of stock is faster, with an increasing number of products in the -4°F to -22°F range, and there is a need to respond quickly to market demands.

Maintaining a high throughput rate, along with inventory and fulfillment accuracy, is a much more difficult task than at ambient temperature or inside a chilled warehouse.

While the temperature in these deep-freeze facilities is cold enough to store food products safely, it creates an extreme environment with difficult working conditions for personnel, increased safety issues, and staff recruitment and retention problems.



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Compared to non-deep-freeze facilities, most manually operated sub-zero warehouses have a higher incidence of product damage, missed product rotation and wrong item fulfillment, which have negative impacts on production and cost efficiency.

Increasingly, frozen-food producers and distributors need to track and identify where each product lot originated, where pallets came from, where they were stored, what the temperature was in storage, and other critical data to keep track of their perishable inventory and to ensure its product integrity.

Manual handling leaves open the possibility of human error in recording and providing this data quickly, with reliable and verifiable documentation.

Automation of deep-freeze warehousing presents an optimal solution to these difficulties.

The most streamlined deep-freeze warehouses today are highly automated sites, typically equipped with robust material-handling systems that are engineered to function optimally under deep-freeze conditions.

These include high-density storage utilizing robotic pallet shuttle systems and automated storage and retrieval systems, robotic picking and palletizing, smart modular conveying, and management systems capable of integrating all functions from receipt of materials, through production, end-of-line packaging, warehousing and shipping.

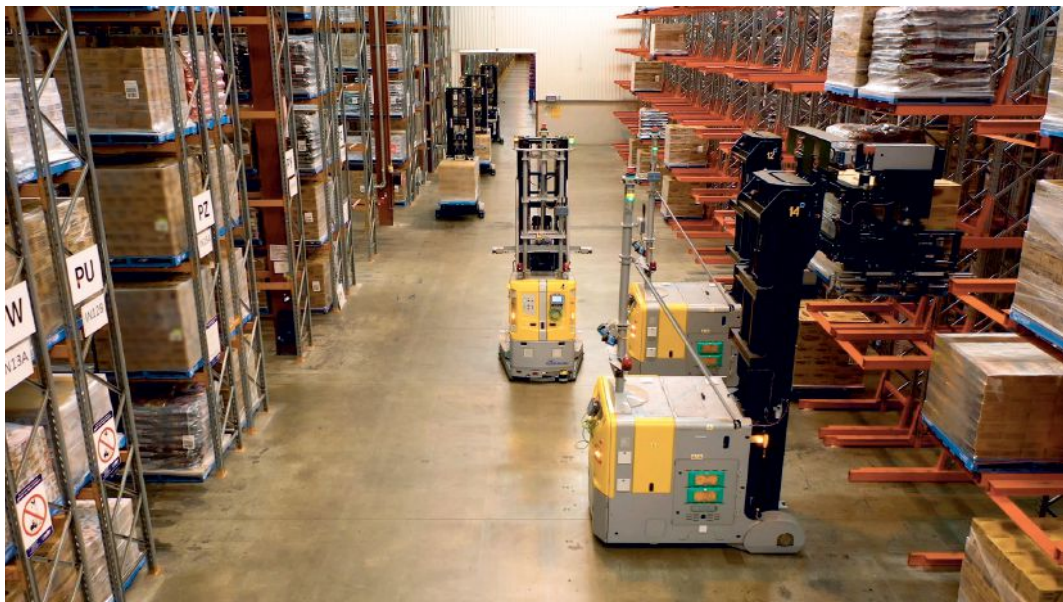
One increasingly critical feature amongst these automated systems is the laser-guided vehicles (LGVs), which provide for movement of pallets between these integrated functions.

The use of LGVs has played a pivotal role in facilitating process and throughput efficiency in deep-freeze manufacturing and distribution operations.

Interfacing with multiple systems, LGVs provide reliable raw material and product handling, with near zero potential for product damage.

Utilizing a combination of logic software and wireless navigation, LGVs can perform tasks that are not possible with other transport

The new range of laser-guided vehicles (LGVs) from Elettric80 are engineered to operate in temperatures down to -22°F, while handling various pallet types with heavy loads weighing up to 3,400 pounds.



systems—such as the uniform movement and positioning of pallet loads to within a fraction of an inch of their designated targets, without noise, and with a high degree of safety for workers and their operational environment.

Transporting heavy pallet loads, however, imparts huge forces upon these vehicles, resulting in significant maintenance and power requirements to keep LGV fleets functioning.

The latest generation of LGVs, however, incorporates design, navigation, sensor, power and controls improvements that significantly streamline their prior operational performance.

An excellent example of these high-performance automated vehicles can be found in the **Elettric80**'s latest forked, counterbalanced LGVs for pallet movement.

Founded in 1980 and headquartered in Viano, Italy, **Elettric80 S.P.A.** (www.elettric80.it) specializes in the development of automated logistics solutions for consumer goods manufac-

turers in the beverage, food and tissue sectors, as well as many other diversified areas.

A leading global manufacturer of LGVs for almost three decades, some of the company's latest technology advances have made LGVs particularly adaptable for operating in deep-freeze environments.

Focusing on extreme cold temperatures down to -22°F, Elettric80's latest forked LGVs have been engineered to function optimally under these deep-freeze conditions.

Made from specially blended steels, all the oils, greases and other lubricants for gearboxes, bearings and drives in these workhorses are specified for extreme low temperatures, with all the wiring and electrical cables designed to flex in these freezing temperatures.

All the programmable logic controllers (PLCs), PCs and other electronic control components are kept in heated cabinets, while photo-electronic sensors that feed computer information and detect pallets are maintained to be free from frost by being equipped with heating devices.

Automated systems for deep-freeze need to be designed to include these features, not only so they can function reliably, but also for system longevity.

A key factor in LGV operation, and particularly in deep-freeze environments, is battery performance.

The most conventional power source used in LGVs has been, and still is, lead acid. But lead is heavy, and these batteries require extensive maintenance, they are slow-charging, and perform



The Elettric80 LGVs can accommodate both single- and double-deep racking, as well as extended depths, with satellite remote units.

poorly in extreme sub-zero temperatures, making LGVs a limited technology solution for deep-freeze work.

Happily, the introduction of lithium ion batteries has changed much of this for the better. A lithium ion solution, for example, with the capability of putting out 140 amp hours (Ah) of power would weight about 150 pounds. Compare this to a lead acid battery putting out the same power, but weighing 700 pounds.

Moreover, a lithium ion phosphate battery will charge four times faster, and deliver four times the service life compared to lead acid.

But while they a better solution for LGVs in deep-freeze environments, they still lack the performance capability compared to operating in ambient or even refrigerated environments.

An even better solution for deep freeze is lithium flash battery technology, which was first introduced for use with LGVs by Elettric80, and remains a proprietary technology reserved for

Elettric80 LGVs.

Flash batteries provide higher performance than any other type of battery for industrial vehicles. With power output up to 300 Ah, they deliver balancing speed up to 20 times faster than other lithium batteries, and can be recharged to 50 per cent in less than 30 minutes, compared to twice that time for traditional lithium batteries.

The control electronics in a lithium flash battery keep it balanced and efficient, eliminating the need for regular maintenance.

It is also equipped with a remote monitoring system that enables the condition of the battery to be determined at any time, while reporting any malfunctions.

Only one lithium flash battery is required per LGV, compared to two or three batteries needed with traditional lead acid LGV applications.

One very unique value-added feature of this battery is wireless induction charging. In fact, the battery stays in the LGV while charging with no



Lithium flash battery technology provides a better solution for LGVs operating in deep-freeze environments.

connecting wires, while the LGV does not even have to leave the deep-freeze environment to be recharged.

The implications of this are considerable—reduced time for not having the LGV leave the facility, and for not having to switch out the battery; and no connection sparks from cable connecting, resulting in improved safety within dry deep-freeze facilities.

So critical to LGV performance, the latest-generation of LGVs designed for deep freeze—like those from Elettric80—are equipped with multi-navigation capabilities based on laser guidance, supplemented with vision guidance.

Both navigation methods are seamlessly combined to switch back and forth from laser to vision guidance without stopping the vehicle.

This allows the LGV to move throughout a deep-freeze facility, where one system alone may not have access to the physical surroundings necessary to support that system.

Laser navigation is based on target triangulation to keep the vehicle on course. The vehicle is equipped with a rotating laser beacon, which scans 360° around the vehicle for laser targets mounted on columns, walls and stationary machinery.

The reflections from these targets are measured relative to angles from the vehicle,

and triangulated to allow the vehicle to determine its position.

This position is compared to a CAD-type map stored in the vehicle's memory. The system uses positive-positioning feedback in real time, computing algorithms hundreds of times per second, and the steering is adjusted accordingly to keep it on track.

It can then navigate to a desired target using the constantly updating position, with saser navigation obtaining tracking accuracy of about ± 0.75 -inch.

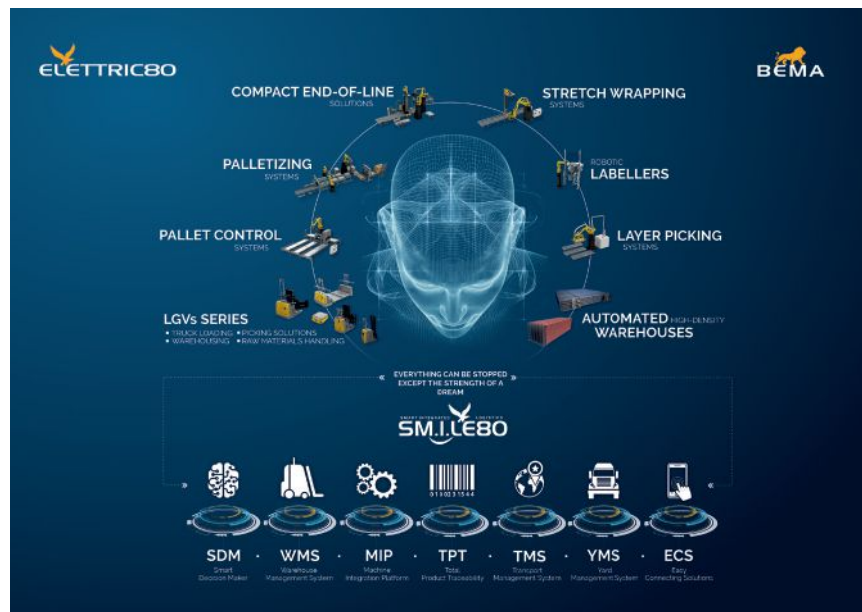
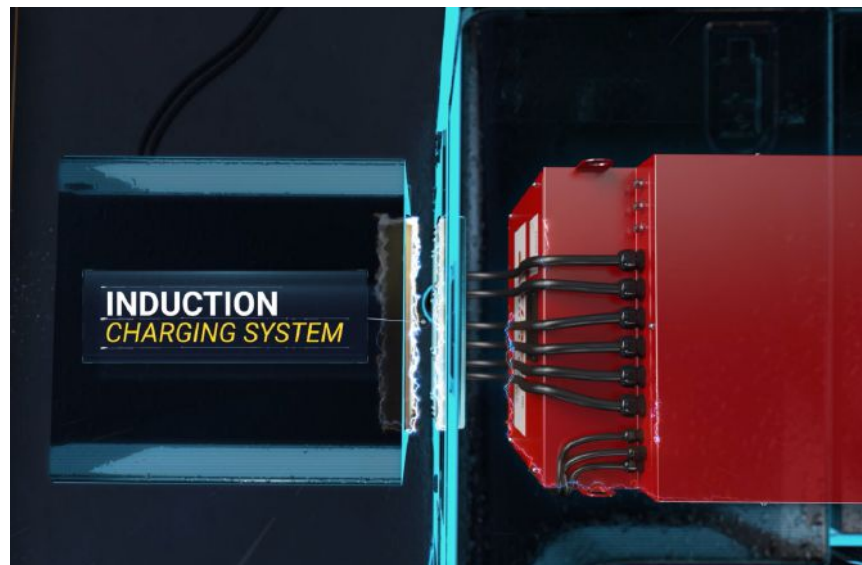
Vision navigation uses cameras or lidars onboard the LGV to detect the vehicle's surroundings and understand its position. Each vehicle has a CAD-type map of the system layout in its memory, and all are equipped with outboard laser bumper sensors for object detection.

Covering the vehicle 360°, including upwards, the sensors are designed to cause the vehicles to adjust their speed, or stop if necessary, if an obstacle is detected in their path. Once the path is clear, the LGV will automatically continue its mission.

The smooth functioning of LGVs is dependent on their controls system, which has the task of coordinating the orders received from the plants' process system, a warehouse management system (WMSm, or ERP (Enterprise Resource Planning) system.

One of the most advanced LGV controls systems for automated deep freeze applica-

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Powerful software and state-of-the-art controls make it easy for operators of deep-freeze warehouses or production lines to optimize their cold-storage LGV fleets for optimal system flexibility.

tions is the *Smart Integrated Logistics (SM.I.LE80)* from Elettric80.

The positional status of each LGV is continuously being updated through this control system regarding such factors as whether it is loaded or unloaded, emergency stopped or soft-stopped, operating in manual mode, and battery level.

A simulation module simulates the LGVs in the system., while the HMI (human-machine interface) graphical interface gives the operator a graphical overview of the LGV locations in the system and monitors each in real-time.

Operational flexibility is a key factor: not just in its capability to direct and manage the fleet of LGVs, but also in its expandability.

Any number of automated guided vehicles can be added to the network, at any time plant production or distribution needs require.

But the latest-generation of LGV control systems can do much more.

For example, *SM.I.LE80* ensures the integrated and automated management of systems and flows—communicating with production lines, palletizers and wrappers—as well as coordinating the movement of pallets in the warehouse, right through to shipping.

The entire logistics flow of the controlled-temperature environment can be centrally managed from an integrated logistics software platform that ensures the efficient integration and optimization of all operations.

Such a controls system also guarantees total product traceability and safety throughout the deep-freeze supply chain.

A *WMS* module within *SM.I.LE80* can also substitute for a traditional *WMS*.

The *WMS* module contains the standard interface system that integrates with the factory's *ERP* system.

It enables the implementation of multi-site communication by providing a centralized *ERP* interface and transmitting information to different systems as needed, so that all system activities can be monitored in real time.

The *WMS* module also provides a statistics and reporting package for analyzing productivity, monitoring system KPIs (key performance indicators) and operator performance, and checking system exceptions, among other functions.

Another option offered within the *SM.I.LE80* controls package is its *Yard Management System*

(*YMS*) module, which oversees, manages and tracks trucks, trailers and containers in the yard of a production plant, warehouse or distribution center. This module encompasses:

- Real-time information on the arrivals and locations of vehicles and containers, with associated parking times;
- Real-time monitoring of order shipping and loading bays;
- Reports and dashboards on KPIs for processes and people, with statistical analysis of delays, workloads and yard parking times.

Today, 3D mapping in temperature-controlled environments permits extremely detailed LGV system simulations factoring all the variable conditions, such as human interaction on the floor where LGVs are in motion.

Fleet size is monitored by volume of product transported per move, and length of the route. The bigger the LGV system, the more important is the need for simulation.

In a system larger than five or six vehicles, simulation would be highly recommended, as mathematics calculations alone cannot adequately profile vehicle-to-throughput ratios.

The most recent automation developments in forked LGVs for pallet movement in deep-freeze environments enable warehouse operators and plant production supervisors to optimize for system flexibility, modularity and scalability.

Designed to handle various pallet types—such as *CHEP*, *EURO*, *Blockpallet* and *Stringer*—with load requirements up to 3,400 pounds, these LGVs are able to accommodate single-deep and double-deep racking with a telescope fork. Using a satellite remote unit, the lane depth can also be considerably extended.

An increasing number of supply chain manufacturers, including food processors, bottlers and distributors, require 24-hour operation at maximum throughput in cold-storage facilities.

Happily for them, today's latest generation of LGVs have been designed to efficiently meet and exceed these requirements.

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