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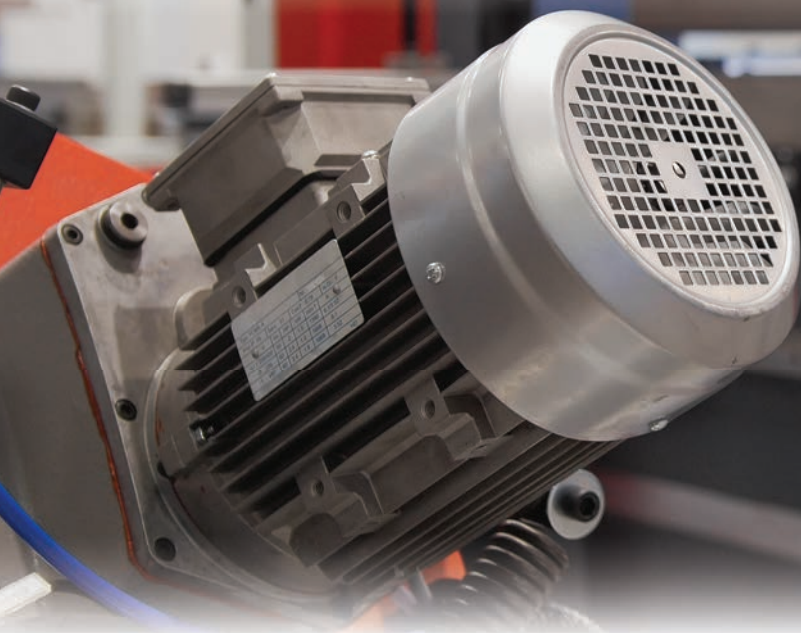
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Material Handling/Logistics

MOBILE ROBOTS

- 8 Mobile Robotics and Safety: Building a Better Work Environment**
A look at the benefits of using cobots, AGVs and other mobile robots in any facility to raise productivity.

PALLETS

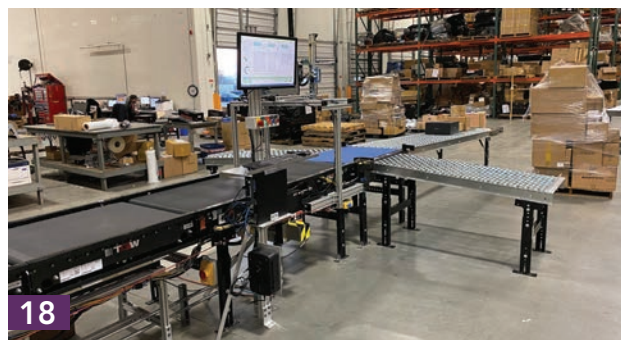
- 12 The Difference Between Pallet Audits and Total Pallet Management**
How to choose which is best for your facility to improve optimization and performance.

LIFT TRUCKS

- 15 Fork(Lifts) in the (Off-)Road:**
Should we ban internal combustion engines for electric?

CUBING & WEIGHING

- 18 Don't Be Afraid of Automation**
A look at available solutions to help you reduce errors, make your operations more efficient and avoid chargeback scenarios.



In Every Issue

- 6 Editor's Column**
61 Product Spotlight
62 Ad Index

Environmental Health & Safety

OSHA'S TOP VIOLATIONS

- 24 Duty to Have Fall Protection**
28 Respiratory Protection
30 Ladders
32 Scaffolds
34 Hazard Communication
38 Control of Hazardous energy (LOTO)
42 Fall Protection Training
44 Eye and Face Protection
46 Powered Industrial Trucks
48 General Requirements for all Machines

FACILITY SAFETY

- 50 Resist Being Penny Wise or Dollar Foolish**
A look at practical solutions to boost your facility safety.

EYEWASHES & EMERGENCY SHOWERS

- 54 Five Best Practices for Emergency Eyewashes and Showers**
When purchasing, placing and maintaining your emergency equipment, remember these five key things.

HAND PROTECTION

- 56 Essential Hand Protection for Worker Safety**
Hand protection best practices for everyday tasks, chemical exposure, impact protection and more.



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This year, as I always do, I've been compiling information for the Product Innovations of the Year section we run in our December issue. This process begins in January and represents our dual editorial focus: material handling and safety. Because I receive so many press releases about new products, it is sometimes difficult to decide which ones make the final cut. (They are *all* featured on our website at the time we get the information.)

I'm always amazed at how manufacturers are constantly engaged in innovation. Personal protective equipment (PPE) gets more specialized. Machinery gets more efficient. It would be interesting to summon up a few workers from the past and transport them into modern workplaces, to see their reactions.

Someone who lived a few hundred years ago and moved grain by using a simple conveyor made of a leather or canvas belt over a flat wooden bed would be astounded if he or she were suddenly plunked down into a distribution center of today. So would a worker who helped build Model T cars in the early part of the 20th century. The conveyors Henry Ford introduced into his automotive manufacturing plants helped reduce the time required to build a car by 80%. They were remarkable for their time, but there is no comparison between them and the complex, tech-driven ones in use today. The speed and ease with which items can be moved over long distances and along monorails, electric tracks or trolleys would have been inconceivable to those long-ago workers, as would the variety and quantity of the items that have to be moved.

Managers who used to keep track of inventory by hand, in notebooks, would marvel over advancements that have revolutionized inventory management, like bar codes and the scanners used to recognize them, as well as radio frequency identification (RFID) chips that report when an item arrives in a warehouse and directs a forklift driver to put it in a specific location. Automated locker systems that use chips to record the locations of items and relay that information to a computerized system also make it easier to manage inventory.

Horse-drawn wagons have been replaced by lift trucks. Communication has been transformed. Instead of being shouted over the noise of a factory, instructions can now be communicated via radio headsets – even among employees who are wearing hearing protection.

Personal protective equipment (PPE) has also evolved. The shipyard workers of today are probably happy to have alternatives to what their 19th century counterparts used to do to shield their heads from falling objects: slather them with a thick layer of tar, which dried in the sun to produce a tough covering. Leather headgear came along later. It was ultimately replaced by hard hats inspired by the helmets worn by U.S. soldiers during World War I.

Blacksmiths hammering horse shoes on hot forges during the Middle Ages wore heavy leather aprons for protection; today's welders have flame resistant options. Work gloves and boots, safety eyewear, fall protection – everything in use today had its origins in earlier, simpler versions. Firefighters long ago reportedly grew long beards, soaked them in water and then flipped them up to cover their noses as a form of rudimentary respiratory protection – a far cry from the self-contained breathing apparatus (SCBA) devices commonly used by today's firefighters.

Manufacturers will, no doubt, continue to innovate, to design and make products that are more specialized, durable, sustainable and user-friendly. For our part, *Workplace Material Handling & Safety* will continue to keep you updated on the equipment, automation and PPE that will make your operations more efficient and your workers safer. You don't have to wait until our end-of-the-year "best of" section, either. Check out the advertisers who bring you information about their products in our monthly issues. You can also go to www.workplacepub.com and click on both Material Handling and Safety on the main menu to access lots of product information.

Maureen Paraventi Chief Editor, WMHS, Maureenp@rdgmedia.net



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Randy Green, President & Group Publisher

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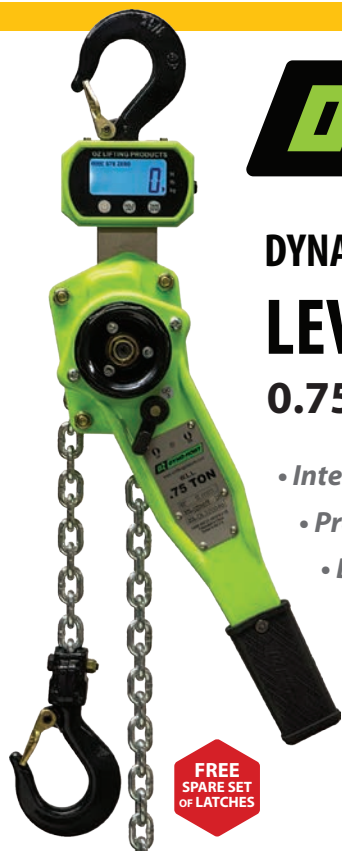
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A photograph of a white mobile robot with a black top deck, carrying a large brown cardboard box. The robot is on a grey floor with white grid lines. Other similar robots are visible in the background.

Mobile Robotics and Safety: Building A Better Work Environment

By: **Steven LaFevers**, Contributor

Warehouse robotics are past the awareness stage. From horizontal transportation to storing and retrieving pallet loads at height, increasingly capable robotic solutions are becoming regular fixtures at warehousing and automation events, and in trade and business publications across the globe.

And with technology advancing to become increasingly capable and scalable, the signals for greater adoption of robotic solutions are clear. What better way to augment your labor pool, enable social distancing, boost productivity and improve retention than by automating repetitive, non-value-added tasks and focusing employees on more engaging, satisfying work?

The underlying industry forces make adopting robotics a pending reality, not just a possibility. Instead of building an understanding of robotic capabilities and their theoretical value, distribution center managers are asking for practical guidance to turn robotic ambition into adoption.

As with any new technology, safety is a critical element in this move to adoption, especially as so-called “cobotic” workflows feature humans working in close proximity to their robotic counterparts. Answering the question of safety on the path to adoption requires understanding robotic lift truck functionality, navigation behavior and how their work can affect the roles of human counterparts – both in the normal course of business and in special circumstances.

MOBILE ROBOTIC NAVIGATION TECHNOLOGY

While traditional automatic guided vehicles (AGVs) require guidance infrastructure like embedded wire, reflectors or magnetic tape to navigate fixed pathways, the latest robotic lift trucks represent a departure from that paradigm. Today’s robotic solutions are capable of moving through indoor logistics environments without navigation infrastructure or an operator.

This competency is made possible by Simultaneous Localization and Mapping (SLAM), in which robotic solutions use a reference map based on structural elements in the operating environment and compare it to what they sense in real time. This process allows the robotic lift truck solution to accurately and precisely self-locate – no additional navigation infrastructure required.

As know-how continues to mature and equipment decreases in cost, an increasingly popular navigation system is the laser-based technology, Lidar – short for light detecting and ranging. This sensing method sends out pulses of laser light to determine the presence and distance of objects. To understand their location while in operation, mobile robotics use Lidar to get the real time “view” of surroundings and compare to the reference map mentioned previously through the SLAM process.

MOBILE ROBOTS AND WAREHOUSE SAFETY

The consistent, strong performance of navigation technology and programming of site-specific rules enable robots to adapt to surroundings and real-time conditions, while strictly following safety protocols. This capability helps reduce the risk of accidents, collisions or other safety incidents, including when compared to lift trucks with human operators.

High turnover is common in warehousing, and with inexperience among operators comes increased risk. OSHA estimates that approximately 70 % of forklift accidents could be avoided through better adherence to standardized training and safety procedures. By comparison, robotic solutions deployed on the warehouse floor perform according to their programming from day one – without the extensive onboarding and training required to bring new operators to a satisfactory level of skill and experience.

While robots are predictable – they always follow safety procedures and can be programmed for site-specific rules

of the road – people are not. And with humans working more frequently in close partnership with robots in what's known as cobotics, training everyone who enters the facility on how to safely interact with robots is especially important.

HOW DO MOBILE ROBOTS AFFECT THE ROLE OF WORKERS?

While it's clear that safety can get a leg-up, another chief advantage of robotics might not be as obvious. For some, the idea of robotic colleagues might conjure a bleak or even dystopian scene for modern workers, but the evidence suggests otherwise.

Automation technology can actually make work more “human” and make people happier at work. Academic research shows that organizations augmented by automation technologies are 33 % more likely to be “human friendly” workplaces, in which employees are 31 % more productive. That's because robots have the power to relieve workers of the monotony of repetitive tasks that are abundant in supply chain environments, and instead focus on more rewarding, higher responsibility work.

But delegating repetitive tasks to robotic solutions goes beyond busting boredom for employees, though it does that too. Enabling personnel to concentrate on more strategic work better equips them to remain focused and practice good judgment – both major advantages for warehouse safety and productivity.

Scientists have found that monotonous work can negatively impact mental health, cause major stress and lead to burnout. In her paper, “Neuroscience Reveals That Boredom Hurts,” Dr. Judy Willis, a neurologist and former classroom teacher, claims that when we're bored our judgment, goal-directed planning, risk assessment, focus and control over emotions all suffer.

For most workers, risk-assessment, focus and judgment are a matter of performance. But for warehouse workers who spend their shifts supervising machinery, maneuvering heavy loads, and operating in a fast-paced environment, those factors are also fundamental to safe – and effective – operation.

As the conversation around employee engagement continues, robotics can play a part in shaping more meaningful work experiences. Improved job satisfaction is significant for individual employees, but it's also a boon to operations. According to a Gallup study, organizations with better employee engagement achieve higher performance, including substantially better retention, fewer accidents and increased productivity. Finding and training new hires can cost thousands, so using robotics to shift human

workers toward responsibilities that help engage and retain them makes good business sense, too.

COBOTICS IN ACTION

Through human-robot collaboration, cobotics capitalizes on the unfaltering reliability we expect from robots, and the knowledge, creativity and decision-making skills of people. An example of a cobotic workflow in practice might include a worker who shifts her focus to picking and retrieving, assembling pallets and other more complex, high-value tasks while an automated lift truck takes on the work of repeatedly traversing the warehouse, transporting product from point to point. Spared from accompanying the lift truck, the worker invests more time completing high-impact tasks that both exercise and benefit from strategic thinking and problem solving. As the robotic lift truck fulfills needs throughout the facility, several features help it serve as a good steward of a safe working environment.

Robotic lift trucks adhere without exception to warehouse “rules of the road,” such as maximum speed or minimum distance from pedestrians, other equipment, facility infrastructure and more. Where workers can be distracted by what they're carrying, co-workers or environmental factors, robotic lift trucks are not prone to such diversions, relying on environmental sensors to detect and avoid obstacles.

Management software can direct robotic lift trucks to take predetermined routes to avoid heavy traffic areas. For operations with multiple robotic lift trucks in use, this ability to manage routes to help avoid bottlenecks is especially valuable, both for efficiency and safety-oriented benefits.

A reduction in warehouse congestion can allow pedestrians and manned lift trucks to navigate without delay or incident more easily. That seamless traffic flow is especially valuable as warehouses ramp up storage capacity and order volumes during seasonal peaks and other demand fluctuations.

SPECIAL CIRCUMSTANCES: WORKER SAFETY IN A PANDEMIC

While robotic solutions offer significant operational benefits in the normal course of business, they've also been uniquely valuable during the COVID-19 pandemic.

As the outbreak unfolded, maintaining at least 6 feet of social distance between workers quickly became a critical measure to protect essential workers. Converting social distancing guidelines into reality required many operations to adjust workflows and reduce staffing levels, an added challenge as facilities worked to keep pace with surging consumer demand also brought on by the pandemic.

Robotics help operations respond to demand without increasing headcount and helping reduce worker-to-worker

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contact that can risk virus transmission. For example, a robotic lift truck that transfers products between locations allows workers to remain relatively stationary or contained to a particular area as they work, helping maintain a safe social distance.

INTRODUCING ROBOTICS TO YOUR WAREHOUSE

Advancements in underlying technologies have made robotics increasingly attractive. These technologies enable solutions that reliably practice facility traffic protocols, allowing them to drive productivity and work according to safety guidelines. Though as with any warehouse tool, training workers on how to properly interact with them is just as essential.

Once employees are thoroughly trained on proper protocol for working in robotic settings, putting robotics to work in your warehouse can also help provide a more nuanced benefit – freeing workers to focus on roles that keep them more mindful and engaged. **WMHS**

Steven LaFevers is the Vice President, Emerging Technology, Hyster Company. To learn more about how Hyster robotics can support your operation, visit www.hyster.com/north-america/en-us/innovations/robotic-lift-trucks/.



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The Difference Between Pallet Audits and Total Pallet Management

Contributed By: **Pallet Consultants**

A pallet audit is a service where your pallets and pallet usage are studied to improve optimization and performance, whereas a total pallet management program is the complete handling of all aspects of your pallet inventory.

There is a variety of pallet services offered by pallet manufacturers, two of which are pallet audits and total pallet management. Although a pallet audit is often paired with total pallet management, the two services are distinct and provide different benefits to facilities. Pallet audits are detailed inspections of pallets and how they are used within the facility in order to meet efficiency targets or other goals provided by the facility. Total pallet management is a complete outsourcing of all aspects of pallet inventory management, from ordering and repairs, to retrieval.



As products and facility layouts change, pallets of different sizes or construction types may offer better performance for loads or be more cost effective.

PALLET AUDITS:

- Take a deep dive into your pallet performance and usage
- Are adapted to each facility and its goals
- Are used to suggest more cost-effective pallets that meets facility needs and suggest ways to optimize pallet inventory
- Can have up to four different specializations

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- Does not use any facility personnel; all workers are provided by the pallet manufacturer

PALLET AUDIT

A pallet audit is a detailed look at your pallets and how they're used throughout the facility. Used both by itself and in the beginning stages of a total pallet management program, a pallet audit is built around addressing specific areas an operation would like to improve. This can range from pallet performance and optimization to automation implementation. Useful across industries, pallet audits can bring benefits to:

- Manufacturers
- Distributors
- Cross Dockers
- LTL Companies
- Logistics & 3PL Businesses

Pallet engineers, logistics experts and teams from other experience backgrounds can be brought in during a pallet audit depending on the facility's goals. Since the emerging e-commerce economy is dynamic and prone to quick change, pallet audits may be necessary every one to three years depending on the industry. The service can document and improve a number of operational facets, such as:

- Pallet design consultation
- Reducing shipping costs
- Minimize product and pallet damages
- Improve efficiency of pallet inventory
- Maximize value in freight transport
- Automation integration

Many of these benefits come from the backbone of a pallet audit, a dive into your pallet type, performance and how those factors work within your use case. As products and facility layouts change, pallets may need to be re-optimized. In many cases, pallets of different sizes or construction types may offer better performance for loads or be more cost-effective. Pallet engineers can even simulate the products facilities handle and recommend more efficient palletization methods, maximizing pallet use and transportation costs. Recommendations for backup pallet inventory and delivery and retrieval schedules can also be made. Pallet audits are a great way for facilities to check up on their pallets, ensuring they're still as lean and effective as possible with their pallet inventory and handling.

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TOTAL PALLET MANAGEMENT

Total pallet management, or TPM, often begins with a pallet audit. The audit is similar to the standalone service, but with TPM it's also an opportunity for a service provider to prepare for a deeper integration with the facility. With a TPM program, the pallet service provider takes complete control and responsibility for all aspects of the pallet inventory and works alongside the facility management. Rather than having facility team members order pallets, unload and handle pallet deliveries and recycle or reuse those pallets, the entirety of the pallet process is handled by the service provider. TPM can include:

- Accurate and lean pallet ordering and inventory management
- Pallet sorting and on or off-site repair
- Pallet recycling and retrieval
- Vendor consolidation across multiple locations
- Trained pallet personnel and equipment like forklifts
- Cardboard and plastic recycling services

TPM can be customized to each facility and industry, allowing those operations to focus on what they do best. Not only are the pallets inventories optimized like with pallet audits, but all other aspects are handled for the facility. Pallets are a necessity, but can also be a drain on time, personnel utilization and logistic flexibility. Having an experienced team handle all pallet functions can increase efficiency in multiple areas.

With a well-run TPM program, all pallets will be ordered and received on time and in the correct quality and size. Trucks will be unloaded by the pallet team, which is done in addition to the sorting and repair of used pallets. Excess idle inventory will be retrieved to maximize usable facility space. Cardboard and plastic recycling can keep operations clean and access to dedicated account representatives ensures communication between facilities and the pallet service provider remains fluid. Total pallet management is the best way for operations to reliably have pallets and maintain throughput in a high-volume environment without the overhead and work. **WMHS**

ABOUT PALLET CONSULTANTS

Pallet Consultants is a national pallet manufacturer that provides both total pallet management and pallet audits, in addition to other services (like pallet retrieval services) and a wide variety of pallet products including recycled pallets, specialty pallets, custom-sized pallets, new pallets and more. Pallet Consultants manufactures large volumes in any size and in custom designs (www.palletconsultants.com).

This article first appeared on the Pallet Consultants blog at: <https://www.palletconsultants.com/blog/the-difference-between-pallet-audits-and-total-pallet-management>.

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Fork(Lifts) in the (Off-)Road:

Should We Ban Internal Combustion Engines for Electric?

Contributor: **Propane Education and Research Council (PERC)**

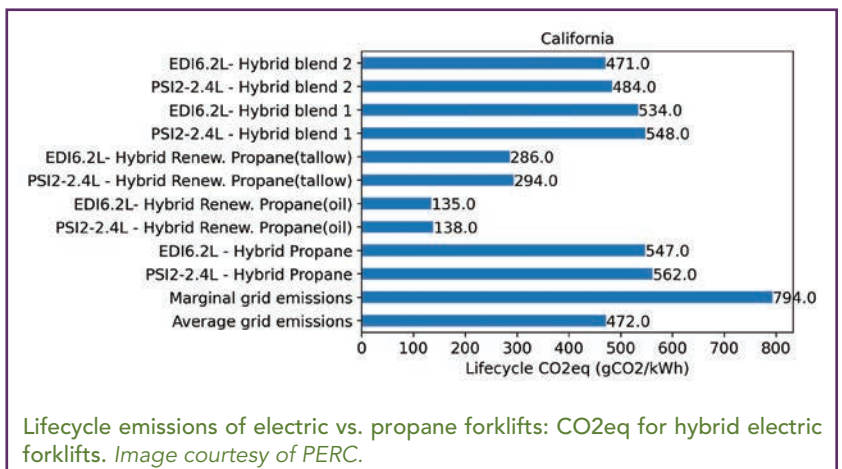
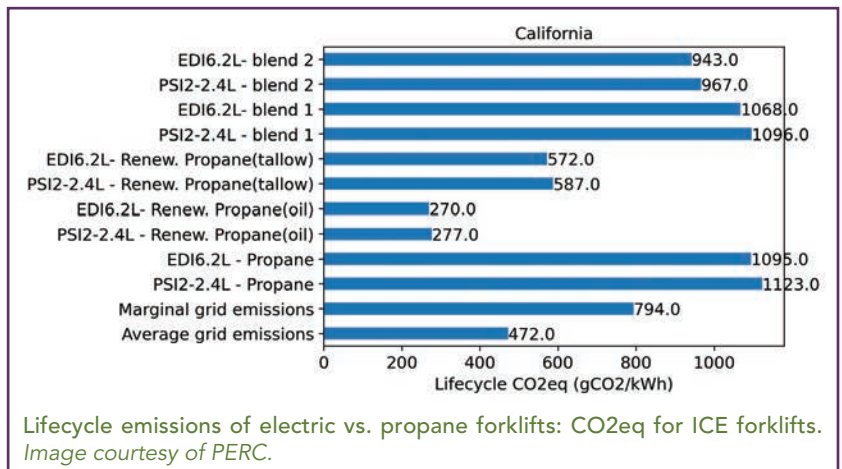
The California Air Resources Board (CARB) recently proposed a ban on Internal Combustion Engine (ICE) forklifts based on the California Governor's Executive Order N 79 20. The proposed ban would impact ICE material handling applications up to 12,000 lbs. of lift capacity with some exceptions (e.g., rough terrain forklifts, military tactical vehicles, pallet jacks and forklifts owned and operated by facilities subject to the mobile carbon handling equipment at ports and intermodal railyards regulation).

As written, CARB's proposal accelerates "zero"-emissions forklift (e.g., battery electric and hydrogen fuel cell electric) adoption through mandating "zero"-emission-only forklift sales by 2025, with a forced retirement of all ICE forklifts over a CARB-defined 13-year useful lifespan. Specifically, CARB is mandating ICE forklifts up to 12,000-lb. (6-ton) capacity, which predominantly includes Class 4 (cushion tire) & Class 5 (pneumatic tire) forklifts. Several fuels are used in material handling operations including diesel, propane, natural gas, and gasoline. The mandate would ban all equipment that uses these fuels, including hybrid electric solutions, and only allow battery electric and hydrogen fuel cell electric forklifts.

This white paper analyzes whether the rulemaking constitutes a favorable solution for the environment not only for California but for the entire U.S. PERC conducted an internal analysis using available certification emissions data and the Environmental Protection Agency's (EPA) MOtor Vehicle Emission Simulator (MOVES3) tool for comparing lifecycle equivalent carbon dioxide (CO₂eq) and nitrogen oxide (NO_x) emissions chiefly between propane and electric forklifts. Note, the white paper does not address the capital costs, infrastructure costs and practicality of the implementation of this rulemaking, including loss of revenue (e.g., charging an electric forklift during a shift, impact of public safety power shutoffs or PSPS on a business operating forklifts) but analyzes it only from a technical standpoint. In this white paper, an energy cycle analysis compares propane and battery electric forklifts for each individual

state, taking into account each state's electricity mix. Note, hydrogen fuel cell forklifts have not been considered in this analysis, as nearly 95 % of hydrogen in the U.S. is produced using a highly endothermic process of conventional natural gas steam methane reforming. For electric forklifts, both state electric grid average and marginal emissions have been accounted for. Since this "zero"-emission forklift transition is expected to occur by 2025, the marginal electric grid emission is a better metric for comparison with propane forklifts since electric forklifts do not currently constitute toward the baseload.

The figures that accompany this article show a variety of cases that were simulated in this study with available certification data for propane forklifts and emissions comparisons with electric forklifts for California. In the charts,



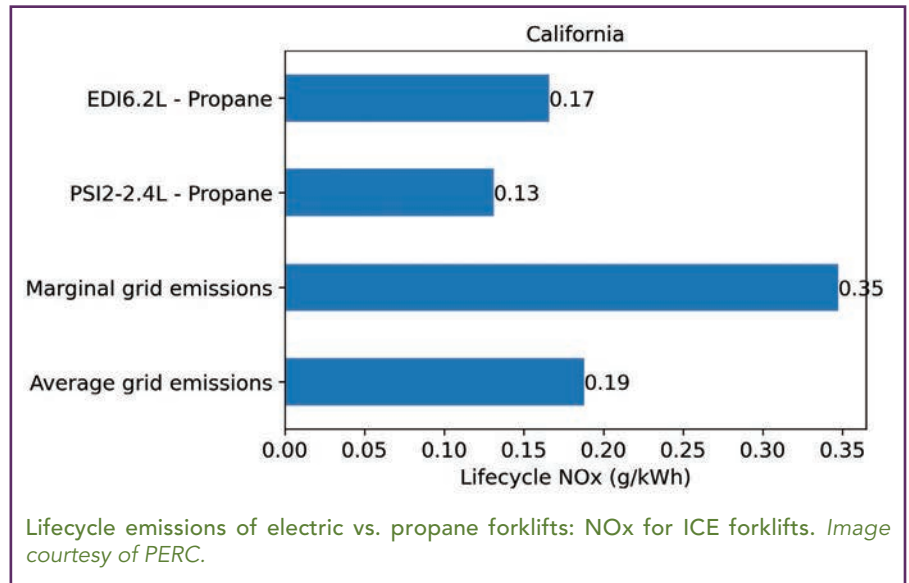
the emissions are expressed in grams per kWh of delivered power.

In California, propane forklifts do emit more lifecycle CO₂eq emissions as compared to electric forklifts even when considering marginal electric grid emissions. The propane industry is investing in renewable propane and blends of propane with renewable dimethyl ether (rDME).

Performance of forklifts operating with renewable propane extracted from U.S.-based used cooking oil and Asia Pacific-based animal tallow is superior to that of electric forklifts, especially when considering marginal emissions. Blended propane/rDME fuels also lead to a lower carbon footprint compared with baseline conventional propane forklifts.

Since “zero”-emission forklifts may not indeed result in significant emissions reduction under all conditions and in some scenarios may indeed lead to degradation of lifecycle emissions, we make the following recommendations:

- Regulatory agencies should conduct detailed lifecycle analyses for gasoline, diesel, propane, natural gas, battery electric and hydrogen fuel cell electric forklifts before considering a ban on specific technologies.
- Criteria pollutant emission standards for non-road spark-ignited engines have not been updated since 2007; however, most current ICE technologies are capable of meeting lower criteria pollutant standards.
- Fuel innovation (e.g., renewable propane, blends of propane and rDME) and technology



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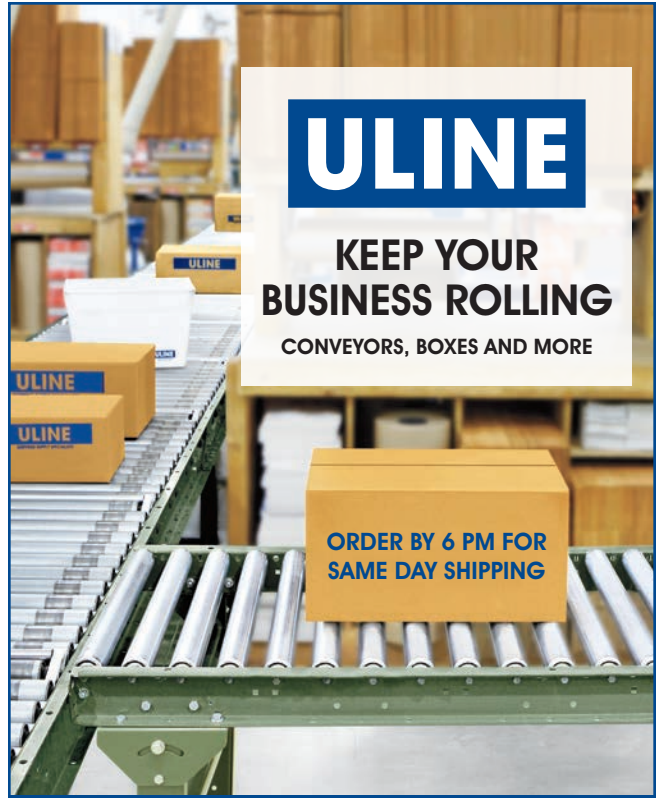
And, boom! Material handling solved.

innovation, including hybridization, must be further developed and utilized in parallel. This co-optimization is key to the success of achieving decarbonization and reducing criteria pollutants.

- An abrupt transition to battery electric-only forklifts would not necessarily reduce CO₂eq emissions and NO_x emissions will only be displaced from warehouses to power plants.
- Replacing all ICE forklifts in the state of California with battery electric forklifts would warrant nearly 10 GWh/day charging capacity. This is extremely challenging to achieve for a state that depends on electricity imports from neighboring states and where PSPS are becoming more frequent.
- Propane and other low-carbon fuels qualify for California LCFS for forklift applications. An abrupt shift toward “zero”-emission forklifts will be a missed opportunity for accelerating decarbonization using low-carbon, renewable and blends of renewable and low-carbon fuels.

As good stewards of environmental justice, we need to ensure that we are not displacing the problem in space and/or time but are indeed solving a problem for the greater good of humanity and all life on Earth. **WMHS**

Read more about this study at propane.com.



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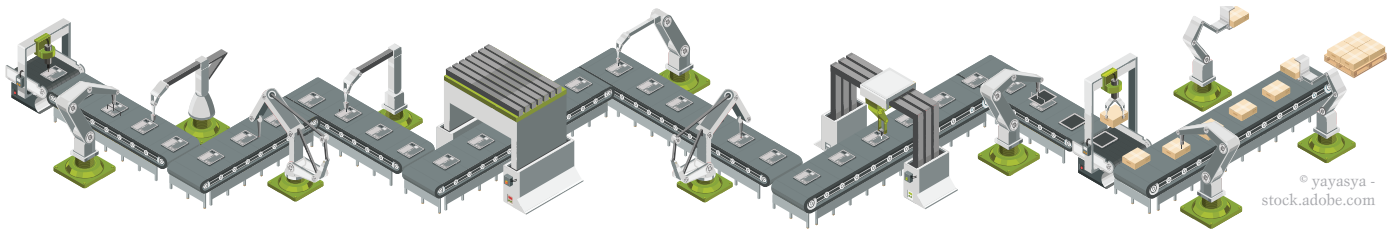
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Don't be Afraid of Automation

Contributed by: **MHI's SLAM Industry Group**



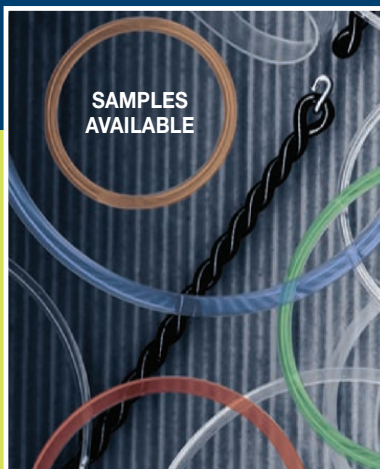
You've just shipped out a load of fishing poles from your distribution center. They're super light, but also very long. Not long after sending them off, you were surprised when your carrier issued you a chargeback. What happened? You shipped based on weight but didn't consider that long length—but your carrier did.

While unfortunate, this scenario is not at all uncommon. A small parcel carrier like UPS, for instance, can charge an additional \$1 fee per package if the inaccuracies on the total of your packages in a given shipment pickup amounts to over \$5 per average package. Over time, these chargebacks can add up, so you want to find a solution that can keep you out of that scenario.

The answer is to add an accurate weighing and dimension system to your scanning, labeling, applying and manifesting (SLAM) operations. There are plenty of good options on the market, but it does help to understand the benefits and drawbacks of the different types. Broadly speaking, you'll be choosing between fully in-motion weighing and dimensioning systems, stopped motion (or accumulation), and those that weigh manually, with many flavors of each on the market.

How do you decide which is right for your operations? You'll need to weigh several factors, but speed and throughput requirements are often at the top of the list. "In-motion systems can operate at throughputs up to 50 cartons per minute (CPM) while stopped motion systems are limited to

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roughly 15 CPM,” says Alex Kinkade, Marketing Manager at StreamTech Engineering, LLC. “This is mostly due to the difference in the scale design, but also the ability for in-motion systems to have multiple printer-applicators arranged in series (throughput roughly doubles for each printer added). If 15 CPM is a satisfactory rate, stopped motion (accumulation conveyed) systems have their own sets of advantages and are recommended as a first step for most applications. “

Some of the choices can come down to the amount of labor you have available—many companies are today facing a labor shortage, making manual systems less appealing. “If you’re looking at a static system, you need to consider how long it takes to manually place and start the weighing process,” says Brad Thomas, Manager of Market Product Management for SICK, Inc. “Also consider the weight of the products you’re managing—does handling them take a toll on the employees?”

In many cases, today, the answer trends toward in-motion weighing and dimensioning systems. They have many advantages, says Jovan Bjelobrk, Vice President of Sales and Marketing at Slate River Systems, Inc. “They automate a very repetitive, time-consuming process,” he explains. “At the same time, they remove the opportunity for error and allowing the system to value add.”

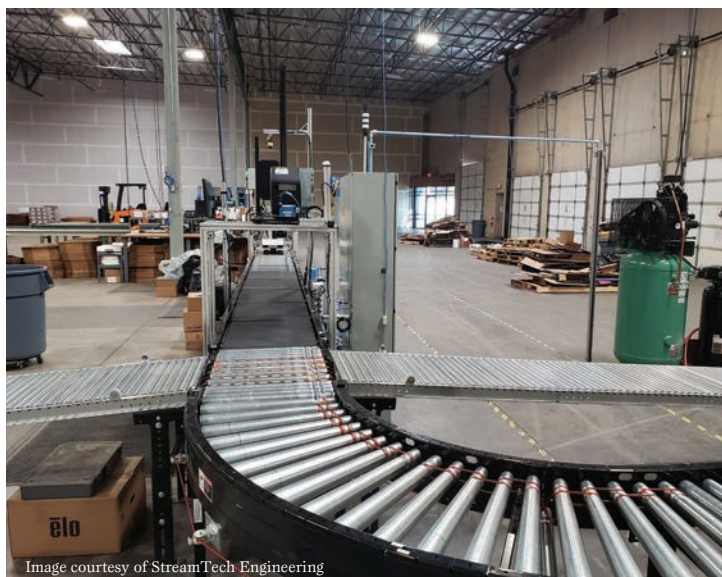


Image courtesy of StreamTech Engineering

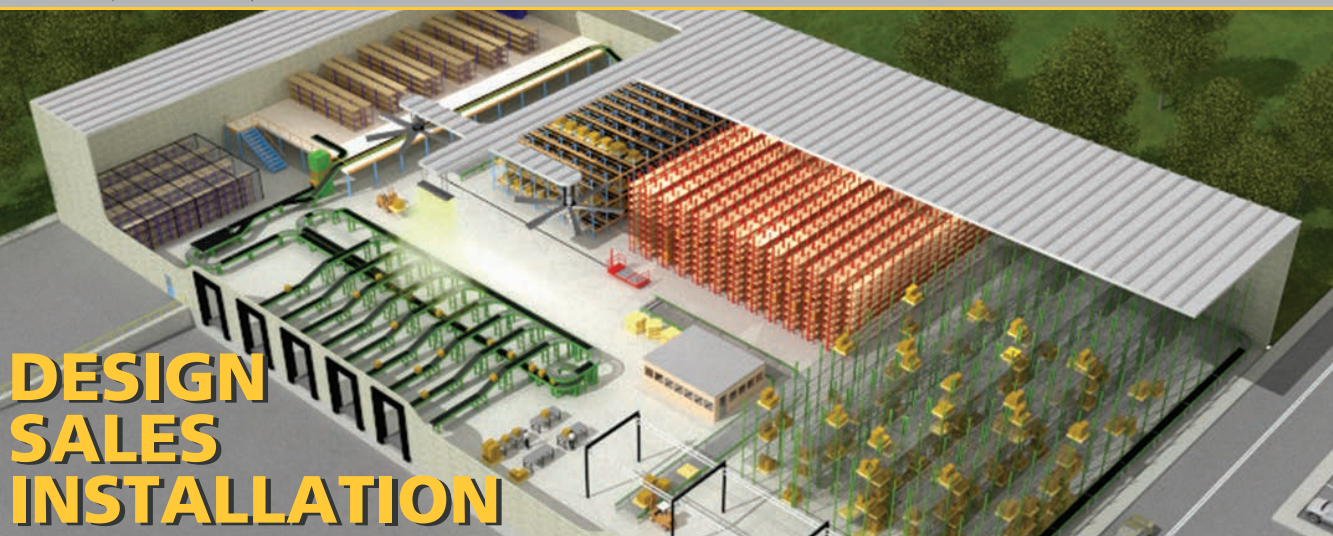
There are also few drawbacks to an in-motion system, says Bjelobrk. “In the scope of automation, the cost is pretty low,” he says. “In general, you are simply adding a scanner and scale to a conveyor.”

You should also consider the multi-carrier/ERP software response speed, however. “For an in-motion SLAM system, host response time of the shipping label and order data is critical,” says Kinkade. “Because the equipment is designed to run at a high throughput and because the equipment



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CUBING & WEIGHING



Image courtesy of StreamTech Engineering

requires continuous motion, there will only be 'X' amount of seconds between the scale where the data is gathered and sent to the host and the print-apply unit where the label needs to be when the package arrives.

"Systems are designed with a comfortable amount of travel time between these locations, but it requires the host system to at least be repeatable/consistent with response times for a successful implementation. Stopped motion accumulation conveyed systems have an advantage here. If the host is late or unpredictable, the package can stop and

wait at the printer for a few seconds. Note that this causes a slowdown of throughput but greatly reduces errors at the end of the shift."

Kinkade's general rule of thumb? "If your operation processes 10,000 packages a day or less, a traditional 'accumulating' or stopped-motion system is appropriate," he says. "Above that, consider in-motion."

DIMENSIONING CONSIDERATIONS

Capturing dimensions can be just as important as weight, as demonstrated in the fishing pole/chargeback example. "There's a lot of need for reporting accurate dimensions to your carrier," says Bjelobrk. "They are often going to charge you for dimension instead of weight, and that charge will be higher."

Thomas says that the most accurate technology for accurate dimensioning is laser. "It's the most proven and reliable for high-speed sortation," he says. "It can work with a variety of conveyor types, manage a 'touching side-by-side' algorithm (in SICK's system), no belt gaps are needed, and can measure a minimum package size of 15 millimeters."

After a laser system, says Thomas, the next most reliable approach is light-grid technology, which can dimension any object type, including flat parcels. Finally, a 3D-camera-based system is a good fit for lower speed—or

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static—systems. It's less accurate and most suited to small product sizes.

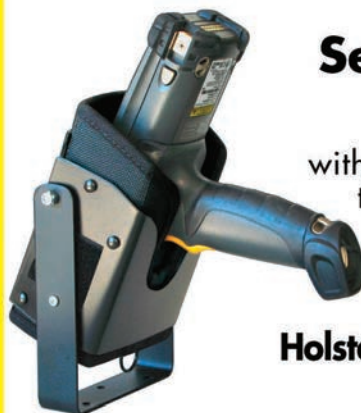
You can find many off-the-shelf, compact 3D/2D vision-capable camera-based dimensioner units that can be easily integrated into an overall SLAM system, says Kinkade. "These work for the vast majority of applications, unless the packages are large," he explains. "In the event that packages are long or completely flat, we can employ other technologies, too, such as light curtains that incorporate multiple scanners and can capture packages as they pass through."

The bottom line: With straightforward, low-cost solutions widely available, you can reduce errors, make your operations more efficient and avoid those all-too-common chargeback scenarios. **WMHS**

MHI's SLAM Industry Group provides education and thought leadership for "the last 100 feet" of warehouse and distribution operations. The group is made up of the companies that make the solutions and technologies that go into e-commerce fulfillment processes. You can learn more at www.mhi.org/slam. Click for more information about:

- StreamTech Engineering: <https://www.mhi.org/members/59907>
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Top OSHA Workplace Violations



OSHA Standard 29 CFR 1926.501: Duty to Have Fall Protection

Ranking: #1

The Risk

Falls are among the most common causes of serious work-related injuries and deaths. There is a myriad of ways in which falls can occur in an occupational setting and falls from even relatively low heights can result in injury, permanent disability and fatalities. Those working in construction and extraction, healthcare support; building cleaning and maintenance; transportation and material moving are at highest risk for on-the-job falls, with the construction industry experiencing the highest frequency of fall-related deaths. Fall injuries create an enormous financial burden for both injured workers and their employers in terms of work missed and workers compensation and medical costs.

Major Provisions of the Standard

- The employer shall determine if the walking/working surfaces on which its employees are to work have the strength and structural integrity to support employees safely. Employees shall be allowed to work on those surfaces only when the

The Numbers

OSHA enforcement statistics for this standard for the period of October 2020 through September 2021:

Citations	Inspections	Penalty	Industry Classification
5,605	5,463	\$29,359,415	Total for All Industries
5,475	5,336	\$28,653,928	23 / Construction
33	33	\$148,071	33 / Manufacturing (part 3 of 3)
31	31	\$232,755	42 / Wholesale Trade
22	20	\$105,975	56 / Administrative and Support and Waste Management and Remediation Services
10	10	\$47,899	22 / Utilities
7	7	\$21,860	54 / Professional, Scientific and Technical Services
5	5	\$51,333	44 / Retail Trade (part 1 of 2)
3	3	\$17,923	51 / Information
3	3	\$12,971	53 / Real Estate and Rental and Leasing

surfaces have the requisite strength and structural integrity.

- "Unprotected sides and edges." Each employee on a walking/working surface (horizontal and vertical surface) with an unprotected side or edge which is 6 feet (1.8 m) or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems or personal fall arrest systems.
- Each employee who is constructing a leading edge 6 feet (1.8 m) or more

above lower levels shall be protected from falling by guardrail systems, safety net systems or personal fall arrest systems. Exception: When the employer can demonstrate that it is infeasible or creates a greater hazard to use these systems, the employer shall develop and implement a fall protection plan which meets the requirements of paragraph (k) of 1926.502.

- Each employee on a walking/working surface 6 feet (1.8 m) or more above a lower level where leading edges are under construction, but who is not engaged in the leading-edge work, shall be protected from falling by a guardrail system, safety net system or personal fall arrest system. If a guardrail system is chosen to provide the fall protection, and a controlled access zone has already been established for leading edge work, the control line may be used in lieu of a guardrail along the edge that parallels the leading edge.

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- Each employee in a hoist area shall be protected from falling 6 feet (1.8 m) or more to lower levels by guardrail systems or personal fall arrest systems. If guardrail systems, [or chain, gate, or guardrail] or portions thereof, are removed to facilitate the hoisting operation (e.g., during landing of materials), and an employee must lean through the access opening or out over the edge of the access opening (to receive or guide equipment and materials, for example), that employee shall be protected from fall hazards by a personal fall arrest system.
- Each employee on walking/working surfaces shall be protected from falling through holes (including skylights) more than 6 feet (1.8 m) above lower levels, by personal fall arrest systems, covers or guardrail systems erected around such holes.
- Each employee on a walking/working surface shall be protected from tripping in or stepping into or through holes (including skylights) by covers.
- Each employee on the face of formwork or reinforcing steel shall be protected from falling 6 feet (1.8 m) or more to lower levels by personal fall arrest systems, safety net systems or positioning device systems.
- Each employee on ramps, runways and other walkways shall be protected from falling 6 feet (1.8 m) or more to lower levels by guardrail systems.
- Each employee at the edge of a well, pit, shaft and similar excavation 6 feet (1.8 m) or more in depth shall be protected from falling by guardrail systems, fences, barricades or covers.
- Each employee less than 6 feet (1.8 m) above dangerous equipment shall be protected from falling into or onto the dangerous equipment by guardrail systems or by equipment guards.
- Each employee 6 feet (1.8 m) or more above dangerous equipment shall be protected from fall hazards by guardrail systems, personal fall arrest systems or safety net systems.
- Each employee engaged in roofing activities on low-slope roofs, with unprotected sides and edges 6 feet (1.8 m) or more above lower levels shall be protected from falling by guardrail systems, safety net systems, personal fall arrest systems, or a combination of warning line system and guardrail system, warning line system and safety net system, or warning line system and personal fall arrest system. Or, on roofs 50 feet (15.25 m) or less in width, the use of a safety monitoring system alone [i.e. without the warning line system] is permitted.

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- OSHA's Falls Prevention Campaign Page
 - Campaign Fact Sheet: English (PDF) Spanish (PDF), Polish (PDF) and Russian (PDF)
 - Campaign Poster: English (PDF). Spanish (PDF)
 - Fall Prevention Wallet Card English (PDF). Spanish (PDF). Portuguese (PDF)
- Fall Prevention Training Guide
 - A Lesson Plan for Employers (PDF) (EPUB | MOBI). Spanish (PDF) (EPUB | MOBI).
- Fall Prevention Publications: Webpage contains fall prevention materials in English and Spanish.
 - Fall Protection in Construction (PDF).
 - Protecting Roofing Workers (PDF). **WMHS**



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Top OSHA Workplace Violations



OSHA Standard 29 CFR 1910.134: Respiratory Protection

Ranking: #2

The Risks

Respirators protect workers against insufficient oxygen environments, harmful dusts, fogs, smokes, mists, gases, vapors and sprays. These hazards may cause cancer, lung impairment, diseases or death. Compliance with the OSHA Respiratory Protection Standard could avert hundreds of deaths and thousands of illnesses annually.

Respirators protect the user in two basic ways. The first is by the removal of contaminants from the air. Respirators of this type include particulate respirators, which filter out airborne particles, and air-purifying respirators with cartridges/canisters which filter out chemicals and gases. Other respirators protect by supplying clean respirable air from another source. Respirators that fall into this category include airline respirators, which use compressed air from a remote source, and self-contained breathing apparatus (SCBA), which include their own air supply.

Major Provisions of the Standard

- In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays or vapors, the primary objective shall be to prevent

The Numbers

OSHA enforcement statistics for this standard for the period of October 2020 through September 2021:

Citations	Inspections	Penalty	Industry Classification
2,193	924	\$4,460,370	Total for All Industries
708	303	\$2,192,877	62 / Health Care and Social Assistance
450	174	\$785,411	33 / Manufacturing (part 3 of 3)
253	104	\$401,705	32 / Manufacturing (part 2 of 3)
236	104	\$259,531	23 / Construction
122	49	\$135,500	81 / Other Services (except Public Administration)
84	34	\$81,301	42 / Wholesale Trade
59	34	\$123,362	56 / Administrative and Support and Waste Management and Remediation Services
49	25	\$110,212	31 / Manufacturing (part 1 of 3)
45	14	\$38,408	71 / Arts, Entertainment and Recreation
43	16	\$86,186	48 / Transportation and Warehousing (1 of 2)

atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to this section.

- A respirator shall be provided to each employee when such equipment is necessary to protect the health of such employee. The employer shall provide the respirators which are applicable and suitable for the purpose intended. The employer shall be responsible for the establishment and maintenance of a respiratory protection program.
- In any workplace where respirators are necessary to protect the

health of the employee or whenever respirators are required by the employer, the employer shall establish and implement a written respiratory protection program with worksite-specific procedures. The program shall be updated as necessary to reflect those changes in workplace conditions that affect respirator use. The employer shall include in the program the following provisions of this section, as applicable:

- Procedures for selecting respirators for use in the workplace;
- Medical evaluations of employees required to use respirators;
- Fit testing procedures for tight-fitting respirators;
- Procedures for proper use of respirators in routine and reasonably foreseeable emergency situations;
- Procedures and schedules for cleaning, disinfecting, storing,

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Top OSHA Workplace Violations

inspecting, repairing, discarding and otherwise maintaining respirators;

- Procedures to ensure adequate air quality, quantity and flow of breathing air for atmosphere-supplying respirators;
- Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations;
- Training of employees in the proper use of respirators, including putting on and removing them, any limitations on their use, and their maintenance; and
- Procedures for regularly evaluating the effectiveness of the program.
- An employer may provide respirators at the request of employees or permit employees to use their own respirators if the employer determines that such respirator use will not in itself create a hazard.
- In addition, the employer must establish and implement those elements of a written respiratory protection program necessary to ensure that any employee using a respirator voluntarily is medically able to use that respirator, and that the respirator is cleaned, stored and maintained so that its use does not present a health hazard to the user. Exception: Employers are not required to include in a written respiratory protection program those employees whose only use of respirators involves the voluntary use of filtering facepieces (dust masks).
- The employer shall designate a program administrator who is qualified by appropriate training or experience that is commensurate with the complexity of the

program to administer or oversee the respiratory protection program and conduct the required evaluations of program effectiveness.

- The employer shall provide respirators, training and medical evaluations at no cost to the employee.
- The employer is required to evaluate respiratory hazard(s) in the workplace, identify relevant workplace and user factors, and base respirator selection on the respiratory hazard(s) to which the worker is exposed.
- The employer shall select a NIOSH-certified respirator. The respirator shall be used in compliance with the conditions of its certification.
- The employer shall identify and evaluate the respiratory hazard(s) in the workplace; this evaluation shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form. Where the employer cannot identify or reasonably estimate the employee exposure, the employer shall consider the atmosphere to be IDLH (immediately dangerous to life and health).
- The employer shall select respirators from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.
- The employer shall provide the following respirators for employee use in IDLH atmospheres:
 - A full facepiece pressure demand SCBA certified by NIOSH for a minimum service life of thirty minutes, or
 - A combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply.
 - Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.
 - All oxygen-deficient atmospheres shall be considered IDLH. Exception: If the employer demonstrates that, under all foreseeable conditions, the oxygen concentration can be maintained within the ranges specified in Table II of this section (i.e., for the altitudes set out in the table), then any atmosphere-supplying respirator may be used.
- For atmospheres that are not IDLH, the employer shall provide a respirator that is adequate to protect the health of the employee and ensure compliance with all other OSHA statutory and regulatory requirements, under routine and reasonably foreseeable emergency situations.

Compliance Resources

OSHA's website provides a variety of respiratory information, including general guidance, training videos and resources in Spanish. Go to: www.osha.gov/respiratory-protection **WMHS**

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Top OSHA Workplace Violations



OSHA Standard 29 CFR 1926.1053: Ladders

Ranking: #3

The Risks

Falls from ladders can result in serious injuries, permanent disability and death. Injuries related to ladders can be traced to a variety of causes. Overreaching instead of descending and moving the ladder to a different location is a common cause. Using a ladder when some other piece of equipment is called for – like a scissor lift, mobile elevated platform or scaffolding – can also result in injuries. A ladder that is in poor condition or is not designed to handle the weight of the user is a hazard. So is placing the base of the ladder on unlevel or soft ground, as well as failing to maintain a 3-point contact with it.

Major Provisions of the Standard

- Ladders shall be capable of supporting the following loads without failure:
- Each self-supporting portable ladder: At least four times the maximum intended load, except that each extra-heavy-duty type 1A metal or plastic ladder shall sustain at least 3.3 times the maximum intended load. The ability of a ladder to sustain the loads indicated in this paragraph shall be determined by applying or transmitting the requisite load to the ladder in a downward vertical direction. Ladders built and tested in conformance with the applicable provisions of appendix A of this subpart will be deemed to meet this requirement.
- Each portable ladder that is not self-supporting: At least four times the maximum intended load, except that each extra-heavy-duty type 1A metal or plastic ladders shall

The Numbers

OSHA enforcement statistics for this standard for the period of October 2020 through September 2021:

Citations	Inspections	Penalty	Industry Classification
2,162	1,838	\$5,835,589	Total for All Industries
2,103	1,787	\$5,646,880	23 / Construction
14	10	\$49,097	33 / Manufacturing (part 3 of 3)
12	12	\$35,594	42 / Wholesale Trade
12	10	\$27,431	56 / Administrative and Support and Waste Management and Remediation Services
5	5	\$19,482	22 / Utilities
4	2	\$21,446	44 / Retail Trade (part 1 of 2)
3	3	\$13,049	54 / Professional, Scientific and Technical Services
2	2	\$6,827	53 / Real Estate and Rental and Leasing
2	2	\$4,553	32 / Manufacturing (part 2 of 3)
1	1	\$4,500	49 / Transportation and Warehousing (2 of 2)
1	1	\$3,000	51 / Information
1	1	\$2,731	62 / Health Care and Social Assistance
1	1	\$1,000	81 / Other Services (except Public Administration)
1	1	\$0	11 / Agriculture, Forestry, Fishing and Hunting

sustain at least 3.3 times the maximum intended load. The ability of a ladder to sustain the loads indicated in this paragraph shall be determined by applying or transmitting the requisite load to the ladder in a downward vertical direction when the ladder is placed at an angle of 75 1/2 degrees from the horizontal. Ladders built and tested in conformance with the applicable provisions of appendix A will be deemed to meet this requirement.

- Each fixed ladder: At least two loads of 250 pounds (114 kg) each, concentrated between any two consecutive attachments (the number and position of additional concentrated loads of 250 pounds (114 kg) each, determined from anticipated usage of the ladder, shall also be included), plus anticipated loads

caused by ice buildup, winds, rigging and impact loads resulting from the use of ladder safety devices. Each step or rung shall be capable of supporting a single concentrated load of at least 250 pounds (114 kg) applied in the middle of the step or rung. Ladders built in conformance with the applicable provisions of appendix A will be deemed to meet this requirement.

- Ladder rungs, cleats and steps shall be parallel, level and uniformly spaced when the ladder is in position for use.
- The rungs of individual-rung/step ladders shall be shaped such that employees' feet cannot slide off the end of the rungs.
- The rungs and steps of fixed metal ladders manufactured after March 15, 1991, shall be corrugated,

Top OSHA Workplace Violations

knurled, dimpled, coated with skid-resistant material, or otherwise treated to minimize slipping.

- The rungs and steps of portable metal ladders shall be corrugated, knurled, dimpled, coated with skid-resistant material, or otherwise treated to minimize slipping.
- Ladders shall not be tied or fastened together to provide longer sections unless they are specifically designed for such use.
- A metal spreader or locking device shall be provided on each stepladder to hold the front and back sections in an open position when the ladder is being used.
- When splicing is required to obtain a given length of side rail, the resulting side rail must be at least equivalent in strength to a one-piece side rail made of the same material.
- Except when portable ladders are used to gain access to fixed ladders (such as those on utility towers, billboards and other structures where the bottom of the fixed ladder is elevated to limit access), when two or more separate ladders are used to reach an elevated work area, the ladders shall be offset with a platform or landing between the ladders.
- Ladder components shall be surfaced so as to prevent injury to an employee from punctures or lacerations, and to prevent snagging of clothing.

- Wood ladders shall not be coated with any opaque covering, except for identification or warning labels which may be placed on one face only of a side rail.
- Where the total length of a climb equals or exceeds 24 feet (7.3 m), fixed ladders shall be equipped with one of the following:
 - Ladder safety devices; or
 - Self-retracting lifelines, and rest platforms at intervals not to exceed 150 feet (45.7 m); or
 - A cage or well, and multiple ladder sections, each ladder section not to exceed 50 feet (15.2 m) in length. Ladder sections shall be offset from adjacent sections, and landing platforms shall be provided at maximum intervals of 50 feet (15.2 m).
- Cages for fixed ladders shall conform to the following:
 - Horizontal bands shall be fastened to the side rails of rail ladders, or directly to the structure, building or equipment for individual-rung ladders.
 - Vertical bars shall be on the inside of the horizontal bands and shall be fastened to them.

Compliance Resources

OSHA's has ladder safety publications on agriculture, construction, extension ladders, step ladders and job made ladders. Access them at: www.osha.gov/publications/bytopic/ladder-safety **WMHS**



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OSHA Standard 29 CFR 1926.451: Scaffolds

Ranking: #4

The Risks

The Bureau of Labor Statistics' Census of Fatal Occupational Injuries (CFOI) reported 52 fatal falls to lower levels from scaffolding in 2020. While some of these are attributable to unsafe work practices, scaffolding that is poorly made or lacking in proper guardrails or protection can be treacherous for workers who use it. This standard specifies requirements for safe scaffolding.

Major Provisions of the Standard

- With exceptions, each scaffold and scaffold component shall be capable of supporting, without failure, its own weight and at least four times the maximum intended load applied or transmitted to it.
- Direct connections to roofs and floors, and counterweights used to balance adjustable suspension scaffolds, shall be capable of resisting at least four times the tipping moment imposed by the scaffold operating at the rated load of the hoist, or 1.5 (minimum) times the tipping moment imposed by the scaffold operating at the stall load of the hoist, whichever is greater.
- Each suspension rope, including connecting hardware, used on non-adjustable suspension scaffolds shall be capable of supporting, without failure, at least six times the maximum intended load applied or transmitted to that rope.
- Each suspension rope, including connecting hardware, used on adjustable suspension scaffolds shall be capable of supporting, without failure, at least six times the maximum intended load applied or transmitted to that rope with

The Numbers

OSHA enforcement statistics for this standard for the period of October 2020 through September 2021:

Citations	Inspections	Penalty	Industry Classification
2,163	1,082	\$6,499,476	Total for All Industries
2,079	1,034	\$6,206,366	23 / Construction
23	13	\$63,125	33 / Manufacturing (part 3 of 3)
17	9	\$73,520	42 / Wholesale Trade
13	5	\$27,584	56 / Administrative and Support and Waste Management and Remediation Services
9	4	\$18,029	32 / Manufacturing (part 2 of 3)
6	4	\$36,211	53 / Real Estate and Rental and Leasing
4	3	\$20,199	44 / Retail Trade (part 1 of 2)
3	3	\$11,053	54 / Professional, Scientific and Technical Services
2	2	\$6,144	22 / Utilities
2	1	\$13,653	72 / Accommodation and Food Services

the scaffold operating at either the rated load of the hoist, or two (minimum) times the stall load of the hoist, whichever is greater.

- The stall load of any scaffold hoist shall not exceed three times its rated load.
- Scaffolds shall be designed by a qualified person and shall be constructed and loaded in accordance with that design. Non-mandatory Appendix A to this subpart contains examples of criteria that will enable an employer to comply with paragraph (a) of this section.
- Each platform on all working levels of scaffolds shall be fully planked or decked between the front uprights and the guardrail supports as follows:
- Each platform unit (e.g., scaffold plank, fabricated plank, fabricated deck or fabricated platform) shall be installed so that the space between adjacent units and the space between the platform and the uprights is no more than 1 inch (2.5 cm) wide, except where the

employer can demonstrate that a wider space is necessary (for example, to fit around uprights when side brackets are used to extend the width of the platform).

- Where the employer makes the demonstration provided for in paragraph (b)(1)(i) of this section, the platform shall be planked or decked as fully as possible and the remaining open space between the platform and the uprights shall not exceed 9 1/2 inches (24.1 cm).
- Exception to paragraph (b)(1): The requirement in paragraph (b)(1) to provide full planking or decking does not apply to platforms used solely as walkways or solely by employees performing scaffold erection or dismantling. In these situations, only the planking that the employer establishes is necessary to provide safe working conditions is required.
- With exceptions, each scaffold platform and walkway shall be at least 18 inches (46 cm) wide.

- Each ladder jack scaffold, top plate bracket scaffold, roof bracket scaffold and pump jack scaffold shall be at least 12 inches (30 cm) wide. There is no minimum width requirement for boatswains' chairs.
- Where scaffolds must be used in areas that the employer can demonstrate are so narrow that platforms and walkways cannot be at least 18 inches (46 cm) wide, such platforms and walkways shall be as wide as feasible, and employees on those platforms and walkways shall be protected from fall hazards by the use of guardrails and/or personal fall arrest systems.
- The front edge of all platforms shall not be more than 14 inches (36 cm) from the face of the work, unless guardrail systems are erected along the front edge and/or personal fall arrest systems are used in accordance with paragraph (g) of this section to protect employees from falling.
- The maximum distance from the face for outrigger scaffolds shall be 3 inches (8 cm);
- The maximum distance from the face for plastering and lathing operations shall be 18 inches (46 cm).
- Each end of a platform, unless cleated or otherwise restrained by hooks or equivalent means, shall extend over the centerline of its support at least 6 inches (15 cm).
- Each end of a platform 10 feet or less in length shall not extend over its support more than 12 inches (30 cm) unless the platform is designed and installed so that the cantilevered portion of the platform is able to support employees and/or materials without tipping or has guardrails which block employee access to the cantilevered end.
- Each platform greater than 10 feet in length shall not extend over its support more than 18 inches (46 cm), unless it is designed and installed so that the cantilevered portion of the platform is able to support employees without tipping or has guardrails which block employee access to the cantilevered end.
- On scaffolds where scaffold planks are abutted to create a long platform, each abutted end shall rest on a separate support surface. This provision does not preclude the use of common support members, such as "T" sections, to support abutting planks, or hook-on platforms designed to rest on common supports.
- On scaffolds where platforms are overlapped to create a long platform, the overlap shall occur only over supports, and shall not be less than 12 inches (30 cm) unless the platforms are nailed together or otherwise restrained to prevent movement.

Compliance Resources


OSHA's *Scaffolding eTool* identifies common hazards associated with scaffolds and discusses requirements for designing and constructing scaffolds. You can find it here: www.osha.gov/etools/scaffolding **WMHS**

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OSHA Standard 29 CFR 1910.1200: Hazard Communication

Ranking: #5

The Risks

Manufacturing, construction, mining, warehousing, welding, transportation, and oil and gas are among the industries in which hazardous chemicals are routinely used. Exposure to toxic substances can cause both short-term health emergencies and long-term illnesses, including severe burns and inflammation, respiratory difficulties and cancer. In order to ensure worker safety, information about the identities and hazards of the chemicals must be available and understandable to workers. OSHA's Hazard Communication Standard (HCS) requires the development and dissemination of such information.

Major Provisions of the Standard

- Chemical manufacturers and importers shall evaluate chemicals produced in their workplaces or imported by them to classify the chemicals in accordance with this section. For each chemical, the chemical manufacturer or importer shall determine the hazard classes, and, where appropriate, the category of each class that apply to the chemical being classified. Employers are not required to classify chemicals unless they choose not to rely on the classification performed by the chemical manufacturer or importer for the chemical to satisfy this requirement.

The Numbers

OSHA enforcement statistics for this standard for the period of October 2020 through September 2021:

Citations	Inspections	Penalty	Industry Classification
53	27	\$167,115	Total for All Industries
18	7	\$26,840	33 / Manufacturing (part 3 of 3)
16	8	\$88,030	32 / Manufacturing (part 2 of 3)
5	4	\$18,477	31 / Manufacturing (part 1 of 3)
5	1	\$4,000	56 / Administrative and Support and Waste Management and Remediation Services
4	2	\$12,834	48 / Transportation and Warehousing (1 of 2)
3	3	\$8,373	42 / Wholesale Trade
1	1	\$6,690	62 / Health Care and Social Assistance
1	1	\$1,873	23 / Construction

- Chemical manufacturers, importers or employers classifying chemicals shall identify and consider the full range of available scientific literature and other evidence concerning the potential hazards. There is no requirement to test the chemical to determine how to classify its hazards.
- Chemical manufacturers, importers, or employers evaluating chemicals shall follow the procedures described in Appendices A and B to Sec. 1910.1200 to classify the hazards of the chemicals, including determinations regarding when mixtures of the classified chemicals are covered by this section.
- When classifying mixtures they produce or import, chemical manufacturers and importers of mixtures may rely on the information pro-

vided on the current safety data sheets of the individual ingredients, except where the chemical manufacturer or importer knows, or in the exercise of reasonable diligence should know, that the safety data sheet misstates or omits information required by this section.

- Employers shall develop, implement, and maintain at each workplace, a written hazard communication program which at least describes how the criteria specified in paragraphs (f), (g), and (h) of this section for labels and other forms of warning, safety data sheets, and employee information and training will be met, and which also includes the following:
- A list of the hazardous chemicals known to be present using a product identifier that is referenced on

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the appropriate safety data sheet (the list may be compiled for the workplace as a whole or for individual work areas); and,

- The methods the employer will use to inform employees of the hazards of non-routine tasks (for example, the cleaning of reactor vessels), and the hazards associated with chemicals contained in unlabeled pipes in their work areas.
- Employers who produce, use, or store hazardous chemicals at a workplace in such a way that the employees of other employer(s) may be exposed (for example, employees of a construction contractor working on-site) shall additionally ensure that the hazard communication programs developed and implemented under this paragraph (e) include the following:
- The methods the employer will use to provide the other employer(s) on-site access to safety data sheets for each hazardous chemical the other employer(s)' employees may be exposed to while working;
- The methods the employer will use to inform the other employer(s) of any precautionary measures that need to be taken to protect employees during the workplace's normal operating conditions and in foreseeable emergencies; and,

- The methods the employer will use to inform the other employer(s) of the labeling system used in the workplace.
- The employer may rely on an existing hazard communication program to comply with these requirements, provided that it meets the criteria established in this paragraph (e).
- The employer shall make the written hazard communication program available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director, in accordance with the requirements of 29 CFR 1910.1020 (e).
- Where employees must travel between workplaces during a work shift, i.e., their work is carried out at more than one geographical location, the written hazard communication program may be kept at the primary workplace facility.
- The chemical manufacturer, importer or distributor shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged or marked. Hazards not otherwise classified do not have to be addressed on the container. Where the chemical manufacturer or importer is required to label, tag or mark the following information shall be provided:
 - Signal word
 - Hazard statement(s)
 - Pictogram(s)
 - Precautionary statement(s)
 - Name, address and telephone number of the chemical manufacturer, importer or other responsible party.
 - Product identifier and words, pictures, symbols or combination thereof, which provide at least general information regarding the hazards of the chemicals, and which, in conjunction with the other information immediately available to employees under the hazard communication program, will provide employees with the specific information regarding the physical and health hazards of the hazardous chemical.
- The employer may use signs, placards, process sheets, batch tickets, operating procedures or other such written materials in lieu of affixing labels to individual stationary process containers, as long as the alternative method identifies the containers to which it is applicable and conveys the information required by paragraph (f)(6) of this section to be on a label. The employer shall ensure the written materials are readily accessible to the employees in their work area throughout each work shift.

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Compliance Resources

Smaller employers will find OSHA's publication, *HAZARD COMMUNICATION: Small Entity Compliance Guide for Employers That Use Hazardous Chemicals* useful. You can find it at: www.osha.gov/sites/default/files/publications/OSHA3695.pdf **WMHS**



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OSHA Standard 29 CFR 1910.147: Control of Hazardous Energy (Lockout/Tagout)

Ranking: #6

Energy sources including electrical, mechanical, hydraulic, pneumatic, chemical, thermal or other sources in machines and equipment can be hazardous to workers. During the servicing and maintenance of machines and equipment, the unexpected startup or release of stored energy can result in serious injury or death to workers. Injuries may include electrocution, burns, crushing, cutting, lacerating, amputating or fracturing body parts, and others. Craft workers, electricians, machine operators and laborers are among the millions of workers who service equipment routinely and face the greatest risk of injury. Proper lockout/tagout (LOTO) practices and procedures safeguard workers from hazardous energy releases.

Major Provisions of the Standard

This standard covers the servicing and maintenance of machines and equipment in which the unexpected energization or startup of the machines or equipment, or release of stored energy, could harm employees. It establishes minimum performance requirements for the control of such hazardous energy.

Minor tool changes and adjustments, and other minor servicing activities, which take place during normal production operations, are not covered

The Numbers

OSHA enforcement statistics for this standard for the period of October 2020 through September 2021:

Citations	Inspections	Penalty	Industry Classification
1,880	1,048	\$11,998,443	Total for All Industries
574	324	\$3,499,057	32 / Manufacturing (part 2 of 3)
505	284	\$2,806,116	33 / Manufacturing (part 3 of 3)
308	177	\$3,074,499	31 / Manufacturing (part 1 of 3)
144	64	\$774,919	42 / Wholesale Trade
66	36	\$374,468	56 / Administrative and Support and Waste Management and Remediation Services
54	32	\$446,056	81 / Other Services (except Public Administration)
48	26	\$280,665	23 / Construction
36	24	\$144,153	44 / Retail Trade (part 1 of 2)
21	11	\$77,417	21 / Mining, Quarrying, and Oil and Gas Extraction
21	7	\$17,554	62 / Health Care and Social Assistance

by this standard if they are routine, repetitive, and integral to the use of the equipment for production, provided that the work is performed using alternative measures which provide effective protection.

- Employers must establish a program and utilize procedures for affixing appropriate lockout devices or tagout devices to energy isolating devices, and to otherwise disable machines or equipment to prevent unexpected energization, startup or release of stored energy in order to prevent injury to employees. Employers are also required to

train each worker to ensure that they know, understand, and are able to follow the applicable provisions of the hazardous energy control procedures. Workers must be trained in the purpose and function of the energy control program and have the knowledge and skills required for the safe application, usage, and removal of the energy control devices.

- If an energy isolating device is not capable of being locked out, the employer's energy control program shall utilize a tagout system.
- If an energy isolating device is capable of being locked out, the employer's energy control program under paragraph shall utilize lockout, unless the employer can demonstrate that the utilization of a tagout system will provide full employee protection.

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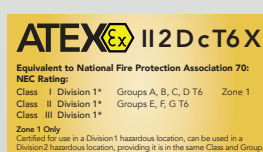
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- Whenever replacement or major repair, renovation or modification of a machine or equipment is performed, and whenever new machines or equipment are installed, energy isolating devices for such machine or equipment shall be designed to accept a lockout device.
- When a tagout device is used on an energy isolating device which is capable of being locked out, the tagout device shall be attached at the same location that the lockout device would have been attached, and the employer shall demonstrate that the tagout program will provide a level of safety equivalent to that obtained by using a lockout program.
- In demonstrating that a level of safety is achieved in the tagout program which is equivalent to the level of safety obtained by using a lockout program, the employer shall demonstrate full compliance with all tagout-related provisions of this standard together with such additional elements as are necessary to provide the equivalent safety available from the use of a lockout device. Additional means to be considered as part of the demonstration of full employee protection shall include the implementation of additional safety measures such as the removal of an isolating circuit element, blocking of a controlling switch, opening of an extra disconnecting device, or the removal of a valve handle to reduce the likelihood of inadvertent energization.
- Procedures shall be developed, documented and utilized for the control of potentially hazardous energy when employees are engaged in the activities covered by this section.
- The procedures shall clearly and specifically outline the scope, purpose, authorization, rules, and techniques to be utilized for the control of hazardous energy, and the means to enforce compliance including, but not limited to, the following:
 - A specific statement of the intended use of the procedure;
 - Specific procedural steps for shutting down, isolating, blocking and securing machines or equipment to control hazardous energy;
 - Specific procedural steps for the placement, removal and transfer of lockout devices or tagout devices and the responsibility for them; and
 - Specific requirements for testing a machine or equipment to determine and verify the effectiveness of lockout devices, tagout devices, and other energy control measures.

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- Locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware shall be provided by the employer for isolating, securing or blocking of machines or equipment from energy sources.
- Lockout devices and tagout devices shall be singularly identified; shall be the only device(s) used for controlling energy; shall not be used for other purposes; and shall meet the following requirements:
- Lockout and tagout devices shall be capable of withstanding the environment to which they are exposed for the maximum period of time that exposure is expected.
- Tagout devices shall be constructed and printed so that exposure to weather conditions or wet and damp locations will not cause the tag to deteriorate or the message on the tag to become illegible.
- Tags shall not deteriorate when used in corrosive environments such as areas where acid and alkali chemicals are handled and stored.

Compliance Resources

OSHA's *Lockout/Tagout Fact Sheet* describes the practices and procedures necessary to disable machinery or equipment to prevent the release of hazardous energy. Access it here: <https://tinyurl.com/33mabu9d> **WMHS**

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OSHA Standard 29 CFR 1926.503: Fall Protection Training

Ranking: #7

The Risk

Workers performing tasks 6 feet or more above lower levels are at risk of fatal falls or serious injuries. In the construction industry alone, falls generally account for about a third of the deaths that occur on the job each year. Equipping employees with the type of fall protection appropriate to the tasks they perform and the environment in which they work is vital. So is regularly assessing the fall protection devices used, to confirm that it is in good shape. However, safeguarding workers from falls and the serious injuries they can cause requires a broader approach – one that includes training about hazard recognition and procedures for erecting and maintaining fall protection.

Major Provisions of the Standard

- The employer shall provide a training program for each employee who might be exposed to fall hazards. The program shall enable each employee to recognize the hazards of falling and shall train each employee in the procedures to be followed in order to minimize these hazards.
- The employer shall assure that each employee has been trained, as necessary, by a competent person qualified in the following areas:

The Numbers

OSHA enforcement statistics for this standard for the period of October 2020 through September 2021:

Citations	Inspections	Penalty	Industry
1,732	1,667	\$3,024,375	TOTAL
1,688	1,627	\$2,938,407	Construction
11	11	\$25,301	Wholesale Trade
8	8	\$32,280	Admin. Support & Waste Mgmt. & Remediation Svcs.
7	6	\$14,555	Manufacturing (pt. 3 of 3)
6	4	\$3,414	Utilities
2	2	\$329	Retail Trade (pt. 1 of 2)
2	1	\$0	Transportation and Warehousing (1 of 2)
1	1	\$5,668	Professional, Scientific & Technical Svcs.
1	1	\$2,458	Manufacturing (pt. 1 of 3)
1	1	\$1,215	Public Administration
1	1	\$750	Other Services

- The nature of fall hazards in the work area;
 - The correct procedures for erecting, maintaining, disassembling and inspecting the fall protection systems to be used;
 - The use and operation of guard-rail systems, personal fall arrest systems, safety net systems, warning line systems, safety monitoring systems, controlled access zones and other protection to be used;
 - The role of each employee in the safety monitoring system when this system is used;
 - The limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs;
 - The correct procedures for the handling and storage of equipment and materials and the erection of overhead protection; and
 - The role of employees in fall protection plans.
- The employer shall verify compliance with paragraph (a) of this section by preparing a written certification record. The written certification record shall contain the name or other identity of the employee trained, the date(s) of the training and the signature of the person who conducted the training or the signature of the employer. If the employer relies on training conducted by another employer or completed prior to the effective date of this section, the certification record shall indicate the date the employer determined the prior training was adequate rather than the date of actual training.
 - The latest training certification shall be maintained.
 - "Retraining." When the employer has reason to believe that any affected employee who has already been trained does not have the understanding and skill required by paragraph (a) of this section, the employer shall retrain each such employee. Circumstances

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where retraining is required include, but are not limited to, situations where:

- Changes in the workplace render previous training obsolete; or
- Changes in the types of fall protection systems or equipment to be used render previous training obsolete; or
- Inadequacies in an affected employee's knowledge or use of fall protection systems or equipment indicate that the employee has not retained the requisite understanding or skill.

Compliance Resources

OSHA has a publication entitled, *Fall Prevention Training Guide: A Lesson Plan for Employers*. This training guide will help you plan how to prevent injuries and fatalities from falls among your crew and provide training to your workers. It includes advice for trainers, a series of Toolbox Talks, instructions for how to use the Toolbox Talks to train workers in fall prevention and details about various fall prevention topics. There are also educational materials that include a fall prevention fact sheet and wallet card in both English and Spanish,

prevention videos and a fall prevention poster. The training is designed to be short, participatory, and easy to follow. Access it at: <https://tinyurl.com/yej7n47t> **WMHS**



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OSHA Standard 29 CFR 1926.102: Eye and Face Protection

Ranking: #8

The Risk

Thousands of people are blinded each year from work-related eye injuries that could have been prevented with the proper selection and use of eye and face protection. The majority of eye injuries result from small particles or objects – like dust, cement chips, metal slivers and wood chips – striking or scraping the eye. These materials are often ejected by tools or windblown. Some fall from above a worker. Large objects may also strike the eye or face, or a worker may run into an object causing blunt force trauma to the eyeball or eye socket. Nails, staples, or slivers of wood or metal can go penetrate the eyeball and result in a permanent loss of vision. There are also chemical and thermal burns to the eyes and surrounding tissue (often among welders) as well as diseases resulting from exposure to blood splashes, droplets from coughing or sneezing, or from touching the eyes with a contaminated finger or object.

Major Provisions of the Standard

- The employer shall ensure that each affected employee uses appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation.
- The employer shall ensure that each affected employee uses eye protection that provides side protection when there is a hazard from flying objects. Detachable side protectors (e.g., clip-on or slide-on side shields) meeting the pertinent requirements of this section are acceptable.

The Numbers

OSHA enforcement statistics for this standard for the period of October 2020 through September 2021:

Citations	Inspections	Penalty	Industry Classification
1,513	1,507	\$4,858,498	Total for All Industries
1,496	1,490	\$4,803,612	23 / Construction
4	4	\$11,746	33 / Manufacturing (part 3 of 3)
4	4	\$7,022	56 / Administrative and Support and Waste Management and Remediation Services
2	2	\$15,214	62 / Health Care and Social Assistance
2	2	\$7,752	53 / Real Estate and Rental and Leasing
2	2	\$3,470	54 / Professional, Scientific, and Technical Services
1	1	\$5,000	71 / Arts, Entertainment, and Recreation
1	1	\$2,926	32 / Manufacturing (part 2 of 3)
1	1	\$1,755	42 / Wholesale Trade

- The employer shall ensure that each affected employee who wears prescription lenses while engaged in operations that involve eye hazards wears eye protection that incorporates the prescription in its design, or wears eye protection that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses or the protective lenses.
- Eye and face PPE shall be distinctly marked to facilitate identification of the manufacturer.
- Protectors shall meet the following minimum requirements:
 - They shall provide adequate protection against the particular hazards for which they are designed.
 - They shall be reasonably comfortable when worn under the designated conditions.
 - They shall fit snugly and shall not unduly interfere with the movements of the wearer.
 - They shall be durable.

- They shall be capable of being disinfected.
- They shall be easily cleanable.

Compliance Resources

The **American Optometric Association** (AOA) offers information about workplace eye safety, including the two major reasons for on-the-job eye injuries; the four types of potential eye hazards at work and a discussion of types of eye protection. Click here to visit the AOA website: <https://tinyurl.com/4v7aj98x>

Why You Should Consider Foam-Lined Eye and Face Protection explains why this type of eyewear is being adapted in more and more workplaces and how the inserts that prevent foreign particles from making contact with the eyes. Click here to read the article: <https://tinyurl.com/3yrv2vjv>

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Top OSHA Workplace Violations

EYEWASH MAINTENANCE CAN PREVENT INFECTIONS

A related standard (29 CFR 1910.151(c)) requires eyewash facilities in workplaces where corrosive chemicals are used. Having eyewashes be available if a worker's eyes are exposed to hazmat is important, but if they are not properly maintained, they may contain organisms known to cause infections, such as *Acanthamoeba*, *Pseudomonas* and *Legionella*. Eye injuries, as well as skin damage or a compromised immune system, can leave workers who come in contact with these organisms especially susceptible to infection. Serious health effects, including permanent vision loss, neurological infections and severe lung diseases

are possible. Eye pain, blurred vision, light sensitivity, and eye inflammation are also possible.

To properly maintain eyewash stations, refer to manufacturer instructions on how often and how long to activate specific plumbed systems in order to reduce microbial contamination and generally reference the American National Standards Institute (ANSI) standard Z358.1-2014. Maintenance procedures include flushing the system and using only solutions appropriate for flushing eyes. For more information, see OSHA's FactSheet, Health Effects from Contaminated Water in Eyewash Stations: <https://tinyurl.com/2p8ehz8v>

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OSHA Standard 29 CFR 1910.178: Powered Industrial Trucks

Ranking: #9

The Risks

Powered industrial trucks, commonly called forklifts or lift trucks, are used in many industries, primarily to move materials. They can also be used to raise, lower, or remove large objects or a number of smaller objects on pallets or in boxes, crates, or other containers. Powered industrial trucks can either be ridden by the operator or controlled by a walking operator. Different types of powered industrial trucks present different operating hazards. For example, a sit-down, counterbalanced high-lift rider truck is more likely than a motorized hand truck to be involved in a falling load accident because the sit-down rider truck can lift a load much higher than a hand truck. Workplace type and conditions are also factors in hazards commonly associated with powered industrial trucks. Retail establishments often face greater challenges than other worksites in maintaining pedestrian safety. Beyond that, many workers can also be injured when (1) lift trucks are inadvertently driven off loading docks; (2) lifts fall between docks and an unsecured trailer; (3) they are struck by a lift truck; or (4) they fall while on elevated pallets and tines.

Major Provisions of the Standard

- All new powered industrial trucks acquired and used by an employer shall meet the design and construction requirements for powered industrial trucks established in the "American National Standard for Powered Industrial Trucks, Part II, ANSI B56.1-1969," except for vehicles intended primarily for earth moving or over-the-road hauling.

The Numbers

OSHA enforcement statistics for this standard for the period of October 2020 through September 2021:

Citations	Inspections	Penalty	Industry Classification
1,624	1,088	\$5,572,637	Total for All Industries
353	233	\$1,144,514	33 / Manufacturing (part 3 of 3)
271	171	\$799,833	32 / Manufacturing (part 2 of 3)
250	151	\$904,462	42 / Wholesale Trade
162	142	\$387,538	23 / Construction
139	93	\$640,124	49 / Transportation and Warehousing (2 of 2)
105	64	\$394,204	44 / Retail Trade (part 1 of 2)
85	60	\$296,085	31 / Manufacturing (part 1 of 3)
57	41	\$343,122	48 / Transportation and Warehousing (1 of 2)
54	29	\$129,007	81 / Other Services (except Public Administration)
47	31	\$141,741	56 / Administrative and Support and Waste Management and Remediation Services

- Approved trucks shall bear a label or some other identifying mark indicating approval by the testing laboratory. See paragraph (a)(7) of this section and paragraph 405 of "American National Standard for Powered Industrial Trucks, Part II, ANSI B56.1-1969."
- Modifications and additions which affect capacity and safe operation shall not be performed by the customer or user without manufacturers prior written approval. Capacity, operation, and maintenance instruction plates, tags, or decals shall be changed accordingly.
- If the truck is equipped with front-end attachments other than factory installed attachments, the user shall request that the truck be marked to identify the attachments and show the approximate weight of the truck and attachment combination at maximum elevation with load laterally centered.
- The user shall see that all nameplates and markings are in place and are maintained in a legible condition.
- As used in this section, the term, approved truck or approved industrial truck means a truck that is listed or approved for fire safety purposes for the intended use by a nationally recognized testing laboratory, using nationally recognized testing standards.
- *Designations.* For the purpose of this standard there are eleven different designations of industrial trucks or tractors as follows: D, DS, DY, E, ES, EE, EX, G, GS, LP, and LPS.
 - The D designated units are units similar to the G units except that they are diesel engine powered instead of gasoline engine powered.
 - The DS designated units are diesel powered units that are provided with additional safeguards to the exhaust, fuel and electrical

Top OSHA Workplace Violations

systems. They may be used in some locations where a D unit may not be considered suitable.

- The DY designated units are diesel powered units that have all the safeguards of the DS units and in addition do not have any electrical equipment including the ignition and are equipped with temperature limitation features.
- The E designated units are electrically powered units that have minimum acceptable safeguards against inherent fire hazards.
- The ES designated units are electrically powered units that, in addition to all the requirements for the E units, are provided with additional safeguards to the electrical system to prevent emission of hazardous sparks and to limit surface temperatures. They may be used in some locations where the use of an E unit may not be considered suitable.
- The EE designated units are electrically powered units that have, in addition to all the requirements for the E and ES units, the electric motors and all other electrical equipment completely enclosed. In certain locations the EE unit may be used where the use of an E and ES unit may not be considered suitable.
- The EX designated units are electrically powered units that differ from the E, ES, or EE units in that the electrical fittings and equipment are so designed, constructed and assembled that the units may be used in certain atmospheres containing flammable vapors or dusts.
- The G designated units are gasoline powered units having minimum acceptable safeguards against inherent fire hazards.

- The GS designated units are gasoline powered units that are provided with additional safeguards to the exhaust, fuel, and electrical systems. They may be used in some locations where the use of a G unit may not be considered suitable.
- The LP designated unit is similar to the G unit except that liquefied petroleum gas is used for fuel instead of gasoline.
- The LPS designated units are liquefied petroleum gas powered units that are provided with additional safeguards to the exhaust, fuel, and electrical systems. They may be used in some locations where the use of an LP unit may not be considered suitable.

Compliance Resources

An OSHA Alert entitled, *Protect Workers Operating and Working Near Forklifts* is available at <https://tinyurl.com/ywp392xj>. It contains a safety checklist that includes the use of seatbelts, adherence to rated loads and speed limits, and making sure loads are balanced and there is sufficient clearance when raising and loading materials.

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OSHA Standard 29 CFR 1910.212: General Requirements for All Machines

Ranking: #10

Machinery and Machine Guarding

Moving machine parts have the potential to cause severe workplace injuries, such as crushed fingers or hands, amputations, burns or blindness. Workers who operate and maintain machinery suffer approximately 18,000 amputations, lacerations, crushing injuries, abrasions, and over 800 deaths per year. Safeguards are essential for protecting workers from these preventable injuries. Any machine part, function, or process that may cause injury must be safeguarded. When the operation of a machine or accidental contact injure the operator or others in the vicinity, the hazards must be eliminated or controlled. Mitigating machine hazards requires a hazard analysis that includes identifying activities, mechanical components and mechanical motions that could pose a danger to machine operators.

Major Provisions of the Standard

- One or more methods of machine guarding shall be provided to protect the operator and other employees in the machine area from hazards such as those created by point of operation, ingoing nip points, rotating parts, flying chips and sparks. Examples of guarding methods are-barrier guards, two-hand tripping devices, electronic safety devices, etc.

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The Numbers

OSHA enforcement statistics for this standard for the period of October 2020 through September 2021:

Citations	Inspections	Penalty	Industry Classification
1,281	1,144	\$10,435,925	Total for All Industries
558	481	\$4,623,282	33 / Manufacturing (part 3 of 3)
287	259	\$2,240,860	32 / Manufacturing (part 2 of 3)
167	151	\$1,438,108	31 / Manufacturing (part 1 of 3)
69	65	\$506,469	42 / Wholesale Trade
42	40	\$595,347	44 / Retail Trade (part 1 of 2)
29	27	\$209,718	56 / Administrative and Support and Waste Management and Remediation Services
21	20	\$222,788	81 / Other Services (except Public Administration)
16	14	\$39,211	11 / Agriculture, Forestry, Fishing and Hunting
15	14	\$0	92 / Public Administration
14	14	\$194,999	23 / Construction
13	12	\$111,869	49 / Transportation and Warehousing (2 of 2)

- Guards shall be affixed to the machine where possible and secured elsewhere if for any reason attachment to the machine is not possible. The guard shall be such that it does not offer an accident hazard in itself.
- Point of operation is the area on a machine where work is actually performed upon the material being processed.
- The point of operation of machines whose operation exposes an employee to injury, shall be guarded. The guarding device shall be in conformity with any appropriate standards therefore, or, in the absence of applicable specific standards, shall be so designed and constructed as to prevent the operator from having any part of his/her body in the danger zone during the operating cycle.
- Special hand tools for placing and removing material shall be such as

to permit easy handling of material without the operator placing a hand in the danger zone. Such tools shall not be in lieu of other guarding required by this section but can only be used to supplement protection provided.

- The following are some of the machines which usually require point of operation guarding:
 - Guillotine cutters
 - Shears
 - Alligator shears
 - Power presses
 - Milling machines
 - Power saws
 - Jointers
 - Portable power tools
 - Forming rolls and calendars
- Revolving drums, barrels, and containers shall be guarded by an enclosure which is interlocked with the drive mechanism, so that the

barrel, drum, or container cannot revolve unless the guard enclosure is in place.

- When the periphery of the blades of a fan is less than seven feet above the floor or working level, the blades shall be guarded. The guard shall have openings no larger than 1/2 inch.
- Machines designed for a fixed location shall be securely anchored to prevent walking or moving.

Compliance Resources

OSHA has a *Machine Guarding* eTool that focuses on recognizing and controlling common amputation hazards associated with the operation and use of certain types of machines. You can access it at: www.osha.gov/etools/machine-guarding

Amputation is one of the most severe and crippling types of injuries in the occupational workplace, and often results in permanent disability. OSHA's publication, *Safeguarding Equipment and Protecting Employees from Amputations* provides guidance on preventing amputations. It explains how to recognize and control common amputation hazards associated with the operation and use of certain types of machines, including saws, presses, and plastics machinery. You can find it at: <https://tinyurl.com/2s3fck4e> **WMHS**

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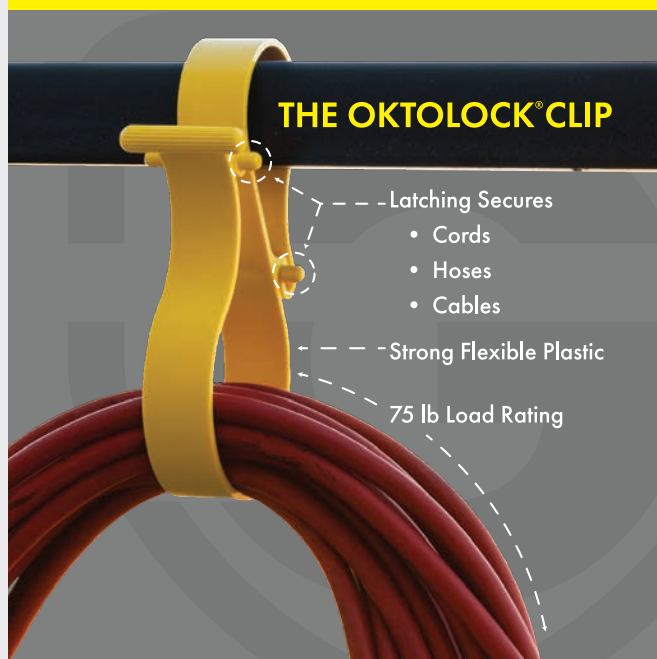
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Resist Being Penny Wise or Dollar Foolish

By: **Rolly Clendening**, Contributor

Making plans for your new or expanded warehouse or production facility is a lengthy and expensive project. Decisions need to be made for every fixture and accessory to make your project practical and efficient. Planning the new home for your operation is a natural function for an architect, addressing the size and utility needs for your building.

Decisions get more difficult when it comes to machinery, fixtures, racking for storage and facility support areas. Questions arise on how budgets are to be used to get both values in saving money, while investing where quality objects will benefit the operation best.

Over the last 18 months I have been contacted to travel the country, helping address a safety issue that was never included into the building plans for a national retail company's distribution centers. Some of the facilities were older and some were fairly new, but intersection safety was one of the unaddressed concerns in the planning process. Forklift and pedestrian safety were left to the forklift operators that sounded their horns when approaching blind spots at the end of aisles.

Fortunately, these distribution centers avoided traffic-related injuries for years. But like most good things, the luck ran out and an employee lost a limb when pinned between two moving vehicles at an intersection at the end of an aisle.

The national safety director for this company recalled seeing various safety options for intersections and other blind spots at national trade shows like MODEX, ASSP and NSC Conferences. Their first call was to ask our company to develop an intersections/blind spot protection program for their facilities. I traveled the U.S. performing full site mirror surveys to protect each intersection and problem blind spots in multiple regional distribution centers. They

have also installed "blue light" forklift lights and signage to project a distanced warning that these vehicles are approaching.

What does this have to do with project planning?

The cost for the single accident expense that started the *reactive* project was probably more than the cost for all the mirrors in the solution project itself. Workman compensation claims, increased insurance premiums and possible OSHA fines are not usually considered in an initial building budget.

Proactive planning will help protect your products, machinery and most importantly the staff that makes your company a success. Step one in your traffic and pedestrian safety program needs to happen first, then a prioritized plan that can grow into a healthy safety culture for your team. Implementing your complete plan should be a big cost savings, having installers and the needed equipment in for one visit would be beneficial.

In my 20 years of site safety surveys, I would estimate that close to 75 % of the facilities I have visited had little to no mirrors, blue light or projection warning devices at intersections. Self-preservation instincts of the staff, along with management vehicle safety policies can keep the majority fairly safe. The expensive reality is that one major incident will send everyone searching for solutions that could have been avoided with a more complete safety plan.

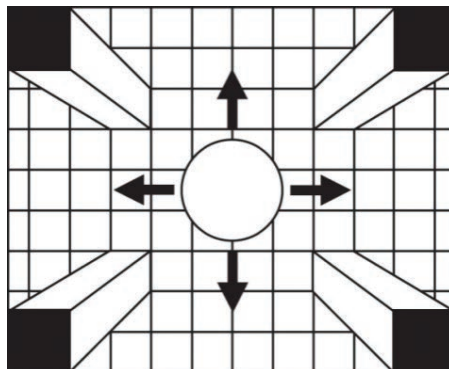
What are some of the most practical choices?

It is the responsibility of the facility manager & safety director to ensure the safety of the operation and to seek knowledgeable assistance from facility safety professionals. Management doesn't need to know everything, just a source to provide the widest assortment of solutions. If

your safety distributor doesn't offer solutions, ask them to find the best answers. Selling primary PPE keeps the distributor busy, but most of them offer mirrors and other warning systems from manufacturers that can provide assistance.



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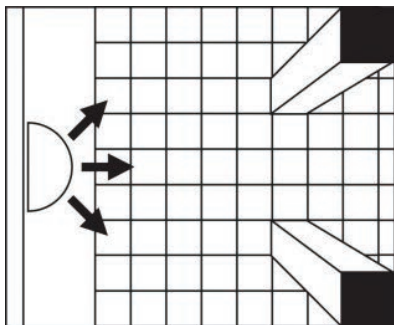
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Here are a few basic guidelines for mirrors:

- Domes and convex mirrors use a common estimate of one inch of mirror diameter will provide one foot of viewing distance. (36" = 36' view)
- Mirrored domes at four-way intersections should be hung with the bottom of the mirror 1-2 feet above the highest moving forklift or load. Consider the height of the mounted dome to be included when evaluating viewing distances.
- Three-way intersections commonly use half domes or dome mirrors mounted at eye-level, flat against the wall at the end of an aisle.

One of the best sources for hazardous areas in your building is your own forklift operators and the pedestrians that walk the aisles on a regular basis. Taking the first step toward your safety plan will build confidence with your operations staff and will be identified by your insurance provider and OSHA visitors.

Trying to save on prevention early can cost you in the future. **WMHS**

Rolly Clendening is a Product Engineer and Sales Manager for Se-Kure Domes and Mirrors, a Made in America Company based in Sturgis, Michigan (www.domesandmirrors.com).

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Five Best Practices for Emergency Eyewashes and Showers

By: **Eric Clark**, Contributor

For many employers, selecting and maintaining safety equipment is a small component of their overall safety plan. There are many pre-emergency measures that are necessary to ensure a safe environment for team members, as well as meeting complex OSHA requirements. Emergency response can sometimes be an afterthought, as prevention is perceived as paramount. However, OSHA regulations call out and address emergency eyewash and shower equipment response requirements in 29 CFR 1910.151. Specifically, OSHA states: “Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use.”

A key emphasis should be placed on the terms “suitable” and “immediate” as those are of vital importance when procuring, planning and maintaining emergency equipment. Since 1981, the International Safety Equipment Association (ISEA) has been producing the American National Standard for Emergency Eyewash and Shower Equipment, ANSI Z358.1, to establish uniform minimum performance and use requirements. This standard is a comprehensive outline that serves as a guideline for companies and safety professionals to provide safe working environments.

By applying a few additional best practices, you can exceed the minimum response requirements and ensure that each site implements and manages appropriate emergency response systems, minimizing related employee injuries, and preventing a situation from going from bad to worse. While the hope may be that you’ll never have to use your emergency equipment, you should maintain the mindset that an emergency could happen at any moment. In a safety industry survey conducted by Haws®, professionals who make product recommendations and/or buying decisions were asked what they considered the most important factors when selecting an eyewash and/or eyewash/ shower combination unit. Not surprisingly, the top two answers were ANSI compliance and victim comfort. Victim comfort is an important consideration that should be factored into creating a complete safety response environment for your employees. By putting yourself in a victim’s shoes when making a purchasing decision you are most likely to



Emergency equipment must be located on the same level and within an unobstructed, 10-second walk from a potential hazard (roughly 55 feet). Image courtesy of Haws Corporation.

purchase equipment that not only meets the ANSI standard but provides the most critical care during an emergency.

When purchasing, placing and maintaining your emergency equipment, remember these five key things:

- 1. Proper product specification and placement.** When it comes to emergency response equipment, there is no shortage of available products. With many choices – oftentimes differentiated only by subtle differences – it’s important to critically assess specific risks to determine the most suitable product. For example, in a chemical plant where liquids form the general risk, an eye/face wash would be the most appropriate choice. With recent product advancements such as flow controls and designs inspired by eye irrigation protocols used within the medical community, choosing the most suitable equipment also means selecting from the most current generation of products. Many of these have been designed to meet changes imposed in the Z358.1 Standard revision (2009).

- 2. Location** should be the next critical consideration. Per ANSI, emergency equipment must be located on the same level and within an unobstructed, 10-second walk from a potential hazard (roughly 55 feet). The number of showers/eyewashes available and their individual locations must be evaluated when determining installation locations. The second key thing

is to assure proper visibility. High visibility of safety equipment can be achieved with clear signage, proper lighting and the use of the color known as “safety green.” This color is used industrially to designate both the concept of safety and the physical locations of first aid and emergency response equipment, including drench showers and eyewashes. ANSI Z535.1 takes this one step further by providing a standard for color schemes, sizing, meaning and application for various workplace hazards. The standard is intended to provide uniformity across organizations and industries by helping employees identify the severity of a given hazard in the workplace. Often, an emergency station is not clearly marked, causing the victim to frantically locate an improper form of flushing such as a sink. Consistently using the familiar color for emergency signage can minimize unnecessary confusion in a crisis, especially if the injured party has contaminants in or around their eyes, reducing visibility.

3. Tepid water. Excessively hot or cold-water temperatures in safety showers and eyewashes can exacerbate the very injuries the safety equipment is designed to reduce. In the 2009 revision of ANSI Z358.1, the standard outlines suitable water temperatures as tepid, defined as a range between 60° and 100°F (15.5° to 37.77°C). It also specifies a full 15-minute drench or irrigation cycle, a length of time that must be considered with the victim in mind. An uncomfortable victim will be less inclined to abide by the flush requirements, which could worsen an injury. By selecting a suitable mixing valve and defining a tepid water range that is more comfortable to the user, you are not only encouraging the full flush period but also increasing the likelihood that a victim will remove contaminated clothing, which further enhances the

wash objective. Selecting a thermostatic mixing valve that offers protection against temperature spikes is an ideal solution to providing reliable temperature controls. A paraffin-base thermal actuation will keep outlet temperature within tight specifications to prevent scalding and hypothermia. In addition, a funnel design in the mixing chamber generates turbulent flow to ensure consistent temperature blending across the entire flow range.

4. Perform continuous maintenance and testing. One of the implied responsibilities of specifying and installing emergency equipment is assuring a maintenance process is designed to keep safety showers, eyewashes and associated system components functioning optimally. A common question relates to the appropriate frequency and length of time for unit testing. While a quick, random activation to test the unit might seem sufficient, it is more impactful and valuable to test each unit for the required 15-minute flush every time. The intention behind routine testing is not only to guarantee that each piece of equipment has the proper flushing fluid supply and flow, but also to clear the line of any sediment build-up and to minimize contamination related to inactive water. Testing should replicate a real-life scenario to ensure that each site can be confident in the emergency unit’s ability to reliably perform. In addition, documentation of the routine testing including location, dates and performance provides records to demonstrate your facility’s diligence in protecting and monitoring each unit. These records can be managed in a variety of forms, including inspection tags on the units and safety equipment surveys. The proper coordination of testing alleviates any questions or concerns related to functionality and allows your safety team an instant reference for monitoring all safety equipment performance.

5. Create a robust safety culture. This may be the most important overarching aspect of what we do in the safety industry, yet it is not covered as thoroughly as it should be. The hope is that emergency eyewashes and showers will never have to be used, and it is this mindset that exposes facilities to risks and potential severe fines for non-compliance. **WMHS**



Tepid water makes it more likely that a victim will perform the required 15-minute drench or irrigation cycle. Image of facewash/shower combo is courtesy of Haws Corporation.



Eric Clark is the Director of Services at Haws Corporation. Haws Services is a warranty and service provider for all brands of emergency shower and eye/face wash products to ensure your emergency equipment is ANSI compliant and functioning properly. From startup and commissioning to annual inspections and preventative maintenance, Haws Services’ experts specialize in emergency response equipment (www.hawscorp.com/solutions-services/services).



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Essential Hand Protection for Worker Safety

By: Jane Marsh, Contributor

It's impossible to overstate the importance of essential hand protection for worker safety. Statistics show hand injuries can — and do — happen regularly, whether in manufacturing, engineering, warehousing or one of the trades.

According to OSHA, wearing proper personal protective equipment (PPE) could prevent around 70.9 % of worker injuries sustained to the hands or arms. When most individuals think of hand protection, they think of gloves. Consider this a quick but thorough guide to matching gloves, product characteristics and other tools to the task at hand to reduce safety incidents.

HAND PROTECTION FOR EVERYDAY TASKS

Everyday work gloves are satisfactory for tasks like moving boxes in warehouses or operating lift trucks. The right gloves enhance safety by reducing the likelihood of incidents and equipment-operation blunders, as well as by protecting the hands themselves. Choose everyday disposable task gloves that:

- Provide a confident grip, usually through rubberized and textured palms and fingers
- Come in a range of sizes to accommodate all employees comfortably
- Offer a secure fit without slipping or stretching out too quickly
- Allow the hand, wrist and fingers to move without their range of motion impeded
- Don't rip or tear easily and can be worn for multiple shifts before disposal

HAND PROTECTION FOR MORE INTENSE TASKS

Some of the tasks in supply chains, on construction sites and elsewhere require more robust forms of hand and arm protection. The most common hazards in such environments are lacerations and cuts.

CUT AND IMPACT PROTECTION

Take time to study the cut resistance levels as outlined by the American National Standards Institute (ANSI).

Gloves rated "A1" provide protection for low-cut-hazard tasks and cutting force up to 499 grams. "A5" gloves

provide substantial (5,999 grams) protection against cuts, harsh impacts and vibrations.

Some tasks, like operating packaging-dispensing machines, should see gloves paired with protective sleeves and specialized task-specific versions. These protect workers from lacerations from the cutting blades. Some gloves are woven with nontraditional materials for greater protection, like metal mesh.

CHEMICAL PROTECTION

OSHA's Code of Federal Regulations requires employers to "select and require employees to use" hand protection in all situations involving identified hazards (1910.138(a)). The regulations also require employers to evaluate the nature of these hazards and match the danger of the task with appropriate and specific hand protection products (1910.138(b)).

Material Safety Data Sheets (SDS) often provide recommendations for hand protection levels. When evaluating products on the market, consider factors such as:

- Type and concentration of chemical
- Temperature of chemical
- Duration and type of exposure — i.e., immersion vs. splashes
- Level of grip and dexterity required for the task
- Degree of protection (hand, forearm, entire arm, etc.)

Manufacturers should make it simple to find their laboratory results and match protective equipment to specific tasks. The industry regulations and associations informing their product design should be apparent. If these things are not in evidence, they may not be the best safety partner.

OTHER HAND PROTECTION CONSIDERATIONS

Other factors should be considered when ensuring workers' hand safety. Companies should keep these additional safety precautions in mind.

CHOOSING DIFFERENT TOOLS

In some cases, it's possible to think beyond hand protection and choose a slightly different tool that further reduces the chances of sustaining injury.

Some cutting and shaping tools, including blades, are designed to make glove penetration and worker injury even less likely than with traditionally shaped implements.

It's also important to note that not all gloves boasting puncture resistance keep workers safe from certain tools, such as needles. If especially hazardous or physically dangerous products are handled or processed at your facility, ensure your disposal/transport containers and hand protection are up to the task.

FACTORING IN ENVIRONMENTAL PROTECTION

The best hand protection products should be designed with their environmental impact in mind. Hand protection is ultimately a disposable product category, but that doesn't mean single use in every case.

The material sciences improve regularly. If it's been some time since your purchasing agents shopped around for more environmentally friendly hand and arm protection, this may be the moment. Durability and material choice should be top-tier concerns. Buying products that last longer often provides a better ROI and minimizes landfill waste.

CREATING ADEQUATE AND ONGOING TRAINING

Material interventions and investments in hand safety are usually the focus while training takes the back seat. This is a mistake.

Hand and arm safety should focus on new-worker onboarding and refresher training modules delivered regularly for everyone else. Do not make this an afterthought. Workers will sometimes complain about protective equipment impeding their work, which underscores the importance of matching the glove to the task — and the nature of personal responsibility in a facility or on a work site.

Identify the best and most relevant workplace safety training experiences and courses available to you. Take employee concerns seriously and work to improve processes and protections within reason. Don't sacrifice sound legal or ethical footing to save money or time.

FOR HAND PROTECTION, LEAVE NOTHING TO CHANCE

Take time to understand the form and function of site and facility safety signage, and be sure workers understand their significance, too. No detail is too small to ignore or a hazard too insignificant to avoid.

Workplace safety is an individual mandate, but positive examples must come from the top. The right intentions and investments will create a lasting safety culture that sustains itself. **WMHS**

Jane Marsh covers topics in green technology and manufacturing. She also works as the Editor-in-Chief of environment.co.

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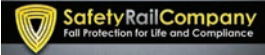



















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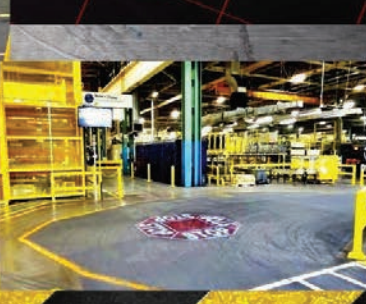
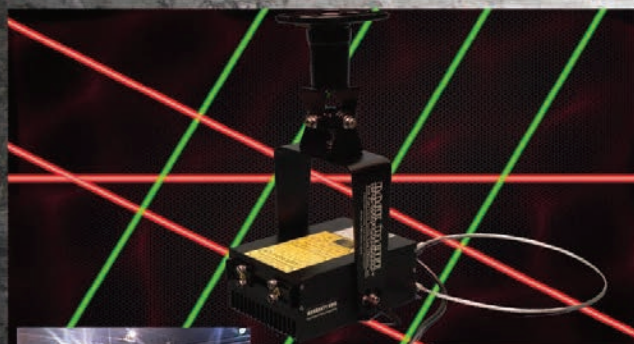
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