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THE ELECTRIC CURRENT

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Yale

New Narrow Aisle Reach Truck from Yale Wins Product of the Year Award

The recently launched Yale® narrow aisle reach truck is already earning recognition, crowned a 2020 Product of the Year Award winner by the readers of Material Handling Product News and MaterialHandling247.com. The NR/NDR series beat out four other candidates in the ergonomics and safety category for its operator comfort, visibility and productivity in high-density warehousing applications.

“With space and labor becoming scarce and more expensive, warehouses are looking to narrower aisles and higher-level storage locations to manage growing inventories,” says Brad Long, Brand Manager, Yale Materials Handling Corporation. “We engineered the new reach truck to be the gold standard, equipping operators to efficiently service high-density storage configurations and achieve faster cycle times, with the ergonomic features for performance all shift long.”

Operator comfort: The reach truck offers a generous lineup of industry-exclusive features for a more comfortable ride that staves off fatigue. The Operator Sensing System detects operator presence without traditional pedals, offering freedom to comfortably adjust stance, and the optional smart ride suspended floor system alleviates up to 60% of shocks and vibrations transmitted to the operator.

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mum lighting, guidance and viewing perspective to eliminate guesswork when positioning forks at high-level storage locations.

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Low Voltage Electrical Hazards in the Workplace

Each year 120 Volt circuits cause more deaths and injuries than circuits of all other voltage levels combined. Such low-voltage circuits are extremely hazardous for two reasons. First, low-voltage circuits are the most common because they are the final distribution voltage, 240V, 208V, and 120V circuits are used throughout residential, commercial, industrial, and utility systems.

The second reason for extreme danger of low-voltage circuits is user apathy. Comments such as "It can't hurt you; it's only 120 volts" are heard all too often. 120 Volt circuits can produce currents through the human body that can easily reach fibrillation levels. Consider a perspiring worker using a metal electric drill with one foot immersed in water. Clearly under this condition a worker can be subjected to a lethal shock. Furthermore, if sustained for a sufficient period, 120 Volt contact can create severe burns. I will spell out several techniques to avoid electrical incidents later in this article.

Warning Signs

It is my opinion that we have dumbed down our society's electrical safety knowledge by placing "DANGER – HIGH VOLTAGE" signs on every level of voltage and have led the population to believe the only voltage that is dangerous is high voltage. In reality, and by OSHA voltage standards, most people in American workplaces are always exposed to low voltage and almost never exposed to high voltage.

Electrical Hazard Warning Signs should be labeled "DANGER – HAZARDOUS VOLTAGE," to help people understand that all voltages are potentially dangerous. Based on the

fact we kill more people on low voltage than any other voltage, "HAZARDOUS VOLTAGE" markings make a lot of sense.

A Common Low-Voltage Hazard Sources
Some of the low voltage hazards that lead to electrical shock and electrocution hazards are related to the use of extension cords and portable electric tools.

Extension cords that are not handled properly can easily become an electrocution hazard. If cords are twisted up, run over with forklifts, pinched or crushed, or if the jacket is broken at the plug cap or where the cord is wrapped around a drill, saw or grinder, the ground conductor can easily become broken.

Frequently, ground pins are broken off so the cord can be plugged into a two-wire receptacle that does not have a ground. Or, a three-prong plug is plugged into a UL approved adapter designed to be plugged into a two-pronged outlet. Plug caps are replaced by personnel that are not electrically qualified and are improperly wired. These situations create a death hazard because there is no low impedance ground connection to cause enough current to flow to blow a fuse to trip a circuit breaker to clear the fault.

The Circuit is Grounded
We have all heard many, many times a phrase that should have never been uttered in the first place. That phrase is: "Electricity always takes the past of least resistance." Because of this misunderstood statement, many assume that all current will flow through the ground wire. However, this statement is only partially true! The truth is that electricity takes every path available to it no matter what the resistance of the path, and there is almost always more than one path.

For example, when an electric tool equipped with a three-prong plug shorts out, the person holding the tool is an alternate path to the earth; thus, the current will split between the person and the electrical ground wire. If the ground conductor is broken, or if the ground pin has been broken off the plug, or the 3 prong plug is plugged into an adapter and energized from a 2 prong receptacle, and the tool shorts out, the person becomes the only path to the earth. In either of these cases, there may be enough current through the body to be fatal.

How much current is enough?
There is no safe path through a human body for electrical current That is – any current through the body from an external source can cause unwanted results depending on magnitude.

Current	Effect
1 mA	Barely perceptible
1-3 mA	Perception threshold (most cases)
3-9 mA	Painful sensations
9-25 mA	Muscular contractions (can't let go)
25-60 mA	Respiratory paralysis (may be fatal)
60 mA or more	Ventricular fibrillation (probably fatal)
4 A or more	Heart paralysis (may restart through CPR)
5 A or more	Tissue burning (fatal if vital organ)

Table 1 shows the approximate effects that current may have on the human body. Several conditions may modify any given effect such as:

The actual path through the body. For example, current from the hand to the shoulder is not likely to cause fibrillation since it does not pass through the heart.

The length of time the current continues to flow. For example, currents in the 9-25 milliamp range through the heart for a short time, will probably not cause fibrillation to occur. However, since the victim


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may not be able to release contact, fibrillation may indeed result.

The health and other physical characteristics of the individual receiving the shock.

The frequency of the current flow may make a difference. Different frequencies of current affect the body in different ways. All the values in Table 1 assume frequencies of 60Hz or lower.

Example
If the path through the body has 7,500 Ohm resistance, and the tool is energized at 120 volts, the resulting current flow through the person is 0.016 of an Ampere, or 16 milliamps. When you pass current through a muscle, the muscle contracts. When the current reaches the level where the muscle contracts and the person loses voluntary muscle control, it is referred to as the let go threshold or paralysis threshold. This means that the muscles clamp down and the victim cannot release their grip on the shorted tool.

Fibrillation
When the heart is in fibrillation, it flutters arrhythmically and does not pump any blood. Fibrillation of the heart is the most common cause of low voltage electrocutions.

As you can see in Table 1, the range of current flow for this example is between 9 and 25 milliamperes. This varies among individuals. Even with that small amount of current, the victim can be paralyzed and can do nothing to help themselves. If no one is available to rescue the victim, their heart may start to fibrillate.

There are no documented cases of anyone's heart going into fibrillation and returning to normal rhythm without the assistance of outside intervention. If the heart goes into fibrillation and there is no one available and trained on the use of an AED (Automatic External Defibrillator), the person will die.

Protection from the effects of electrical shock
Most untrained and even some well-trained employees do not understand that anytime you place your hand on a piece of energized electrical equipment, you become a resistor in parallel with a short piece of conductive wire or metal structure. The voltage characteristics of parallel resistors is that each of the parallel resistances experience the same voltage drop across them.

Generally, breakers and fuses in industrial installations are sized according to the current carrying capacity of the conductors installed in the circuit. Everything is installed according to the National Electrical Code (NFPA 70) and are designed to not overheat the conductor and thereby prevent burning the plant down. This means that the fuses and circuit breakers in a system cannot be depended upon to protect the worker from shock.

Ground Fault Circuit Interrupter (GFCI)
The only electrical device designed to protect personnel is a GFCI. This device will trip for currents between 4 and 6ma. They are equipped with a breaker in the energized leg that will trip within 25 milliseconds If a person is holding a steel cased tool that shorts out with bare hands, all the time the case of the tool is energized they are part of the circuit with current flowing through their body.

OSHA and the NEC rules mandate the use of a GFCI anytime portable energy supply is used. This means anytime you use a portable generator or an extension cord in the workplace the use of a GFCI is mandated.

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OSHA states that qualified electrical workers are the only personnel that can be exposed to voltages greater than 50 volts. NFPA 70E 2018 Edition defines Qualified Person. "One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify the hazards and reduce the associated risk." Note that only qualified persons may work on or near energized conductors.

OSHA also mandates a Job Briefing be held before the start of each job. "The employee in charge conducts a job briefing that meets paragraphs (b), (c), and (d) of this section with the employees involved before they start each job."

"The briefing shall cover at least the following five subjects: Hazards associated with the job, work procedures involved, special precautions, energy source controls, and personal protective equipment requirements."

The number of briefings: "At least one before the start of each day or shift. If the work or operations to be performed during the workday or shift are repetitive and similar, at least one job briefing shall be conducted before the start of the first job of each day or shift.

"Additional job briefings: shall be held if significant changes, which might affect the safety of the employees, occur during the course of the work."

Extent of job briefings
"Short discussion: A brief discussion is satisfactory if the work involved is routine and if the employees, by virtue of training and experience, can reasonably be expected to recognize and avoid the hazards involved in the job. A detailed discussion shall be conducted if the employee cannot be expected to recognize and avoid the hazards involved in the job." "Detailed discussion. A more extensive discussion shall be conducted: If the work is complicated of particularly hazardous, or, If the employee cannot be expected to recognize and avoid the hazards involved in the job."

"Working alone: An employee working alone need not conduct a job briefing. However, the employer shall ensure that the tasks to be performed are planned as if a briefing were required."

When the heart is in fibrillation, it just flutters and does not pump any blood. Fibrillation of the heart is the most common cause of low voltage electrocutions.

Training requirements
Training, or lack thereof, is a relatively large problem in the United States. OSHA and NFPA 70E lay out mandates and responsibilities. An example can be found in NFPA 70E 2018 Edition in Article 105.3, and I quote it here:

"Responsibility. The employer shall have the following responsibilities:

- Establish, document, and implement the safety-related work practices and procedures required by this standard.
- Provide employees with training in the employer's safety-related work practices and procedures.
- Employee Responsibility. The employee shall comply with the safety-related work practices and procedures provided by the employer."

Another excellent information source is the Informative Annex Section published in NFPA 70E 2018 Edition.

Informative Annex K. General Categories of Electrical Hazards. Lists General information pertaining to Electrical injuries and fatalities, and general categories of electrical shock and electrical burns. It states, "About 98 percent of fatal occupational electrical injuries are electrical shock injuries. 40 percent of electrical incidents involved 250 volts or less and were indicative of a misperception of electrical safety as a high voltage issue."

Informative Annex Q – Human Performance and Workplace Electrical Safety

Annex Q states: "Based on studies done by high-risk industries indicate human error is often a root cause of incidents. The premise of this annex is that human error is similarly a frequent root cause of electrical incidents."

Summary

This article considers some of the safety-related concerns that apply to low voltage circuits – that is, circuits of 1,000 Volts ac or less and 250 Volts dc and less. Workers should treat low-voltage with the same degree of respect afforded medium and high-voltage circuits.

Electrical safety does not just happen. It requires knowledge of the electrical hazards and potentially hazardous conditions and situations. And, it takes constant effort and vigilance to maintain an electrical safety program, whether you are working alone or with other employees.

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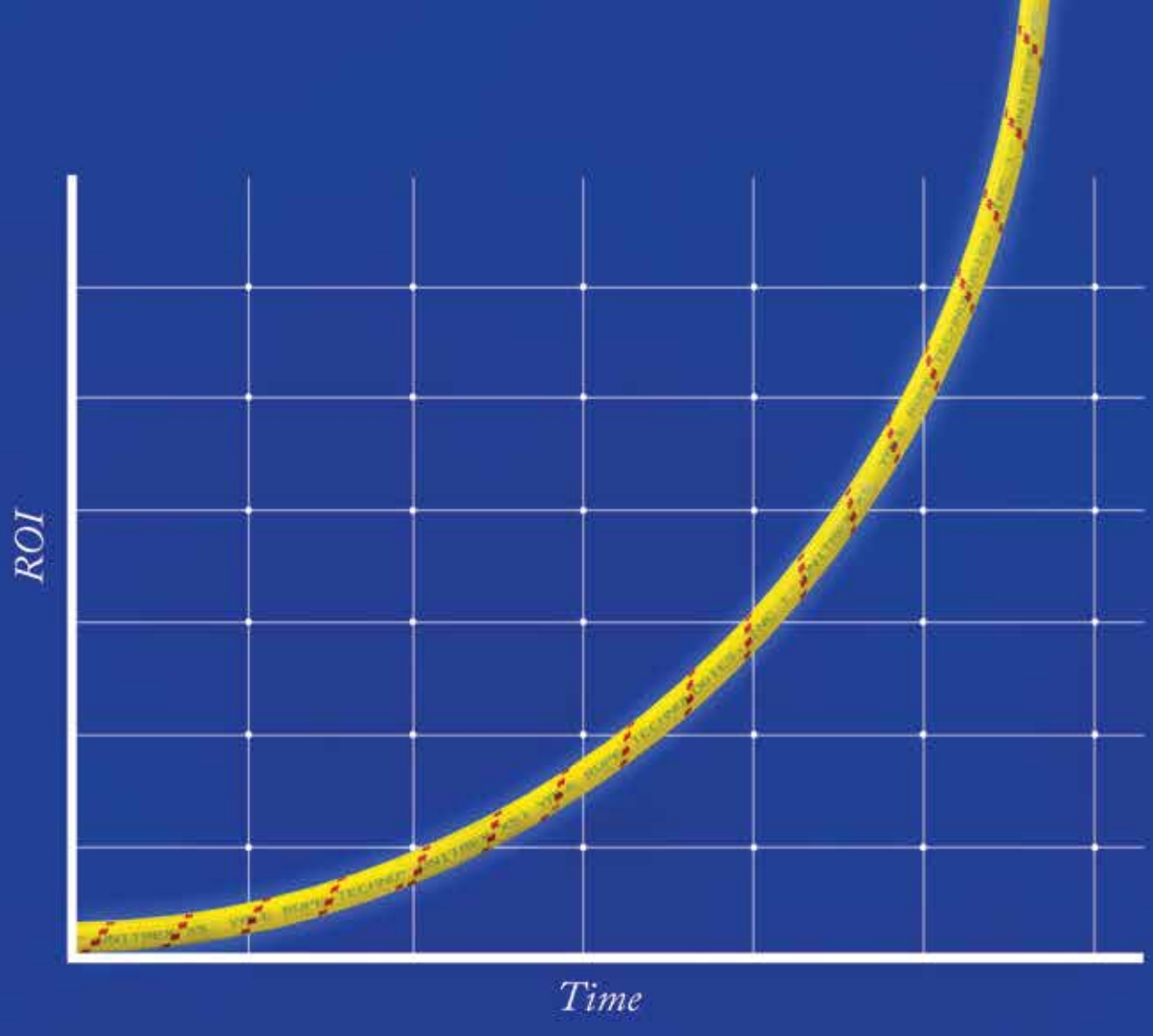

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