

ELECTRICAL SAFETY BY DESIGN

SAVE LIVES. INCREASE PRODUCTIVITY.



GRACE
PESDs®

Electrical safety is personal, and it starts with YOU. Whether you are a task-qualified maintenance person, qualified electrician, or responsible for design and management; you have a unique role and responsibility to protect yourself and the people around you from the devastating hazards of electrical energy.

SAFETY BY DESIGN

Safety by design is an approach to reducing risk that involves designing products, systems, and environments with safety in mind from the very beginning. Reducing risk is an ongoing process that involves identifying potential hazards and implementing measures to mitigate them. Whether you're at home, at work, or on the go, there are always steps you can take to reduce risk and ensure your safety. By exploring the concept of safety by design you can improve safety and create a safer environment for yourself and those around you.

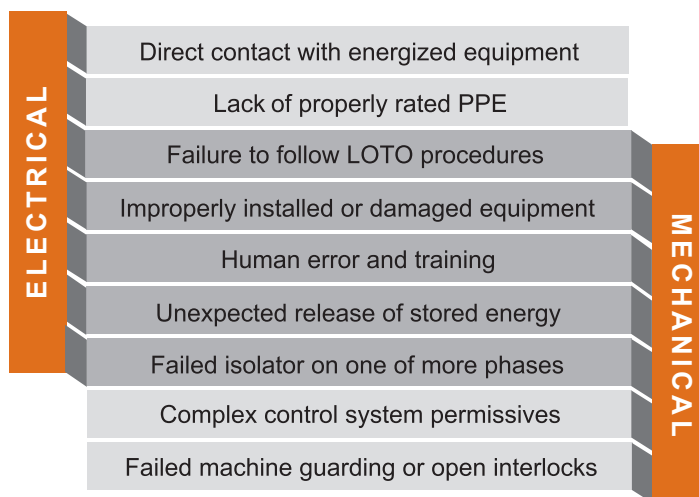
In this publication, we will be exploring the benefits of incorporating safety by design principles into your Electrical Safety Programs. The NFPA 70E standard for electrical safety has existed for many decades, and yet to this day compliance is difficult to achieve for many organizations. With our expert guidance, you will learn how to enhance your compliance efforts, improve safety, and reduce Lockout/Tagout (LOTO) procedure times. We will delve into the Process for Establishing and Verifying an Electrically Safe Work Condition using Permanent Electrical Safety Devices (PESDs®), in compliance with NFPA 70E 120.5, and show you how to make compliance and maintenance safer, smarter, and more productive.

WHY SHOULD YOU IMPROVE LOTO SAFETY IN YOUR FACILITY?

Two of the top ten most cited OSHA violations are related to the control of hazardous energy and the use of electrical work practices. These are covered under the following OSHA regulations:

- **CFR 1910.147** 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 personnel.
- **CFR 1910.333** covers the safety-related work practices to prevent electrical shock or other resulting injuries from direct or indirect electrical contact when work is performed around the electrical equipment and circuits.

Most common reasons personnel are affected by hazardous energy





Failure to perform proper mechanical or electrical LOTO can lead to electrocution, electrical shock, arc flash, and other hazards. In addition to OSHA fines and penalties, these hazards often result in lost time wages, compensation claims, permanent disability, and fatalities.

In 2021, the U.S. Bureau of Labor Statistics reported 152 electrical fatalities in the United States; 94% of which were from private industries. The Bureau also reported 2,220 non-fatal electrical injuries involving days away from work; a 17% increase from the previous year.

PESDs® are developed with safety by design to mitigate the risks of electrical exposure that result in fatalities and injuries by substantially improving personnel safety and productivity in mechanical and electrical LOTO procedures. PESDs® also assist facility personnel by providing preventive measures for repetitive electrical maintenance tasks that require access to the inside of panels where energy may be present and maintenance tasks are performed.



ChekVolt® allows you to test absence of voltage outside of an enclosure

Enhance Compliance

- ✓ 29 CFR 1910.147 & 29 CFR 1910.333
- ✓ NFPA 70E & 70B

Increase Productivity

- ✓ Increase task efficiency
- ✓ Reduced downtime & liability

Save Lives

- ✓ Reduce accidents
- ✓ Improve employee retention
- ✓ Improve catastrophic

Promotes Safety Culture

- ✓ Social responsibility
- ✓ Employee involvement
- ✓ Motivation & accountability

What do
PESDs®
really do?



HOW THE SAFETY BY DESIGN PHILOSOPHY MITIGATES RISKS

PESDs® work to confront common LOTO procedural and implementation issues, user error, compliance, and productivity by providing innovative safety solutions that mitigate or eliminate various task risks. When properly incorporated into a facility's Electrical Safety Program, thru-door voltage indicators, Safe-Test Points™, voltage portals, and combination units inherently reduce risk by providing a safer and more efficient method of performing verification of hazardous energy isolation. In addition, PESDs® are designed to improve the ease of compliance with NFPA 70E and OSHA energy isolation principles.



Safe Test-Point™
PESD

ENHANCING LOCKOUT/TAGOUT/TRYOUT

Qualified maintenance personnel performing mechanical LOTO are tasked with isolating electrical energy. As part of the verification of de-energized conditions, OSHA requires a person to operate the equipment controls, also known as "Tryout", to ensure the equipment cannot be restarted. There are several significant risks associated with solely relying on the Tryout process.

Risks associated with Tryout Process:

- ✦ Isolating incorrect controls
- ✦ Accidental restart of the equipment
- ✦ Getting caught in mechanical equipment
- ✦ Contact with live source of energy at the machine level
- ✦ Citations for not following 1910.147 procedures

Safety conscious and forward-thinking companies have started to require electricians to perform absence of voltage testing for mechanical LOTO. Research on arc flash has enabled companies to realize through a job hazard analysis that this task increases electrical hazard risks and personnel exposure to electricity when performing a tryout process.

The involvement of an electrician in a simple mechanical LOTO further hampers productivity. An externally mounted voltage indicator provides a means to verify the voltage presence inside an electrical panel safely from the outside in addition to the mandatory OSHA Tryout. Without a voltage indicator or portal, a mechanic performing mechanical LOTO is required to work in tandem with an electrician using a voltmeter to physically verify voltage inside an electrical panel. In this case, the electrician is exposed to voltage. With the combination of the Tryout process and thru-door voltage indication, a mechanic can solely verify de-energized conditions without any voltage exposure.

How do **PESDs**[®] fit into **Electrical Safety**?

A sound Electrical Safety Program should constitute all aspects of the Risk Control Hierarchy in eliminating, substituting, engineering controls, awareness, administrative controls, and Personal Protective Equipment (PPE). While it is important to understand the fault currents, arc flash labels, types of PPE, and other incident energy calculation tools; nothing comes close to avoiding one's exposure to the incident itself.

When it comes to electrical safety, what is important to you?

RISK CONTROL HIERARCHY

ELIMINATION

SUBSTITUTION

ENGINEERING CONTROLS

AWARENESS

ADMINISTRATIVE CONTROLS

PPE



ChekVolt®

Elimination/Substitution:

- Eliminating the need to open the door of an electrical cabinet, therefore, eliminating the exposure to arc flash.
- Performing the three-point test (live-dead-live) for absence of voltage from outside the door.
- Visually verifying the voltage presence from outside the cabinet.



R-3W Voltage Indicator



Custom Label



Flex-Mount Voltage Indicator

Engineering & Administrative Controls

- Through enclosure voltage indication.
- Verifying the stuck blade or lost phase on a failed disconnect switch.
- Adding a procedure label for task qualified workers.



HOW PESDs® ENHANCE YOUR PROGRAM AND COMPLIANCE

PESDs® engineer out the risk associated with routine maintenance tasks allowing it to be safely conducted from outside of the electrical cabinet, inherently reducing the risk of arc flash and shock hazards significantly. When properly incorporated into a facility's electrical and mechanical LOTO safety

procedures, PESDs® enhance compliance with NFPA 70E and OSHA energy isolation principles.

PESDs® empower users with a safer and more productive method of performing mechanical and electrical LOTO. With PESDs®, users can enhance compliance while performing the steps outlined in the NFPA 70E standard for establishing and verifying an electrically safe work condition.

NFPA 70E Article 120.5 Process for Establishing and Verifying an Electrically Safe Work Condition

Establishing and verifying an electrically safe work condition shall include all of the following steps, which shall be performed in the order presented, if feasible



- 1** *Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.*

PESDs® installed by a qualified electrician and documented in the drawings identify all possible sources of electrical supply to specific equipment through connection to the line side/load-side of the source.



Safe Test-Point™
PESD®

For every \$1 invested in safety and health programs, companies can expect a return of \$4 - \$6



2 After properly interrupting the load current, open the disconnecting device(s) for each source.

3 Wherever possible, visually verify that all blades of the disconnecting devices are fully open or that drawout-type circuit breakers are withdrawn to the test or fully disconnected position.

Voltage indicator PESDs® connected to the load side of the disconnect switch verify voltage presence at the energy isolation device in the event of phase loss, back feed, or a stuck blade condition.



R-3W Voltage Indicator PESD®

4 Release stored electrical energy.

PESDs® verify the release of stored electrical energy or dissipation of energy when connected to capacitive loads. Voltage indicators continue to illuminate when voltage is present automatically without switching meter settings.



Flex-Mount Voltage Indicator PESD®

5 Block or relieve stored nonelectrical energy in devices to the extent the circuit parts cannot be unintentionally energized by such devices.

6 Apply lockout/tagout devices in accordance with a documented and established procedure.

7 Use an adequately rated portable test instrument to test each phase conductor or circuit part to test for absence of voltage. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on any known voltage source.

Safe-Test™ Point & ChekVolt® PESDs® use high impedance protected test points to enable qualified persons to perform an absence of voltage test from outside the cabinet in normal operating condition with equipment doors closed and secured per Article 130.2 (4).



ChekVolt® PESD®

8 Where the possibility of induced voltages or stored electrical energy exists, ground all circuit conductors and circuit parts before touching them. Where it could be reasonable anticipated that the conductors or circuit parts being de-energized could contact other exposed energized conductors or circuit parts, apply temporary protective grounding equipment.



Sample Job Hazard Analysis

Rating Scale: 1-5, Probability rating of 1 is unlikely and 5 is Highly probable and

Exposure rating of 1 is less than 1x per month and 5 is exposed at all times.

Task Owner	Task Scenario	Risks Involved	PESD Application	Risks Mitigated
Qualified Electrician, Task Qualified Maintenance Tech and Machine Operator	Maintenance tech, operator and a qualified electrician needs to verify release of stored energy, and establish an electrically safe work condition to perform major maintenance on a machine press - Mechanical & Electrical LOTO and site specific switching procedures.	- Possible Shock/and Arc-flash Hazard - Accidental release of stored energy - Accidental contact with the live source of energy - Wrong feeder shut down - Back feed from other sources - Accidental drop of tools and objects on live conductors inside the cabinet - Lack of properly rated PPE	Voltage Test Station or ChekVolt® installed in the MCC and Flex-Mount Voltage Indicator installed on the disconnect switch at the machine	Voltage Test Station and ChekVolt® visually verify: - Voltage presence - Release of stored electrical energy - Backfeed from other sources - Perform Three Point Test (Live-Dead-Live) to verify absence of voltage from outside the door - Verify zero voltage from outside the door Flex-Mount Voltage indicators enable operator to verify: - Release of stored electrical energy - Hazardous voltage presence at the disconnect switch - The stuck blade condition of the disconnect switch - Backfeed from another source
Qualified Electrician	Verifying and creating an electrically safe work condition to perform a maintenance task on a MCC – Electrical LOTO and site specific switching procedures.	- Possible Shock/and Arc-flash Hazard - Accidental contact with the live source of energy - Wrong feeder shut down - Back feed from other sources - Accidental drop of tools and objects on live conductors inside the cabinet - Lack of properly rated PPE	Voltage Test Station or ChekVolt® installed in the Motor Control Center (MCC)	Voltage Test Station and ChekVolt® visually verify: - Voltage presence - Release of stored electrical energy - Backfeed from other sources - Perform three point test (live-dead-live) to verify absence of voltage from outside the door - Verify zero voltage from outside the door
Task Qualified Machine Operator	Minor servicing and adjustments to the machine - Routine Maintenance	- Sudden release of energy - Mechanical failure of the disconnect switch (stuck blade)	Voltage Indicator and Voltage Portal installed in the machine control cabinet	Voltage indicator enables operator to verify: - Release of stored electrical energy - Hazardous voltage presence at the disconnect switch - Verifies the stuck blade condition - Backfeed from another source Voltage Portal & NCVD Pen: - User can perform a voltage presence test - Provides additional risk reduction by visual indication
Task Qualified Machine Operator	Removing a stuck part from a machine on a production line- Task integral to production process	- Unexpected release of stored energy - Mechanical failure of the disconnect switch (stuck blade)	Voltage indicator installed in the machine control cabinet or on the disconnect switch	Voltage indicator enables operator to verify: - Release of stored electrical energy - Hazardous voltage presence at the disconnect switch - Verifies the stuck blade condition - Backfeed from another source

As the exposure to incident energy is reduced with PESDs®, the risk score and the injury risk costs are significantly reduced by 60 - 75% based on the single or multiple PESDs® used in the below task scenarios.

Task with PESDs	Exposure	Severity	Probability	Assumed Risk with Admin Controls	Reduced Risk with PESDs & Admin Controls
Enables qualified electricians to -Live) for door panel les operator to visually verify: isconnect onnect switch	3 Less than 1x shift	5 Major Permanent Impairment or death and caught by equipment	4 Probable	60 \$390,000	15 \$97,000
Enables qualified electrician to visually re) for absence panel to visually verify: isconnect e check. going beyond	4 More than 1x shift	5 Major Permanent Impairment or death	3 Possible	60 \$350,000	15 \$88,000
to visually verify: isconnect e check. going beyond	4 More than 1x shift	3 Lost time, Full Recovery, and some permanent impairment	4 Probable	48 \$60,000	12 \$15,000
to visually verify: isconnect	4 More than 1x shift	3 Lost time, Full Recovery, and some permanent impairment	4 Probable	48 \$78,000	19 \$31,000



PESD® users report **LOTO procedure** time reductions of **35-40 minutes**; test point **PESDs® pay for themselves** after **6-8 LOTO procedures** from time saving alone

HOW PESDS® IMPROVE PRODUCTIVITY

The cost of injury prevention is far less than the cost of an injury. Workplace injuries cost companies in lost time, increased insurance premiums, OSHA citations, penalties, and other workers' compensation to name a few. Electrical safety efficiency demands a precise answer to the question of voltage absence.

NFPA 70E/CSAZ 462 requires an absence of voltage test to verify an electrically safe work condition. The traditional process poses arc flash and shock hazards

to comply with NFPA 70E Article 120.5: Process for Establishing and Verifying an Electrically Safe Work.

PESDs®, such as the Safe-Test Point™ and ChekVolt®, improve LOTO procedure times by allowing an absence of voltage test to be performed outside of an enclosure. With the enclosure closed, qualified electricians using their trusted voltmeters can insulate the meter's probes with 0.080" tips into any two test point jacks and take a voltage reading.



ChekVolt®
PESD®

The Cost of Non-Compliance



Injuries or possible death



Lost time production



Decline in production quality and employee morale



Wages for work not performed



Employee turnover resulting in hiring and/or training new employees



Increased compensation and insurance costs



OSHA citations and hefty fines

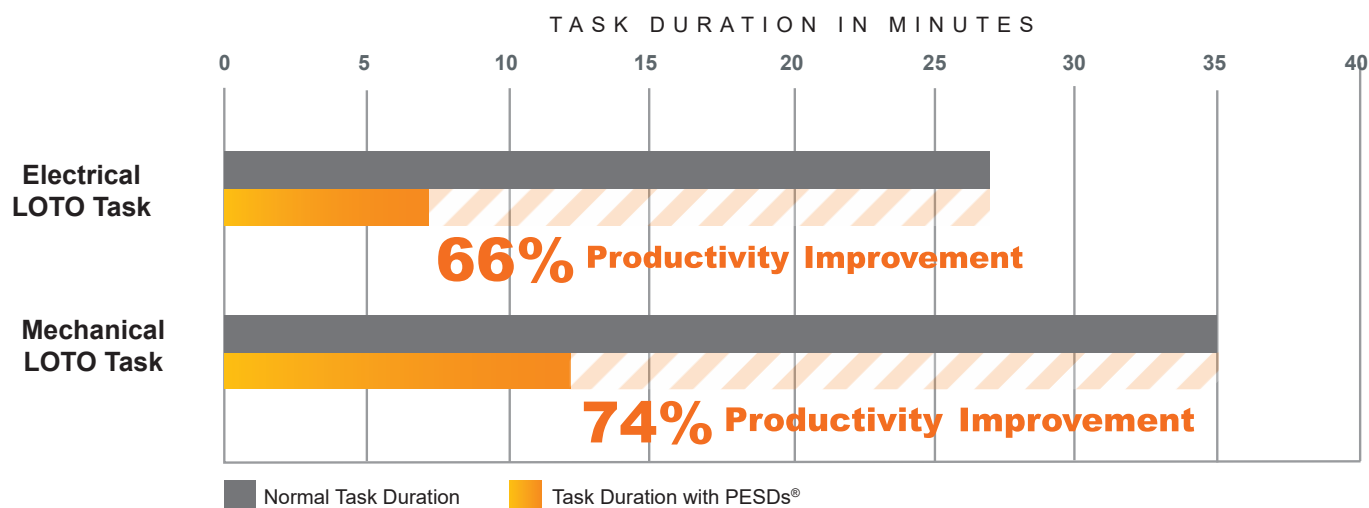


Damage to equipment or machinery





Productivity Improvement with PESDs®



ABOUT PESDs®

PESDs® enhance compliance with NFPA 70E and OSHA energy isolation principles by providing procedure enhancements for mechanical and electrical LOTO. Incorporating PESDs® into an electrical safety program not only improves productivity metrics, but also mitigates the risk of human error during routine procedures with safety by design innovations.

disconnects and will illuminate whenever hazardous voltage or stored energy is present in any individual phase, enhancing mechanical LOTO safety and productivity.

VOLTAGE PORTALS

Voltage portals provide maintenance personnel a safe-touch portal to energy on the outside of grounded electrical enclosures. Permanently mounted voltage portals detect voltage presence from the outside of a cabinet using a Non-Contact Voltage Detector (NCVD) pen without the risk of being exposed to arc flash or shock hazards during mechanical LOTO procedures.



R-3K Voltage Portal PESD®

VOLTAGE INDICATORS

Voltage indicators are PESDs® that visually represent presence of voltage with flashing or non-flashing, redundant LED lights. Indicators can be hardwired to the line side or load side of



R-3W Voltage Indicator PESD®

At Grace, **electrical safety** is not just our business; it's our **mission**.
Choose **PESDs®** when you choose to **go beyond compliance**.

SAFE TEST-POINT™

Safe-Test Point™ allows qualified personnel to perform absence of voltage tests with their trusted multimeter through high impedance protected test points. The device reduces the risk of arc flash and shock hazard during electrical LOTO procedures. A 4-Wire option comes complete with a tool-entry dust cap that also includes a label and a 5-Wire option is featured in a pad-lockable housing that also includes tool-entry.



Safe-Test-Point™
PESD®

CHEKVOLT®

The ChekVolt® is a compact device that enables absence of voltage testing from outside of the cabinet and features LED voltage presence indication rated up to 1000V. The device installed through a single, 30mm knockout and includes four terminal connections that make installation quick and simple. Like the Safe-Test Point™, the ChekVolt® is designed to work directly with a qualified electrician's multimeter and ensures the user has a safer method of testing for absence of voltage while complying with the steps outlined in NFPA 70E Article 120.5.



ChekVolt®
PESD®

VOLTAGE TEST STATION

One of the most popular combination unit is the UL-Listed Voltage Test Station which combines a voltage indicator with the Safe-Test Point™ within a protective housing. Depending on a user's desired application, a combination unit will assist their task qualified or qualified personnel with a safer method of performing mechanical and electrical LOTO procedures.



Voltage Test Station
combination PESD®

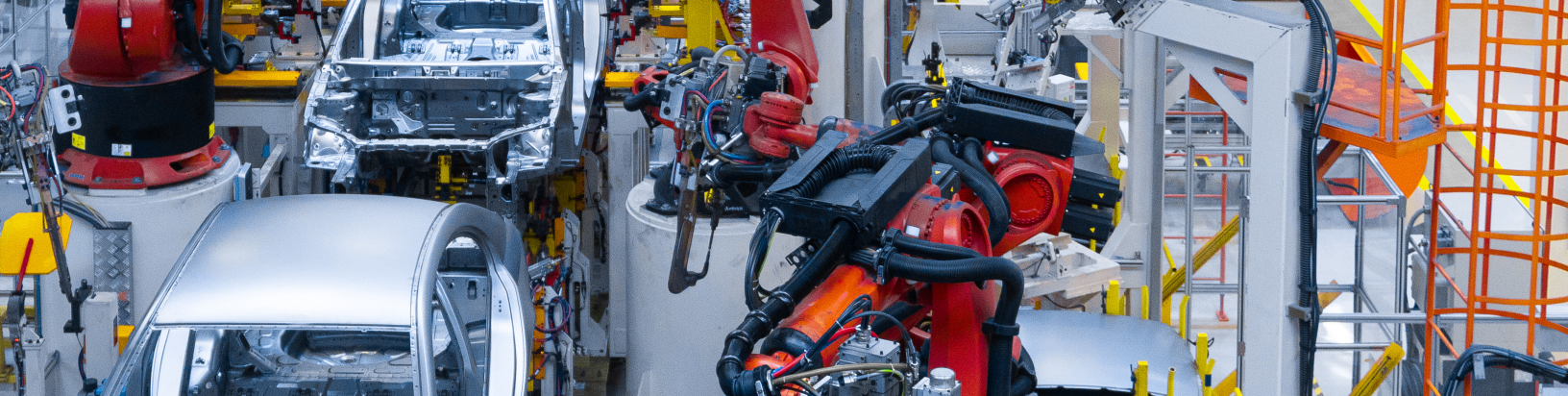
COMBINATION PESDs®

Various combination units can be made out of individual PESDs® for a convenient, all-in-one solution. This includes combining indicators with portals and/or Safe-Test Points™ including either a safety label or a protective housing.



1000 VAC/VDC
Safe-Test-Point™
PESD®





WHY CHOOSE GRACE FOR ELECTRICAL SAFETY BY DESIGN?

Voltage is the common denominator in an electrical accident involving shock, electrocution, or arc flash; a compliant and verifiable method of absence of voltage means no accident. At Grace, our mission has always been to ensure that every electrical worker returns home safely to their family and loved ones. With electrical safety meshed in our DNA and programmed in our brains, we are always striving for ways to improve the workplace electrical safety standards by developing innovative products and solutions that minimize the risk of electrical exposure. PESDs® are a result of our pursuit to find simple, innovative, and practical ways of developing electrically safer work conditions that reduce accidents, improve productivity, enhance compliance, and foster an impactful electrical safety culture.

GOOD FOR BUSINESS: ENHANCING COMPLIANCE AND FOSTERING A SAFETY CULTURE

Electrical safety goes beyond legislation and compliance. An environment that is highly productive and efficient is a culture where employees are secure, safe, and cared for.

According to the U.S. Department of Labor, a safe and healthy workplace culture not only protects workers from injury and illness, but also lowers injury/illness costs, reduces absenteeism and turnover, increases productivity and quality, and raises employee morale. In other words, safety is not just good practice...it is good for business.

	INDIVIDUAL PESDs®			
Type of Energy Verification	Voltage Indicators	Voltage Portals	Safe-Test Point™	Voltage Indicator & Voltage Portal Label Combo Units
Part Number	 R-3W Series  R-3F2  R-3D2	 R-3K	 R-3MT	 R-3KW2-LCF
Voltage Presence	YES	YES with NCVD Pen	YES with adequately rated meter	YES
Phase Loss				
Stored Energy Dissipation				
Voltage Absence	NO			NO
Primary Task	Mechanical Lockout/Tagout	Mechanical Lockout/Tagout	Electrical Lockout/Tagout	Enhanced Mechanical Lockout/Tagout
Type of Worker	Machine Operator, Task Qualified Worker	Machine Operator, Task Qualified Worker	Qualified Electrician, Electrical Engineer	Machine Operator, Task Qualified Worker

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Significantly reduce the risk of arc flash and shock hazard by using PESDs® to allow maintenance and inspection to be safely conducted outside the electrical cabinet.

MULTI-PESDs® (COMBO UNITS)			MEDIUM VOLTAGE INDICATOR PESD®
Voltage Indicator & Safe-Test Point™ Label Combo Units	Voltage Test Station Environmentally Protected	ChekVolt®	Medium Voltage Indicator
 R-3WMT-LMH	 P-S10S21-M3RX	 R-3MT-VI-KIT	 R-1VL003
YES			YES
YES			NO
with adequately rated meter and follow process NFPA 70E 120.5			
Enhanced Electrical Lockout/Tagout with adequately rated portable test instrument			Visual Indication
Qualified Electrician, Electrical Engineer			Qualified Electrician, Electrical Engineer



Certifications may vary by product. Refer to the individual product datasheet for additional details.

