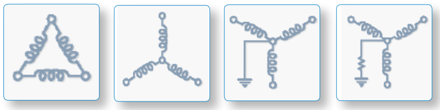
iGARD

Unparalleled Protection

2022 Healthcare Segment Brochure



WHY GROUNDING IS KEY?

When designing or selecting an electrical grounding system for industrial operation for voltages of 5kV and below there are three basic choices – Ungrounded, Solidly Grounded or High Resistance Grounded.

When deciding which type of grounding system to specify there is a need to consider:

- Reliability
- Electrical Risk
- Operating Costs

Under normal conditions any of the three grounding methods are reliable, free from electrical risks and have similar operating costs but ground faults are a reality in any electrical system and so the question becomes how does the grounding system decision affects reliability, risk and costs?

During a ground fault on an UNGROUNDED SYSTEM, the arcing nature 'charges' the system capacitance. When the arc extinguishes the charged system cannot dissipate the charge, so it holds it. When the arc re-strikes, more charge is added to the system. This continues until the insulation breaks down at the weakest point in the system.

The concern over the safety aspect of ungrounded systems when experiencing a ground fault is noted in the IEEE 242-1986 *Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems 7.2.5:*

"A second ground fault occurring before the first fault is cleared will result in a phase-to-ground-to-phase fault, usually arcing, with current magnitude large enough to do damage, but sometimes too small to activate overcurrent devices in time to prevent or minimize damage.

Ungrounded systems offer no advantage over high-resistance grounded systems in terms of continuity of service and have the disadvantages of transient overvoltages, difficulty in locating the first ground fault, and burndowns from a second ground fault".

In effect, ungrounded systems have no advantages over high resistance grounded systems and have higher costs associated with equipment damage, loss of process continuity and risk of arcing flash.

Under normal operating conditions a SOLIDLY GROUNDED SYSTEM is safe and reliable, however both criteria are impacted when the system is subject to a ground fault. A ground fault of sufficient magnitude will trip the over-current protection and interrupt the process.

An arcing fault may not be of sufficient magnitude to be detected by and trip the over-current device until the arc fully develops and it becomes destructive and possible deadly.

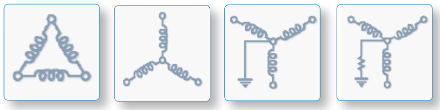
In the IEEE 141-1993, *Recommended Practice for Electrical Power Distribution for Industrial Plants section 7.2.4, it states that:*

"The solidly grounded system has the highest probability of escalating into a phase-to-phase or three-phase arcing fault, particularly for the 480 and 600V systems".

"A safety hazard exists for solidly grounded systems from the severe flash, arc burning, and blast hazard from any phase-to-ground fault".

The following table provides a summary of arc flash data over a 23 year period - not all arc flash incidents are effectively captured or reported. This data validates the occurrence of injuries and fatalities associated with arc flash incidents at different voltage levels.

Voltage	Burns	Smoke Inhalation	Shock	Fatalities
Under 400V	19	0	3	0
480V and 600V	283	18	5	33
1kV to 5kV	78	1	0	13
5kV to 15kV	100	3	13	10
Over 15kV	50	16	2	5

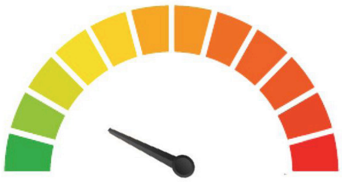


NFPA 70E states in Annex O *Safety-Related Design requirements:*

"A great majority of electrical faults are of the phase-to-ground type. High-resistance grounding will insert an impedance in the ground return path and will typically limit the fault current to 10 amperes and below (at 5 kV nominal or below), leaving insufficient fault energy and thereby helping reduce the arc flash hazard level".

IEEE141-1993 Recommended Practice for Electric Power Distribution for Industrial Plants Section 7.2.2:

"There is no arc flash hazard, as there is with solidly grounded systems, since the fault current is limited to approximately 5A".



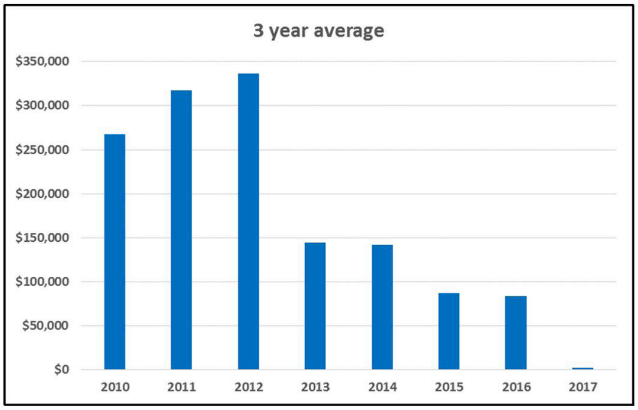
By choosing HIGH RESISTANCE GROUNDING on your electrical distribution system you control the ground fault magnitude to the point where the vast majority of arc flash accidents simply never occur.

Not only does HRG technology allow for process continuity during a single phase to ground fault thereby avoiding unnecessary process interruptions, there is evidence that converting to HRG will reduce equipment repair costs.

One leading industrial company made the decision to change their 3 phase 4 wire system to 3 phase 3 wire high resistance grounded on the basis of arc flash reduction. This company received the unexpected but welcomed benefit of reducing motor repair costs.

In solidly grounded systems, it is not unusual to have several hundred amps of fault current, insufficient to trip the over-current device but more than enough to damage motors.

The change to HRG where the ground fault is limited to 10 Amps or less, reduced the damage so significantly that this factor alone would have provided less than a 3-year return on investment.



The two limitations with standard HRG technology are that a second ground fault trips the entire system, and the arc flash energy levels are not reduced by HRG technology, both of these limitations are overcome through the application of SMART (ADVANCED) HRG technology.

SMART HRG with second fault protection ensures that your most critical process is operational at all times, providing an opportunity for increased revenue.

Feeder indication of a ground fault shortens the time needed to find a fault and removes personnel from the risk involved in starting the search at the main switchgear.

Detecting and interrupting an arc flash as quickly as possible reduces the incident energy levels and ensures workplace safety.

What does a SMART (ADVANCED) HRG offer in terms of features and benefits? It is described through SMART acronym, which stands for:

S - Selective Instantaneous Feeder Trip (SIFT) on 2nd ground fault

M - Mitigate 95-98% of arc flash incidents on 1st phase-to-ground fault

A - Assisted Fault location through pulsing system and indication/alarm of faulted phase and feeder

R - Resistor integrity monitoring. It continuously monitors neutral and resistor continuity to meet the new CSA code requirement

T - Time selective feeder isolation. Feeders can be programmed to trip on 1st fault, first fault with time delay, trip on 2nd fault. It allows the user to set priority levels

CASE STUDY

High-Resistance Grounding provides safer, more reliable electrical distribution for healthcare facilities

By: Ajit Bapat, Nick Carter & Sergio Panetta

High-resistance grounding is relatively simple and easy to apply in radial distribution systems. It has been used in the healthcare industry for many years, considered to be best practice for hospitals. The concept is well-known, recognized by the Canadian Electrical Code and driven by four basic factors: power is not interrupted in the event of a single ground fault; negligible damage at the point of fault, resulting in lower repair costs and faster return of equipment to service; negligible arc flash hazard in the event of a single ground fault; and negligible risk of a single ground fault escalating into a damaging line to line or three phase fault.

It is best practice to have the low voltage (600V) and high voltage (4,160V) systems equipped with high-resistance grounding. This has often taken the form of a neutral grounding resistor applied between trans-former neutral and ground. An alarm is raised on the occurrence of a ground fault in the distribution as required by the installation codes.

In modern relays, the zero-sequence sensor signal causes a pick up, then the simultaneous presence of unbalanced voltage to ground is verified before an alarm is indicated. To avoid the possibility of nuisance alarms caused by inrush currents and non-linear loads, the zero-sequence current sensor output is filtered and only the fundamental signal is extracted.

These measures have been effective in avoiding nuisance alarms and trips in sensitive ground fault relays.

VANTAGE POINT

The use of high-resistance grounding offers many benefits. Arc flash and blast hazard for a line to ground fault is prevented. For systems up to 4,160V, where the resistor let-through current is 10A (amperage) or less, the arc blast is unlikely. Such systems can continue to operate with one ground fault. The fault does not escalate so the distribution system is safer. Accidents causing line to ground faults will not produce a hazardous blast or arc flash.

Fault damage at the point of fault is very low and can be easily repaired. It minimizes maintenance repair costs. Motor and generator laminations will not get burnt and winding repair costs will be small.

For systems up to 4,160V, where the resistor let-through current is 10A or less, the line to ground fault can be kept on the system continuously. No fault isolation needs to occur per Canadian Electrical Code 10 -1100 through 1108.

Damaging voltage transients that can occur on ungrounded systems are avoided since the system is grounded.

On the other hand, four application concerns arise when resistance grounding is applied to distribution.

All cables need to have a line to ground voltage rating of line to line voltage for the maximum duration of the line to ground fault. This is not an issue at low voltage, such as 600V. The standard cables have adequate ratings.

Lightning arrestors and surge suppression devices that are connected line to ground also need to be adequately rated.

Voltage to ground impressed on capacitors will also increase to line to line value.

The circuit breakers and contactors employed in resistance grounded systems must be able to break line to line voltage across one pole of the device.

For example, a three pole 600V breaker must be able to open fault current and withstand 600V across one pole, which most 600V breakers are capable of. However, some breakers only have a 347/600V rating. This means they are able to interrupt only 347V across one pole, making them unsuitable. The same would apply to contactors.

FAULT SCENARIO

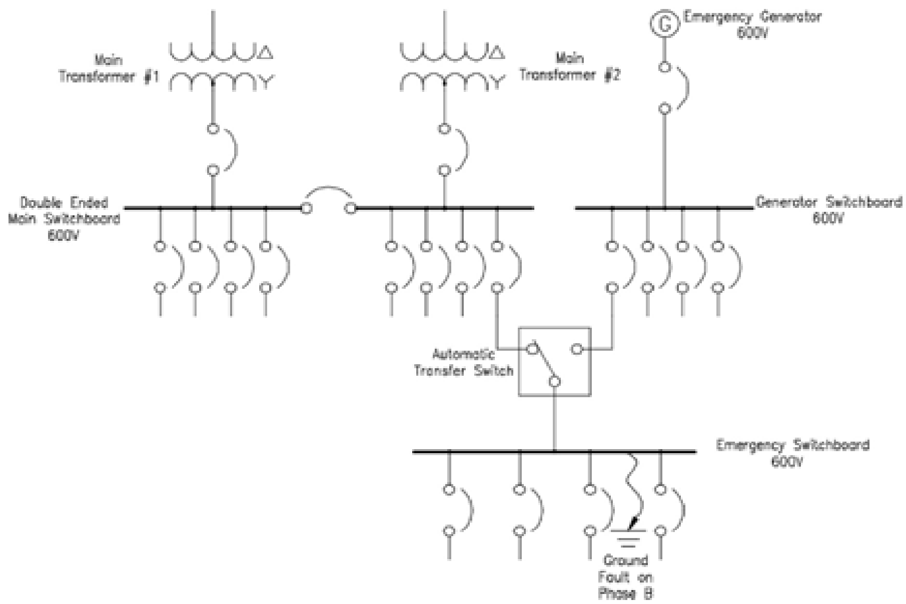
In a typical hospital, there will be a 600V normal power system and a 600V generator power system. The most critical loads are fed from the emergency power distribution, which is downstream of one or more transfer switches.

The transfer switches get power from both the normal power system and the generator power system. In this scenario, a ground fault occurs in the switchboard downstream of a transfer switch.

This fault could have a number of causes. In the solidly grounded system, the ground fault results in a large current flow creating significant damage within the switchboard, vapourizing components and coating the inside of the switchboard with semi-conductive residue. The high fault current subjects the upstream transformer to high stresses and causes the upstream breaker to trip. All power to the critical loads is lost. The loss of power is sensed at the transfer switch, which starts the emergency generator and transfers the critical load over to the generator.

Since the switchboard is contaminated with residue from the previous fault, another fault occurs and this further damages the switchboard. It also stresses the generator with a high magnitude fault current and causes the generator breaker for the transfer switch to trip.

The critical loads, including the emergency department and intensive care unit, are shutdown and remain so until their feeders can be cut away from the failed switchboard, spliced and extended to another source of power — a process that takes many hours and leaves the critical loads on normal power only.



In this scenario, a ground fault occurs in the switchboard downstream of a transfer switch.

The hospital is forced into emergency mode and must transfer critical patients to other areas of the hospital, which were not designed for their care, and in some cases to another hospital. Full restoration of the system requires replacement of the switchboard. This takes many months as switchgear is built to order.

In the resistance grounded system, the ground fault results in an alarm. There are no power interruptions, the main transformer is not subjected to the stresses of a fault, and the generator does not start and is not exposed to a fault cur-rent. Most importantly, the damage to the switchboard is minimal requiring the replacement of a single insulator, which is scheduled for a time when the hospital can accommodate the short shutdown necessary to perform the work.

GROUND CURRENT DETECTION

A major functional enhancement occurs when detection and alarm of ground faults is supplemented with monitoring of all the feeders to indicate which feeder is faulted and administer assistance for quickly locating the fault.

To provide assistance in locating a fault in high-resistance grounded systems, the fault current is modulated by oscillating it between values such as 5A-10A, typically at one cycle per second. This is accomplished by changing the resistor value using a contactor, which has been called 'pulsing' in the industry. The pulsing is manually started. A flexible zero-sequence sensor or a clamp on the current transformer (CT) encircling all phase conductors is used to provide an oscillating signal to a handheld multimeter. Readings are taken on the faulted feeder moving away from the switchboard.

The signal will disappear once the fault location is passed. Often, two or three measurements are sufficient to point to the fault location.

Readings are taken from the outside of the grounded raceways, conduits or busways, while the system is energized and running. This technique has been in use for many years. It is quite effective for voltages up to 4,160V.

TRIPPING UP

The primary benefit of using high-resistance grounding is the faulted feeder does not need to be isolated on the occurrence of a phase to ground fault. While the faulted system continues to operate, there is a possibility that another phase to ground fault may occur on a different phase in some other weak spot in the distribution system.

With the presence of a second fault, the fault current is no longer limited by the resistor and will be a higher magnitude fault. The zero-sequence sensors continue to monitor the fault current and if a significantly higher current than that limited by the resistor is detected, then the system recognizes that a line to ground to line fault exists and identifies the two feeders involved.

Only one feeder breaker needs to be tripped to revert the rest of the system to a single fault condition. A level of priority can be assigned based on the relative importance of the feeders. The one feeder with lower priority is tripped. Fast operation provides protection and minimizes fault damage. Such systems have been in use for a long time and this first fault alarm and second fault trip is best applied to monitor specific loads.

IMPROVING THE SYSTEM

On low voltage systems and systems up to 5 kilovolt (kV), high-resistance grounding provides a safer and more reliable distribution system. The arc flash hazard in the event of a line to ground fault can be eliminated and power continuity maintained.

The performance of the distribution system can be enhanced by using high reliability neutral grounding resistors with low temperature coefficients, monitoring the neutral ground resistor continuously, using a pulsing system to find ground faults and using coordinated selective second fault tripping. In many applications, it is more beneficial to apply the neutral grounding resistor at the main bus. In such a case, the incoming supply feeders can be monitored for ground fault very cost-effectively by applying multi-circuit relays.

HEALTHCARE CUSTOMERS

I-Gard values its long standing relationships with hundreds of industry leaders and widely recognized institutions, many of which are in the Healthcare industry. Discover which companies have used and continue to use I-Gard products. Please see a small portion of our Healthcare clients outlined below.

Customer	Product	Location	Year
Michael Garron Hospital	DSP, Sleuth	Ontario, Canada	2020-2021
North York General Hospital	DSP	Ontario, Canada	2020
Hôpital Enfant-Jésus	DSP-OHMNI, NGR	Quebec, Canada	2020
Juravinskie Hospital Hamilton	DSP, NGR	Ontario, Canada	2020
Hôpital Rouyn Noranda	DSP-OHMNI, NGR	Quebec, Canada	2019
Woodstock General Hospital	DSP	Ontario, Canada	2019
Hôpital Hôtel Dieu	DSP-OHMNI, NGR	Quebec, Canada	2019
Hôpital CHUM Montréal	DSP-OHMNI, NGR	Quebec, Canada	2019
CHUM	LRG, Gemini	Quebec, Canada	2015
Rexdale Community Health Center	Sleuth	Ontario, Canada	2015
Toronto East General Hospital	Sleuth	Ontario, Canada	2015
The Ottawa Hospital	DSP	Ontario, Canada	2015
Credit Valley Hospital	DSP	Ontario, Canada	2014
Women's College	DSP	Ontario, Canada	2013
Mount Sinai Hospital	DSP	Ontario, Canada	2012
North York General Hospital -Ainsworth	DSP	Ontario, Canada	2007
St. Michael's Hospital	GADP-3-5	Ontario, Canada	2006
Trentech Enterprise Co. Ltd.	MLIM-5/2, Line Insulation Monitor	Taiwan	2006
Scarborough General Hospital	DSP MK III	Ontario, Canada	2006
North Bay Regional Health Centre	NGR, MGFR	Ontario, Canada	2006
Hospital Sacre Coeur	DSP MK III	Quebec, Canada	2006
North York General Hospital -Ainsworth	DSP MK III OHMNI Systems	Ontario, Canada	2006
York Central Hospital	DS-PM-3-5	Ontario, Canada	2005
William Osler Health Centre	OHMNI-6PM-5	Ontario, Canada	2005
Tillsonberg District Hospital	GPD, 2PDT	Ontario, Canada	2005
Shelbourne Health Center	NGR, MGFR	Ontario, Canada	2005
Peterborough Regional Health Centre	OHMNI	Ontario, Canada	2005
North Bay Psychiatric Hospital	GADD3-1	Ontario, Canada	2005
Listowel Memorial Hospital	OHMNI	Ontario, Canada	2005
Hospital for Sick Children	DSP	Ontario, Canada	2005

sherbourne HEALTH

SickKids®

The Ottawa Hospital L'Hôpital d'Ottawa

High-resistance grounding is a proven technology that provides process continuity even under a single ground fault condition.

The SMART HRG from I-Gard is the only HRG system that ensures process continuity of your most critical processes even under second ground fault conditions.

The SMART HRG system offers feeder indication and second fault protection which ensures that your most critical process is operational at all times, providing an opportunity for increased revenue.

The SMART HRG system can be configured with the time delay feeder trip.

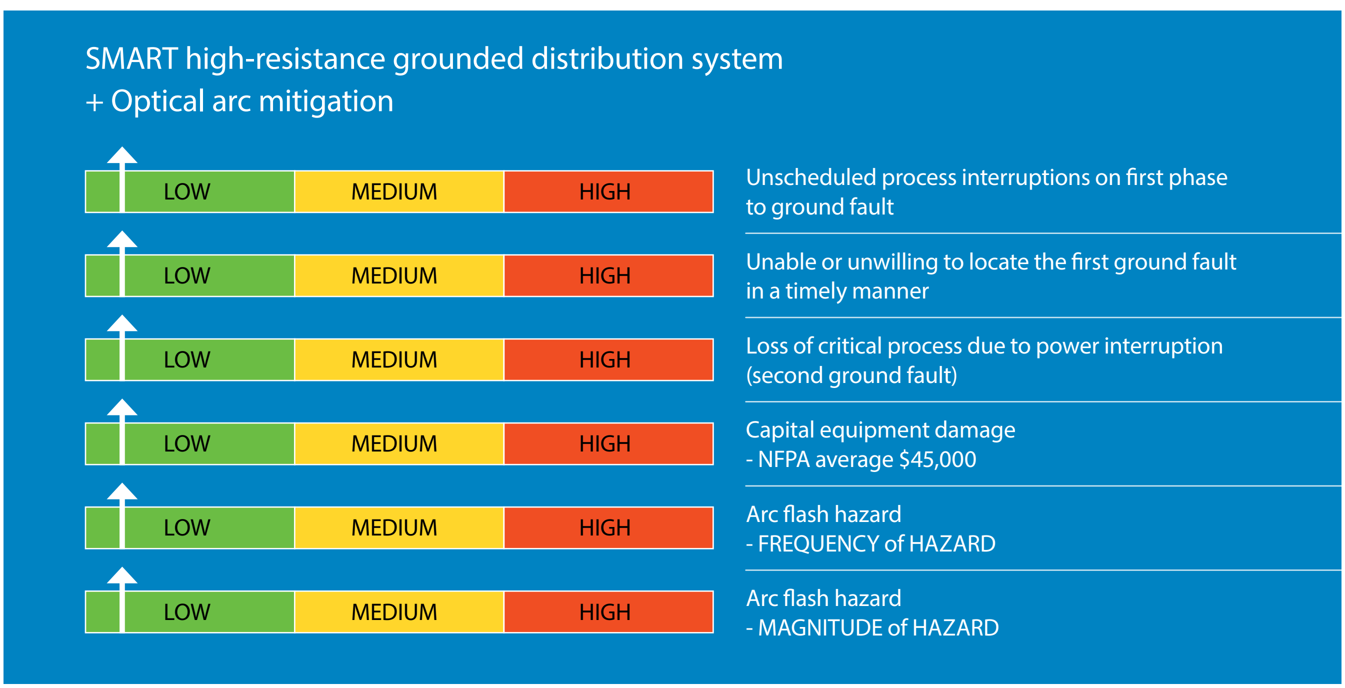
Feeder indication of a ground fault shortens the time needed to find a fault and removes personnel from the risk involved in starting the search at the main switchgear.

- Feeder identification feature provides information of where to start looking for a ground fault.
- With feeder time delay you control how long the ground fault is on the system and reduce the likelihood of a second ground fault.

The SMART HRG solution offers HRG and Arc Flash Mitigation functions in the same system.

- Once a certain level of light produced by an arc flash event is detected, the I-Gard sensors react in 1 milliseconds sending a trip signal to the relay.
- Detecting and interrupting an arc flash as quickly as possible reduces the incident energy levels and ensures workplace safety.

The figure below shows the Low Risk Level that the SMART HRG + Optical Arc Mitigation system provides by reducing the likelihood and magnitude of exposure of an arc flash, enabling achievement of an electrically safe work condition.



ABOUT I-GARD

I-Gard's commitment to electrical safety provides both industrial and commercial customers with the products needed to protect their electrical equipment and the people that operate them.

As the only electrical-safety focused company whose product portfolio includes neutral grounding resistors, high-resistance grounding systems and optical arc mitigation, we take pride in our technologies that reduce the frequency and impact of electrical hazards, such as arc flash and ground faults.

For those customers who have purchased from us over the last 30 years, you know us for the quality and robustness of our product, our focus on quality, customer service and technical leadership. We build on this foundation by investing in developing new products in electrical safety education – including the EFC scholarship program – by actively participating in the IEEE community programs on technical and electrical safety standards, and working with local universities at uncovering new technologies. We remain unrelenting in our goal of improving electrical safety in the workplace.

Our commitment to excellence is validated by our long-standing relationships with industry leaders in fields as diverse as oil and gas, hospitals, automotive, data centres, food processing, aerospace, water and waste water, and telecommunications.

We provide them with the product and application support required to ensure that their electrical distribution system is safe and reliable.

3 SOLUTIONS & FACTS ABOUT I-GARD

I-Gard offers more HRG products at more price points than any other competitor in the industry, with customized solutions for your specific application.

I-Gard is the exclusive supplier of FAIL-SAFE and ADVANCED HRG systems with 2nd ground fault protection to better match your need for electrical reliability and safety.

We are the only HRG supplier that also offers optical arc mitigation for Total Protection against ground faults and arc flash incidences.

- The first power resistor company in North America to be ISO 9001 certified.
- The only resistor manufacturer with a CSA-approved testing facility in-house under CSA SMTC program including CSA 295-15 and CSA 22.2 Part 1.
- The only resistor manufacturer with UL listing of our complete NGR product offering.
- Approved by the Government of Canada in its Controlled Goods Program for Defense applications.


CSA GROUP
Certificate of Qualification
THIS IS TO CERTIFY THAT
I-Gard Corporation
7686 Bath Road, Mississauga, ON L4T 1L2 Canada
has been qualified by CSA Group Testing & Certification Inc., as a Testing Facility for
Supervised Manufacturer's Testing for Certification Program
Based on ISO/IEC 17025:2017
ISSUED DATE: March 23, 2020
EXPIRY DATE: March 23, 2023
Samuel Baison
Operations Manager
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DQD 586.31 Doc Rev 2020-05-08


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CERTIFICATE OF REGISTRATION
This is to certify that the management system of:
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Main Site: 7686 Bath Road, Mississauga, Ontario, L4T 1L2, Canada
has been registered by Intertek as conforming to the requirements of:
ISO 9001:2015
The management system is applicable to:
Manufacture of electrical safety products for industrial applications.
Certificate Number: 0096248
Initial Certification Date: 11 November 2019
Date of Certification Decision: 11 November 2019
Issuing Date: 11 November 2019
Valid Until: 10 November 2022
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- Visit: www.i-gard.com to get access to our technical documentation and certificates.

I GARD

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