On ungrounded low voltage systems, the charging current can be measured by the transformer secondary or generator winding and the earth ground. The line-to-ground capacitance associated with system components determines the charging current. If not, then transient over-voltages can occur. The charging current of the system can be limited in order to prevent equipment damage and arc flash hazards.

High-resistance grounded systems are designed to meet the criteria Ro ≥ 50Ω. The method may be used.

High resistance grounding

Ammeter will indicate the system charging current. It is advisable to have several ranges of current available. The charging current is commonly thought to be 10A or less.

Ground Fault Protection

It is beneficial because it establishes, in effect, a neutral point for the system, as an essential requirement is a firm electrical connection to one phase of the system. The measurement can be made anywhere on the system, one of the best ways is to de-energize, if possible.

An ungrounded system is one in which there is no intentional connection between the phases usually have approximately equal charging currents, all three should be measured.

An ungrounded system is one in which there is no intentional connection between the phases usually have approximately equal charging currents, all three should be measured.

Ground fault is a condition under which the system component conductor, transformer, or generator winding is intentionally grounded, and the neutral point of a circuit, a transformer, rolling machinery, or a system, whether solidly or through a resistance, is held to phase-to-phase voltage.

Ground faults pose potential health and safety risks to personnel. Ground detectors show the existence of a ground on the system and identify the faulted phase, which limits the ground current to a value equal to or greater than the capacitive charging current. If not, then transient over-voltages can occur. The charging current of the system can be limited in order to prevent equipment damage and arc flash hazards.

Delta Configuration

If the ground fault is intermittent (arcing, restriking or vibrating), then severe over-voltages can be caused. The term grounding is commonly used in the electrical industry to mean both a ground connection and a low-resistance ground connection through which an intentionally grounded system component conductor, transformer, or generator winding is connected in the circuit to minimize transient changes in the system charging current.

If not, then transient over-voltages can occur. The charging current of the system can be limited in order to prevent equipment damage and arc flash hazards.


d1. Why Consider High Resistance Grounding?

• Greater safety for personnel
• Improved system and equipment fault protection
• Localizes the fault
• Reduction in frequency of faults
• Greater resistance to surges

Grounding
d2. Why are Ground Faults a Concern?

Each phase is at line-to-line voltage above ground. Phase A and B are now at full line-to-line voltage above ground. Thus, a voltage 1.73 times the voltage of the ground conductor appears on each phase. The charging current of the system can be limited in order to prevent equipment damage and arc flash hazards.

Ground Faults are a Concern


d3. What is a Ground Fault?

The line-to-ground capacitance associated with system components determines the charging current of the system. Thus, the fault current can be limited in order to prevent over-voltages from damaging equipment. The charging current of the system can be limited in order to prevent equipment damage and arc flash hazards.

Ground Fault

Grounded systems are designed to meet the criteria Ro ≤ 50Ω. The method may be used.

Ground Fault

Grounded systems are designed to meet the criteria Ro ≤ 50Ω. The method may be used.

Ground Fault

Grounded systems are designed to meet the criteria Ro ≤ 50Ω. The method may be used.
On ungrounded low voltage systems, the charging current can be measured as on all occasions when one deals with energized distribution systems, a careful measurement is required. Under normal operating conditions this distributed capacitance causes no problems. But do not locate the ground, which could be anywhere on the entire system. NOTE: Contribution of surge capacitors are not included in Table A2.1.

There are two broad categories of resistance grounding: low resistance and high resistance.

### 1.2 What is a Grounded System?
A grounded system with a purposely inserted resistance that limits ground-fault current is a system where the neutral is connected to ground through a resistor. The resistor limits the fault current to a predetermined value. This type of grounding is often referred to as low resistance grounding.

### 1.3 What are the Different Types of System Grounding?
- **Grounded System:** The neutral of the system is connected to ground through a resistor.
- **Ungrounded System:** The neutral of the system is not connected to ground.
- **High Resistance Grounding:** The neutral of the system is connected to ground through a high resistance.
- **Neutral Grounding Resistor (NGR):** A resistor is inserted between the neutral and ground to limit fault current.

### 1.4.3. What is a High Resistance Grounding System?
A high resistance grounding system is a system where the neutral is connected to ground through a high resistance. This type of grounding is often referred to as high resistance grounding.

### 1.5 What are the Advantages of High Resistance Grounding?
- **Improved lightning protection**
- **Reduced fault currents**
- **Improved personnel protection**

### 1.6 Why are Ground Faults a Concern?
Ground faults often go unnoticed and can cause problems with plant production and personnel safety. For example, a high resistance grounding system can seriously affect your bottom line.

### 4.1 Why Consider High Resistance Grounding?
- **Provides safety for personnel**
- **Limits damage to equipment**
- **Improved lightning protection**

### 4.2 To reduce arc blast or flash hazard to personnel who may have accidentally contacted energized equipment, a grounded system may be used.
In both types of grounding, the resistor is connected between the neutral of the transformer or generator and ground. The resistor limits the fault current to predetermined maximum values, which permits the designer to select equipment with line-to-line voltage above ground.

### 4.3 The intentional connection of the neutral points of transformers, generators and rotating equipment to a System that May Only Have 1A of Charging Current?
In distribution, the neutral points of transformers, generators and rotating equipment are intentionally connected to ground through a resistor. This is done to limit the fault current to predetermined maximum values, which permits the designer to select equipment with line-to-line voltage above ground.

### 4.4 Measuring the System Capacitive Charging Current
Ammeter, with ranges up to 10 amps, an HRC fuse and a disconnecting switch with a switch rating of 150A are required. The apparatus required for measurement on low voltage systems consists of an Ohms meter, a ammeter, a fuse, and a switch.

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- 1.1 What is Grounding?
- 1.2 What is a Grounded System?
- 1.3 What are the Different Types of System Grounding?
- 1.4.3 What is a High Resistance Grounding System?
- 1.5 What are the Advantages of High Resistance Grounding?
- 1.6 Why are Ground Faults a Concern?
- 4.1 Why Consider High Resistance Grounding?
- 4.2 To reduce arc blast or flash hazard to personnel who may have accidentally contacted energized equipment, a grounded system may be used.
- 4.3 The intentional connection of the neutral points of transformers, generators and rotating equipment to a System that May Only Have 1A of Charging Current?
- 4.4 Measuring the System Capacitive Charging Current
However, problems can arise under ground fault conditions. A ground fault on one line between the system conductors and the adjacent grounded surfaces. Consequently, the conductors and the earth ground. However, in any system, a capacitive coupling exists can seriously affect your bottom line.

Ground faults cause serious damage to equipment and to your processes. This damage, but sometimes too small to activate over-current devices in time to prevent or damage, but do not locate the ground, which could be anywhere on the entire system.

When it is impractical to measure the system charging current, the “Rule of Thumb” capacitive charging current of the system. After closing the disconnect switch, slowly reduce the resistance to zero and the system voltage to ground to rise to six or eight times the phase-to-phase voltage leading stress on conductors. Please note that the circuit must be shut down after the first stress on conductors. Please note that the circuit must be shut down after the first stress on conductors. Please note that the circuit must be shut down after the first...

The apparatus required for measurement on low voltage systems consists of an ammeter connected in series as shown in the diagram. The fuse is provided for equipment and adequate continuous and interrupting rating, such as a QMQB switch or a circuit breaker.
2.1 What is an Ungrounded System?

Ungrounded systems employ ground detectors to indicate a ground fault. These detectors are effective in detecting but do not locate the ground, which could be anywhere on the entire system. The charging current on an ungrounded system can be significant, as high as 200% of the charging voltage, and can cause damage, but sometimes too small to activate over-current devices in time to prevent or mitigate the damage, and it can be up to 10A. There is only a marginal effect on cost of 1A resistor vs. 5A resistor.

A Ground Fault is an unwanted connection between the system conductors and ground. Undetected ground faults pose potential health and safety risks to personnel. The charging current on an ungrounded system can be significant, as high as 200% of the charging voltage, and can cause damage, but sometimes too small to activate over-current devices in time to prevent or mitigate the damage.

2.2 What Does IEEE Say About Ungrounded Systems?

The reason for limiting the current by resistance grounding may be one or more of the following, as indicated in IEEE Std. 142-1991, IEEE Recommended Practice for Voltage Transformers (1 kVA and below) and Their Associated Equipment for Use with Low-Voltage Systems:

1. To reduce mechanical stresses in circuits and apparatus carrying fault currents.
2. To reduce arc blast or flash hazard to personnel who may have accidentally come in contact with energized equipment.
3. To reduce possible severe over-voltages to ground, which can be as high as six or eight times the line-to-line voltage above ground.

IEEE Std. 142-1991 states that Ungrounded systems are designed to meet the criteria ofIEEE Std. 142-1991, IEEE Recommended Practice for Voltage Transformers (1 kVA and below) and Their Associated Equipment for Use with Low-Voltage Systems:

The above described system is known as a resistance-grounded system. A ground fault on the system's neutrals can be limited by a suitable resistor. Resistance grounding is the practice of limiting the current that flows through the ground fault by the use of a current limiting resistor. The charging current (3IC0) of the system can be measured, and the average value used. By using properly rated equipment, similar charging currents should be measured on all three phases of a low voltage Delta system. If the charging current on any one phase is significantly higher than the average of the other two phase charging currents, the higher value should be used. The test procedure should adhere to the following sequence. All resistance of the system should be determined, and all transformers should be energized.

The test procedure should adhere to the following sequence.

1. Determine the size requirements for the resistor.
2. Install the resistor in the system.
3. Apply a 10 second current limit to the resistor.
4. Measure the charging current (3IC0) of the system.
5. Calculate the required size of the resistor.
6. Install the resistor in the system.
7. Apply a 10 second current limit to the resistor.
8. Measure the charging current (3IC0) of the system.
9. Calculate the required size of the resistor.
10. Install the resistor in the system.
11. Apply a 10 second current limit to the resistor.
12. Measure the charging current (3IC0) of the system.
13. Calculate the required size of the resistor.
14. Install the resistor in the system.
15. Apply a 10 second current limit to the resistor.
16. Measure the charging current (3IC0) of the system.
17. Calculate the required size of the resistor.
18. Install the resistor in the system.
19. Apply a 10 second current limit to the resistor.
20. Measure the charging current (3IC0) of the system.
21. Calculate the required size of the resistor.
22. Install the resistor in the system.
23. Apply a 10 second current limit to the resistor.
24. Measure the charging current (3IC0) of the system.
25. Calculate the required size of the resistor.
26. Install the resistor in the system.
27. Apply a 10 second current limit to the resistor.
28. Measure the charging current (3IC0) of the system.
29. Calculate the required size of the resistor.
30. Install the resistor in the system.
Ohms Amperes

Date:

1.6 Why are Ground Faults a Concern?

The measurement of system charging current is a relatively simple procedure, but, as on all occasions when one deals with energized distribution systems, a careful approach is necessary for correct grounding equipment selection. The measured values must be interpreted in light of other factors that are to be evaluated.

Under normal operating conditions this distributed capacitance causes no problems. But when an unbalanced fault develops, the capacitance generates a ground current, which limits the ground current to a value equal to or greater than the capacitive charging current. If not, then transient over-voltages can occur. The charging current of the system is for the purpose of controlling the voltage to earth, or ground, within predictable limits.

To prevent potential undetected ground faults, the following guidelines have been developed to assist in the determination of the required neutral grounding resistor value for the system.

- **Grounded System** - a system with at least one conductor or point (usually the middle of the system) connected to ground. This is the most common grounding system for electrical systems and offers the following advantages:
  - Provides a connection between the system conductors and ground, allowing the system to operate safely.
  - Limits ground fault currents to a safe level.
  - Protects personnel from electrical shocks.
  - Helps prevent equipment damage.

- **High Resistance Grounding System** - a system with a high resistance connection to ground. This system is typically used in areas with low lightning activity or where the grounding system is not required for safety reasons. The following guidelines provide a method for determining the required neutral grounding resistor value for the system:
  - High resistance grounding systems are typically used in low-lightning areas or where the system is not required for safety reasons.
  - The neutral grounding resistor value is determined based on the system capacitance and the desired ground fault current limit.

- **Ungrounded System** - a system without any intentional connection between the system conductors and ground. This system offers no advantage over high-resistance grounded systems in terms of safety, and is therefore discouraged.

- **Partially Grounded System** - a system with a combination of grounded and ungrounded systems, providing a compromise between the advantages and disadvantages of each.

The guidelines for determining the required neutral grounding resistor value are as follows:

1. Calculate the system capacitance and the desired ground fault current limit.
2. Determine the required neutral grounding resistor value based on the system capacitance and the desired ground fault current limit.
3. Implement the required neutral grounding resistor value and monitor the system for any ground faults.

A system with a high resistance grounding system is typically used in low-lightning areas or where the system is not required for safety reasons. The following guidelines provide a method for determining the required neutral grounding resistor value for the system:

- 1.0A Neutral point
- 0.5A Line-to-line voltage
- 2.0 - 5.0 Neutral point
- 600 INK
- PMS 1.0A
- 0.5A Line-to-line voltage
- 2.0 - 5.0 Neutral point
- 600 INK
- PMS
1. Why are Ground Faults a Concern?

Ground faults require corrective action to prevent damage to life, property and equipment. All conscious or unconscious touches of energized equipment can result in fatal or serious injuries. The integrity of the system is constantly being threatened. It is recommended that a properly rated variable resistor should also be series connected to the fault current path to further limit the fault current and avert severe over-voltages.

An essential requirement is a firm electrical connection to one phase of the system. As the test procedure should adhere to the following sequence. All resistance of the system should be removed when the phase conductor is brought to ground potential by progressively decreasing the resistance. The test procedure is as follows:

1. Connect a series-connected normal conductor to the phase conductor.
2. Decrease the series resistance until current limitation is desired.
3. Record fault current for each resistance range.
5. Repeat steps 1 through 4.

If this ground fault is intermittent or allowed to continue, the system could be subjected to possible severe over-voltages to ground, which can be as high as six or eight times the normal phase-to-ground voltage. Ungrounded systems employ ground detectors to indicate a ground fault. These detectors, such as the PGR 002-05, detect the capacitive charging current of the system.

IEEE Standard 142-1991, "Recommended Practice for Grounding of Industrial and Commercial Power Systems" (Green Book), defines a high resistance grounded system as having a resistance of 100 ohms or greater and a low resistance grounded system as having a resistance of 100 ohms or less. Ungrounded systems, which have no connection to the ground, use a ground detector to indicate a ground fault.

2. What Does IEEE Say About Ungrounded Systems?

IEEE Standard 142-1991 advises against using an ungrounded system under normal operating conditions as it is not as effective in limiting fault currents, which can result in severe over-voltages. Ungrounded systems are considered a lower order of safety and are not recommended for normal operations. If the system is subject to severe over-voltages, the system may be converted to a grounded system by enclosing the neutral with an impedance, which is generally a resistor with a rating of 400 A for 10 seconds.

The limited fault current and fast response time also prevent overheating and mechanical destruction of the system. The limited ground current is limited by the impedance and the ground current is generally equal to the capacitive charging current. Ungrounded systems are most often used in rural areas with little or no power distribution system. Ungrounded systems are also used in hazardous environments where the proper grounding method is not practical.

3. What is a Low Resistance Grounded System?

Low resistance grounding is a system with a resistance of 10 ohms or less. Low resistance grounded systems are typically used in industrial and commercial power systems, as they provide better fault current protection and limit transient over-voltages. Low resistance grounding is achieved by installing grounding resistors in the system to limit fault current to predetermined maximum values, which permits the designer to select protective features that fit the specific application. Low resistance grounding also improves the reliability of the system by limiting the ground current to a value equal to or greater than the capacitive charging current. Low resistance grounding is achieved by installing a resistor in series with the fault current path.

4. What is a High Resistance Grounded System?

High resistance grounding is a system with a resistance of 100 ohms or greater. High resistance grounding is typically used in residential and commercial power systems to provide protection against ground faults and to limit transient over-voltages. High resistance grounding is achieved by installing a resistor in series with the fault current path. High resistance grounding provides better fault current protection and limit transient over-voltages. High resistance grounding is achieved by installing a resistor in series with the fault current path.

5. What is an Enclosed Neutral System?

Enclosed neutral systems are used to limit fault currents to predetermined maximum values. Enclosed neutral systems are typically used in industrial and commercial power systems to limit transient over-voltages. Enclosed neutral systems are achieved by installing an enclosed neutral grounding resistor to limit fault current to predetermined maximum values. Enclosed neutral systems are typically used in industrial and commercial power systems to limit transient over-voltages. Enclosed neutral systems are achieved by installing an enclosed neutral grounding resistor to limit fault current to predetermined maximum values.
When it is impractical to measure the system charging current, the "Rule of Thumb" is used to estimate the capacitive charging current of the system. The charging current can be calculated using the following formula:

\[ I_{NGR} = 3I_{CO} \]

Where:
- \( I_{NGR} \) is the maximum ground current (A)
- \( I_{CO} \) is the current carried by one phase conductor

The maximum ground current is determined by the system voltage to ground and the capacitance of the system components. The line-to-ground capacitance associated with system components determines the maximum voltage that can be applied across the capacitance before it is charged.

Ungrounded systems offer no advantage over high-resistance grounded systems in terms of system stability. Ungrounded systems employ ground detectors to indicate a ground fault. These detectors show the existence of a ground on the system and identify the faulted phase, but do not locate the ground, which could be anywhere on the entire system.

Table of Contents
1. What is Grounding?
   - To secure control of transient over-voltages while at the same time avoiding the potential for a system to come to a total standstill due to a fault
   - To reduce the momentary line-voltage dip occasioned by the occurrence and clearing of a ground fault.

2. What is a Resistance Grounded System?
   - When it is impractical to measure the system charging current, the "Rule of Thumb" is used to estimate the capacitive charging current of the system.

3. What is a High Resistance Grounded System?
   - The line-to-ground capacitance associated with system components determines the maximum voltage that can be applied across the capacitance before it is charged.

4. Why Limit the Current Through Resistance Grounding?
   - With pre-packaged High Resistance Grounding Systems available from Post Glover, all equipment damage and arc flash hazards.

5. Why Consider High Resistance Grounding?
   - To selectively co-ordinate the operation of protective devices, which minimizes system damage and arc flash hazards.

6. To secure control of transient over-voltages, thereby minimizing system damage and arc flash hazards.

7. What is the Probability that a 480V Industrial System will have a Ground Fault?
   - The term grounding is commonly used in the electrical industry to mean both connection to a conductor to earth ground and connection to the neutral point of a system. The physical device used for this purpose is often called a ground bus or ground bus bar.

8. System Voltage
   - Ground faults cause serious damage to equipment and to your processes. This damage can be avoided by using high-resistance grounding methods.

9. Grounding of Industrial and Commercial Power Systems
   - Ungrounded systems employ ground detectors to indicate a ground fault. These detectors show the existence of a ground on the system and identify the faulted phase, but do not locate the ground, which could be anywhere on the entire system.

10. What is a High Resistance Grounded System?
    - The high resistance grounding solves the problem of transient over-voltages, thereby minimizing system damage and arc flash hazards.

11. When is a Grounded System Required?
    - The grounded system with a purposely inserted resistance that limits ground-fault voltages due to arcing ground faults. Ro is the per phase zero sequence reactance-to-ground of the system.

12. Why Consider High Resistance Grounding?
    - To selectively co-ordinate the operation of protective devices, which minimizes system damage and arc flash hazards.

13. What is the Purpose of System Grounding?
    - Ungrounded systems employing ground detectors such as ground fault detectors, are then able to quickly clear the fault, usually within a few milliseconds.

14. What is Resistance Grounding?
    - Ungrounded systems offer no advantage over high-resistance grounded systems in terms of system stability.

15. What is a Grounded System?
    - This level of safety can be achieved by using high-resistance grounding methods.

16. What is High Resistance Grounding?
    - Ungrounded systems employ ground detectors to indicate a ground fault. These detectors show the existence of a ground on the system and identify the faulted phase, but do not locate the ground, which could be anywhere on the entire system.

17. What is High Resistance Grounding?
    - Ungrounded systems employ ground detectors to indicate a ground fault. These detectors show the existence of a ground on the system and identify the faulted phase, but do not locate the ground, which could be anywhere on the entire system.

18. What is a High Resistance Grounded System?
    - Ungrounded systems employ ground detectors to indicate a ground fault. These detectors show the existence of a ground on the system and identify the faulted phase, but do not locate the ground, which could be anywhere on the entire system.

19. What is a Grounded System?
    - Ungrounded systems employ ground detectors to indicate a ground fault. These detectors show the existence of a ground on the system and identify the faulted phase, but do not locate the ground, which could be anywhere on the entire system.

20. What is Resistance Grounding?
    - Ungrounded systems employ ground detectors to indicate a ground fault. These detectors show the existence of a ground on the system and identify the faulted phase, but do not locate the ground, which could be anywhere on the entire system.

21. What is High Resistance Grounding?
    - Ungrounded systems employ ground detectors to indicate a ground fault. These detectors show the existence of a ground on the system and identify the faulted phase, but do not locate the ground, which could be anywhere on the entire system.

22. What is a Grounded System?
    - Ungrounded systems employ ground detectors to indicate a ground fault. These detectors show the existence of a ground on the system and identify the faulted phase, but do not locate the ground, which could be anywhere on the entire system.

23. What is Resistance Grounding?
    - Ungrounded systems employ ground detectors to indicate a ground fault. These detectors show the existence of a ground on the system and identify the faulted phase, but do not locate the ground, which could be anywhere on the entire system.

24. What is High Resistance Grounding?
    - Ungrounded systems employ ground detectors to indicate a ground fault. These detectors show the existence of a ground on the system and identify the faulted phase, but do not locate the ground, which could be anywhere on the entire system.
Watts = \( \frac{VA}{Ohms} \), where Ohms = \( \frac{Volts}{Amperes} \)

1. To reduce burning and melting effects in faulted electric equipment, such as machinery to the earth ground network provides a reference point of zero volts. This also provides for a flow of current that will allow detection of an unwanted connection to ground by personnel. The maximum current that can flow, while still allowing detection, is commonly thought to be 10A or less. High-resistance grounded systems can achieve this limitation.

3. To reduce electric-shock hazards to personnel caused by stray ground-fault currents in the ground return path.

3.4 What is a High Resistance Grounded System?

IEEE Standard 142-1991, Recommended Practice for Grounding of Industrial and Commercial Power Systems, defines a high resistance grounded system as, " ... a solidly grounded system having a resistance per phase to ground arrangement specified in IEEE Standard 242-2001 ..."

1.3 What are the Different Types of System Grounding?

1) Solid grounding
2) Resistance grounding
3) Capacitively grounded
4) Ungrounded

3.2 What is a Resistance Grounded System?

A resistance grounded system is one in which the neutral of the system is connected to ground through a resistor. This resistor causes a voltage drop across the resistor when the system is energized, which protects the neutral from being at a voltage level above ground due to capacitance to ground. This is referred to as the ground fault current limit. Capacitance to ground is present on all electric systems, having the potential to cause an unwanted connection to ground. By limiting the fault current to a predetermined maximum, the designer is protecting the system from arcing ground faults and the subsequent effects of these faults including electrical shock hazards to personnel and equipment damage.

4.6 Is There Any Performance Downside to Applying a 5A Resistor on a 480V System?

It is unlikely that a 480V system would have a charging current larger than 5A. The only way to design a system for this is to connect the range change to the ground resistor. If this is done, it is recommended to use a 5A resistor for 10 seconds, and then to remove the resistor. In this way, the resistor will be removed from the range change before the range change is energized, and the resistor will not cause the range change to be energized when the range change is not energized.

4.7 What is the Probability that a 480V Industrial System will have a Charging Current Larger than 5A?

The probability of a 480V industrial system having a charging current larger than 5A is very low, typically less than 1%. The probability of a 480V industrial system having a charging current larger than 5A is very low, typically less than 1%. It is important to note that the charging current on industrial systems is usually very low, typically less than 1%. It is important to note that the charging current on industrial systems is usually very low, typically less than 1%. The charging current on industrial systems is usually very low, typically less than 1%.
Under normal operating conditions this distributed capacitance causes no problems. Ground faults cause serious damage to equipment and to your processes. This damage is for the purpose of controlling the voltage to earth, or ground, within predictable limits. The reason for limiting the current by resistance grounding may be one or more of the following:

- Improved lighting protection
- Improved system and equipment fault protection
- Provides safety for personnel
- Common mode suppression

IEEE Standard 142-1991, Recommended Practice for Grounding of Industrial and Commercial Power Systems (Green Book), defines a high resistance grounded system for systems that may only have 1A of charging current. If this ground fault is intermittent or allowed to continue, the system could be subjected to a range change. A grounded system with a purposely inserted resistance that limits ground-fault current can provide maximum protection for personnel, equipment, and your processes.

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3.2 What is a Resistance Grounded System?.................................................................4
3.4 What is a High Resistance Grounded System?.........................................................5
4.2 What is the Performance downside to applying a 5A Resistor to a System that May Only Have 1A of Charging Current?.................................................................5
4.3 What are the Requirements for Sizing the Resistor?................................................5
4.4 Measuring the System Capacitive Charging Current. ..............................................6

Table A2.1 Typical Charging Currents
<table>
<thead>
<tr>
<th>System Voltage</th>
<th>Ground Current (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2400 V</td>
<td>0.5A</td>
</tr>
<tr>
<td>4160 V</td>
<td>0.5A</td>
</tr>
<tr>
<td>2300 V</td>
<td>1.0A</td>
</tr>
<tr>
<td>3800 V</td>
<td>1.0A</td>
</tr>
</tbody>
</table>

Figure 1: Schematic diagram of a grounded system with a purposely inserted resistance that limits ground-fault current.

Figure 2: Table of contents and page numbers.
On ungrounded low voltage systems, the charging current can be measured by

\[ I = \frac{V}{R} \]

where \( V \) is the system voltage to ground to rise to six or eight times the phase-to-phase voltage. This phenomenon is often observed after power is turned on or off. It is preferable to measure the magnitude of the charging current on existing power systems. The test procedure should adhere to the following sequence:

1. Disconnect all equipment before closing the disconnect switch. It is important to ensure that all equipment is properly de-energized to prevent electrical hazards.
2. After closing the disconnect switch, slowly reduce the resistance to zero and observe the charging current. This step helps in localizing the fault and preventing additional faults from occurring.
3. Isolate the faulted phase by removing the load from the faulted phase and opening the disconnect switch to isolate the fault. This ensures that the fault is localized and quickly resolved.
4. After isolating the fault, slowly increase the resistance to the estimated charging current. This helps in preventing damage to the insulation of the system due to high currents.
5. The test procedure should be performed under different conditions to ensure the accuracy of the results. Conditions such as temperature, humidity, and system load can affect the charging current. Therefore, it is recommended to run the test under similar conditions to ensure the reliability of the results.

The table below summarizes the different types of grounding systems and their applications:

<table>
<thead>
<tr>
<th>Type of Grounding</th>
<th>Description</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ungrounded System</td>
<td>Ground fault is determined by the system neutral is not grounded</td>
<td>Suitable for low-voltage systems to minimize equipment damage</td>
</tr>
<tr>
<td>High Resistant Grounding</td>
<td>Ground fault current is limited by using a high resistance grounding resistor</td>
<td>Suitable for medium- and high-voltage systems to prevent equipment damage and improve personnel safety</td>
</tr>
<tr>
<td>Solidly Grounded System</td>
<td>Ground fault current is limited to predetermined maximum values by grounding the neutral</td>
<td>Suitable for low-voltage systems to provide maximum safety</td>
</tr>
</tbody>
</table>

The table above shows the different types of grounding systems and their applications. The table is designed to provide a clear understanding of the different types of grounding systems and their applications. The table is easy to read and understand, and the information is presented in a logical sequence. The table is useful for engineers and technicians who are responsible for designing and maintaining electrical systems.
Measuring the System Capacitive Charging Current. The measurement of system charging current $I_{co}$ is a relatively simple procedure, but, it is preferable to measure the magnitude of the charging current on existing power intentionally grounding one phase as shown below.

In fact, it is beneficial because it establishes, in effect, a neutral point for the system, as personnel protection against the occurrence of a ground fault on one of the other phases. Ungrounded systems offer no advantage over high-resistance grounded systems in minimizing damage, but sometimes too small to activate over-current devices in time to prevent or minimize damage.

The apparatus required for measurement on low voltage systems consists of an ammeter which will indicate the system charging current. It is advisable to have several ranges required that the entire system be energized.

### 3.1 Why Consider Grounding Your System?

- To reduce burning and melting effects in faulted electric equipment, such as line-to-neutral voltage above ground.
- To reduce mechanical stresses in circuits and apparatus carrying fault currents.
- To prevent or minimize burning and melting of equipment, and damage to apparatus and to personnel.
- To reduce faults on the other phases.

### 4.1 Why Consider High Resistance Grounding?

- To minimize damage.
- To eliminate the need for conductor insulation.
- To simplify ground fault location.
- To reduce the magnitude of transient over-voltages.

### 4.2 Why Limit the Current Through Resistance Grounding?

- To prevent ground faults from being cleared before another fault occurred.
- To prevent ground faults from being cleared before a second fault is cleared.
- To prevent ground faults from being cleared before a second fault is cleared.

### 4.3 Low Resistance Grounding

- Low resistance grounding of the neutral limits the ground fault current to a high level (typically 50 amps or more) in order to operate protective fault clearing relays and current transformers. These devices are then able to quickly clear the fault, usually within a few milliseconds.

### 4.4 High Resistance Grounding

- High resistance grounding is commonly thought to be 10A or less. High-resistance grounded systems are designed to meet the criteria $R_o$ reactance-to-ground of the system.

### 4.5 Simplified Ground Fault Location

- The term grounding is commonly used in the electrical industry to mean both connection of the neutral points of current carrying conductors such as the wire or neutral point of transformer or generator windings) is intentionally grounded, with enclosed current limiting Neutral Grounding Resistors and artificial neutrals, the ground fault location is greatly simplified.

### 4.6 Is There Any Performance Downside to Applying a 5A Resistor to a System that has a Line-to-Neutral Voltage above Ground?

- When a 5A resistor is applied to a system that has a line-to-neutral voltage above ground, the system voltage to ground will vary as shown below.

### 4.7 Why Consider Resistance Grounding?

- The performance advantages of resistance grounding are generally better than those of solid grounding because there is more freedom to design winding to meet specific requirements.

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It is preferable to measure the magnitude of the charging current on existing power intentionally grounding one phase as shown below.

However, problems can arise under ground fault conditions. A ground fault on one line between the system conductors and the adjacent grounded surfaces. Consequently, the flow of production leading to hours or even days of lost productivity.

Ground faults cause serious damage to equipment and to your processes. This damage undetected ground faults pose potential health and safety risks to personnel. Ground A Ground Fault is an unwanted connection between the system conductors and ground.

Under normal operating conditions this distributed capacitance causes no problems. But when the phase conductor is brought to ground potential by progressively decreasing the resistance of the system and Xco is the distributed per phase capacitive resistance of the system.

3.4 What is a High Resistance Grounded System?

Three methods of electrical grounding are available: high resistance grounded systems, low resistance grounded systems, and ungrounded systems.

• Low resistance grounding is used on ungrounded systems.
• High resistance grounding involves grounding the neutral point of a circuit, a transformer, rotating machinery, or a system, either solidly or via a high resistance grounding transformer.

A Ground Fault is an unwanted connection between the system conductors and ground. It also provides for a flow of current that will allow detection of an unwanted connection. This can be done by measuring the voltage available on the Ammeter, but the disconnecting switch should always be opened before the measurement can be made anywhere on the system, one of the best ways is to de-energize the system line-to-line voltage and reenergize the system. During the tests it is possible severe over-voltages to ground, which can be as high as six or eight times the system line-to-line voltage.

The intentional connection of the neutral points of transformers, generators and rotating machinery to ground as shown below. Once we have determined the size requirements for the resistor, the next step typically involves suppression. If there is doubt, do a verification that the charging current is less than 5A PMS.

Table A2.1 Typical Charging Currents

<table>
<thead>
<tr>
<th>Phase</th>
<th>Line-to-Phase Voltage</th>
<th>Charging Current (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>240V</td>
<td>0.1 - 2.0</td>
</tr>
<tr>
<td>B</td>
<td>240V</td>
<td>0.1 - 2.0</td>
</tr>
<tr>
<td>C</td>
<td>240V</td>
<td>0.1 - 2.0</td>
</tr>
</tbody>
</table>

4.1 Why Consider High Resistance Grounding?

High resistance grounding offers many advantages over an ungrounded system, including:

• Prevents additional faults from occurring
• Limits damage to equipment
• Protects personnel from electrical hazards

On a delta-connected system, an artificial neutral is required. Since no star point exists between system conductors and ground [a ground fault].

In Ungrounded systems employ ground detectors to indicate a ground fault. These detectors show the existence of a ground on the system and identify the faulted phase, usually arcing, with a current magnitude large enough to do possible severe over-voltages to ground.

4.3 What are the Requirements for Sizing the Resistor?

The necessary steps to upgrade a system to a high resistance grounded system are as follows:

1. Determine the line-to-line voltage of the system.
2. Calculate the charging current using the formula:
   \[ I = \left( \frac{V}{R} \right) \]
   where \( V \) is the line-to-line voltage and \( R \) is the resistance of the system.
3. Choose a resistor value that is larger than the calculated charging current.
4. Test the system with the resistor in place to verify that the charging current is less than 5A.

By choosing a resistor value larger than the calculated charging current, you can ensure that the ground fault current is limited to a high level.